

# CONVERTING TO PHYSICAL % COMPLETE METHOD OF EARNED VALUE IN MICROSOFT PROJECT

## PREPARED BY

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## 1 INTRODUCTION

Use of the Physical % Complete model for Earned Value Management (EVM) is more consistent with industry standards than the %Complete and %Work Complete models used by Microsoft Project and allows a more traditional approach to ANSI EIA-748 EVM to be implemented using Microsoft Project.

This paper, utilizing Microsoft Project 2003 Standard as a basis, describes how to implement a Physical % Complete EVM solution within a project file. The process may be followed at any time, regardless of that project state of completion.

## 2 BACKGROUND

Microsoft placed Physical % Complete into Microsoft Project to offer an alternative to %Complete as an earned value methodology in response to user requests. Generally, %Complete calculated Earned Value as a measurement against task duration, not value.

Some of the user angst over the original EV methodology in MS Project relates to accurate portrayal of Actual Cost of Work Performed (ACWP) and adjustments to Work/Remaining Work which are automatically calculated by Project. For example, if a 100 hour task is loaded to Project and a resource works this task for 40 hours, there is an assumption that 40% of the work has been completed. Indeed, if 40 hours is entered into the Actual Work column, remaining work changes to 60 hours and %Complete marks at 40%.

However, this may not truly be the case in the physical world. The resource applied 40 hours to the task, and claims the task to be 25% complete. Project does not report this %Complete.

In the Project World, it is simply not possible to say, "I worked 40 hours and completed 25 hours value of work." In the Project World of %Complete, the user needs to recognize that 40 hours represents a cost and not a measure of work. The cost of the 40 hours of work for Project is \$2000 and must be entered as such in the Actual Cost Column. Since Actual Work is a measure of Earned Value, not cost (in MS Project), the user needs to recognize the relationship between Actual Work and Remaining Work are cost measures, not measures of time card hours. After thinking about it, the Microsoft implantation is correct, perhaps just labeled in a confusing manner. That is actual work is related to earned value and has nothing to do with time card entries of the resources.

Entering dollar values for work performed makes perfect sense, and requires management to recognize that hours placed on a time card are irrelevant, they are cost measures, not work measures. For certain, if Senior Resource A charges 40 hours of work at \$50/hr, this is entirely different than Junior Resource charging 40 hours at \$30/hr even if the same earned value is claimed. Again, management needs to concern itself with costs and not man-hours per se. To drive the point, the stock market cares only about dollars.

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A different approach to EV in MS Project using Physical % Complete allows users to ignore the incestuous relationship between cost/work deeply ingrained in MS Project. Although Physical % Complete can be used for EV, the field %Work Complete remains useful to adjust remaining work.

### **3 DESIRED GOALS**

After implementing the technique identified in this paper, a user will be able to use MS Project to:

- Enter Actual Cost of Work Performed (ACWP), in \$, from a cost accounting system using the billing code summaries identified by that separate cost accounting system, typically a Job Number (JN)
- Use the Remaining Work column to manually enter the real number of work hours estimated for completion by work groups (a repurposed use of this cost related column to a work column)
- Convert remaining work hour requirements to meaningful measure of Remaining Cost (Estimate to Complete, ETC) and Estimate At Complete (EAC)
- Present 3 traditional estimates of EAC
  - Using raw data,
  - As influenced by CPI (Project already does this)
  - As Influenced by CPI and SPI

### **4 ASSUMPTIONS**

Readers are thoroughly familiar with the idea of a project baseline and how to implement a project baseline in MS Project.

### **5 CHANGE PROJECT OPTIONS**

In the Backstage (File/Options..) select the Advanced Tab and scroll down to the Earned Value area as shown in Figure 2.

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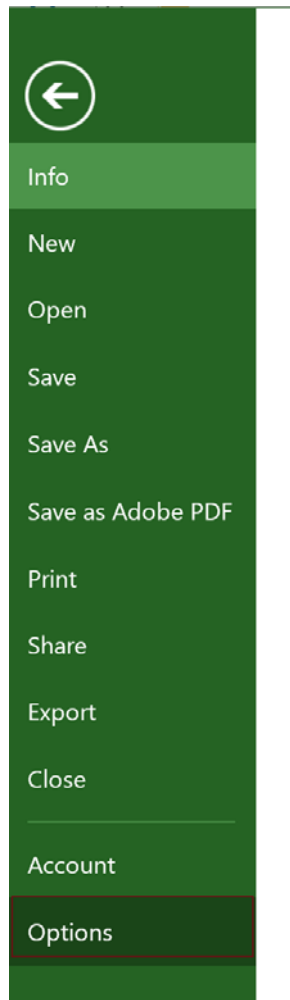


Figure 1 Backstage Menu (File)

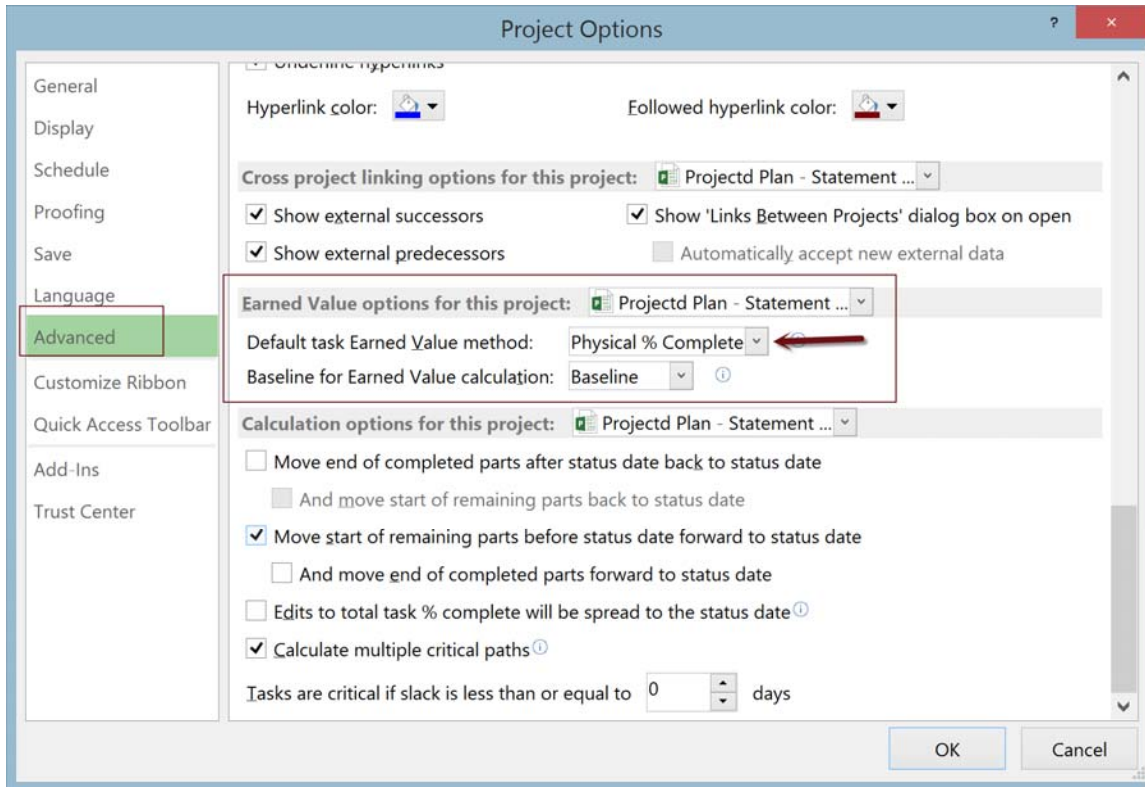


Figure 2 Project Options - Calculations Tab

### 5.1 Configure Calculations

Configure the calculation options with check boxes selected as shown in Figure 2.

- Move end of completed tasks back to the status date (shows correctly on Gantt view)
- Move start of remaining tasks before status date forward to the status date (allows automatic reschedule of incomplete work)
- Edits to total actual cost will be spread to the status date is selected and “Actual costs are always calculated by Microsoft Office Project is de-selected.

Note: The Actual costs are always calculated by Microsoft Project check box has nothing to do with Physical % Complete as an EVM method. However, since this change must be made to support Establish Cost Accounting Fields. Making this selection at this point is actually has nothing to do with the EV methods; while the screen is visible, it is useful to make these changes at this time.

### 5.2 Change Project EVM Method

In the Project Options dialog box, with the calculations tab selected, select Earned Value as indicated in Figure 2

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Select the Physical % Complete as the Default Earned Value method and select an appropriate Baseline for Earned Value calculations from the drop down menus in the Earned Value Dialog Box. After making the appropriate selections, press **Close**.

### 5.3 Change EVMS for all Tasks

Make certain **all** tasks in the entire project are visible and no filters or grouping has been applied. You can show all tasks by selecting "Show All Tasks" from the View ribbon. In the case of Master/Subproject files, it is necessary to go to each separate section in the file.

Once all tasks are visible, select all tasks clicking in the upper left corner of the view,

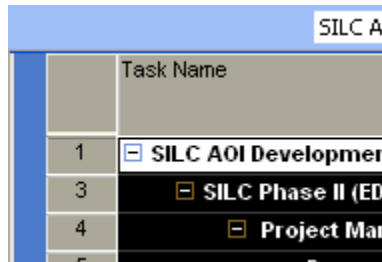


Figure 3 Selecting All Tasks

View the Task Information window for all the selected tasks by using Shift+F2, or, select Task Information from the Task Ribbon These choices will lead to the Figure 4 Multiple Task Information Dialog Box.

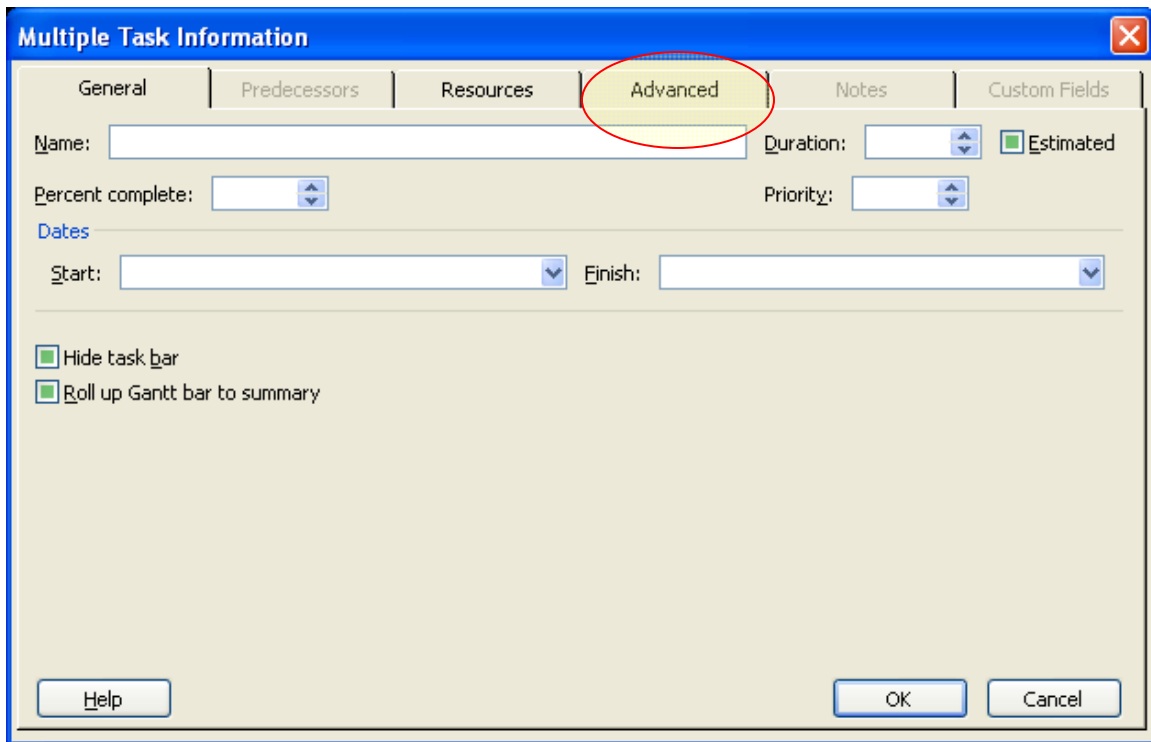


Figure 4 Multiple Task Information Dialog Box

Select the Advanced Tab, change the Earned Value method to Physical % Complete and then select OK, Figure 5.

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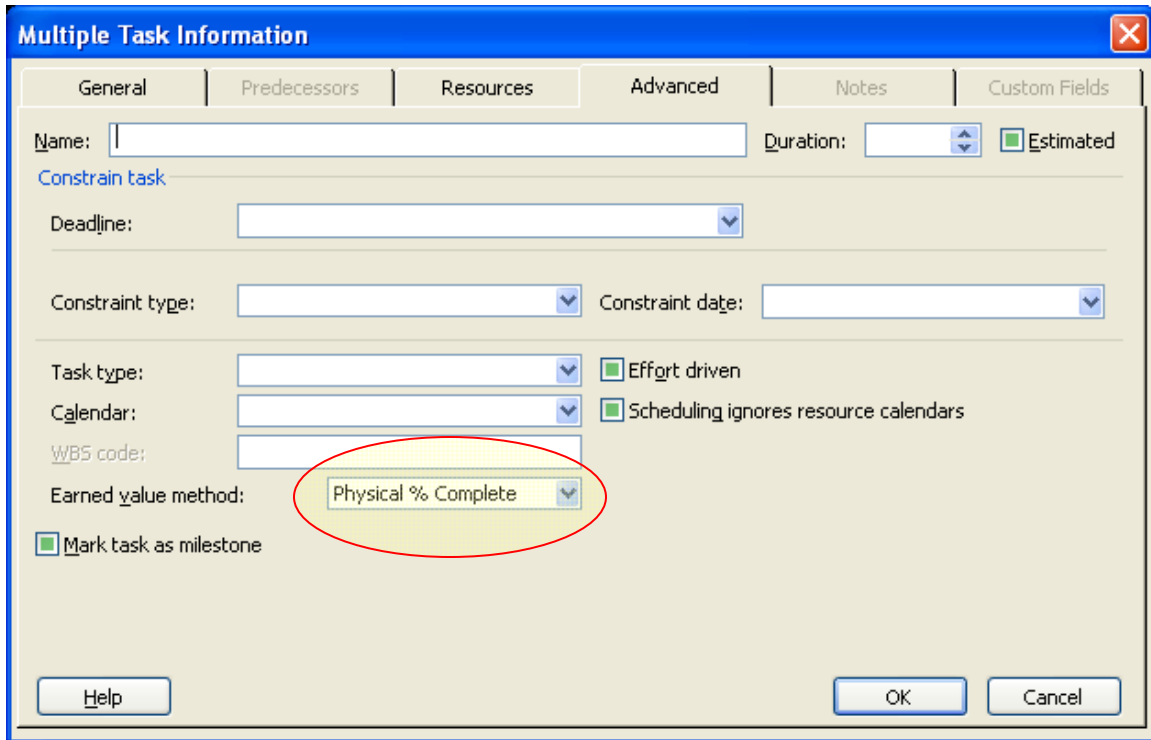


Figure 5 Specifying an Earned Value Method for Selected Tasks

## 6 COST ACCOUNTING CODES

Once all tasks, predecessors, successors, and other relationships have been established, it is necessary to match each task item to a Cost Accounting Code.

Insert a text field, for example, Text5. You should rename the field to reflect a more proper application of the field such as Contract Line Item Number (CLIN), Job Number (JN) or other Cost Accounting Code. Additional text fields allow traceability back to the proposal and funding contract line item. This paper assumes the use of field Text5; almost any text-based field will work.

In the newly inserted field, place some type of identification mapping back to the cost accounting system. For example, if pricing is wanted on a CLIN basis, then place a CLIN identifier in the text field: CLIN 001, CLIN B, etc. Identifiers should only be placed on individual tasks, not on summary level tasks. Every task with resources assigned should have an entry.

Note: MS Project files are actually databases. Database information is stored in tables. MS Project has separate tables for Resources, Tasks, and Assignment data. Therefore, a field named Text5 in the Task view (Gantt chart) has nothing to do with a field named Text5 in the Resources view because they are stored in different tables. However, it is critically important to be able to map the data from the task view to the resource view.

A user created macro will copy data between the Text5 fields of the task view, to field Text5 of the Resource view. See separate documentation if you need the data copied over.

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## 7 FORMATTING GANTT VIEW

There is no preconfigured view in Microsoft Project that automatically displays the Physical % Complete as part of the Gantt bars on the right pane of the Gantt Chart view. The following steps show how to create Physical % Complete information in the Gantt bars. Although this procedure will be shown on the Tracking Gantt view, the procedure may be applied to any Gantt view. It is always possible to save this newly created view as a custom view.

Open the Bar Styles dialog box by either double clicking on a blank portion of the Gantt chart, or, select Bar Styles from the Format Ribbon, Figure 6.

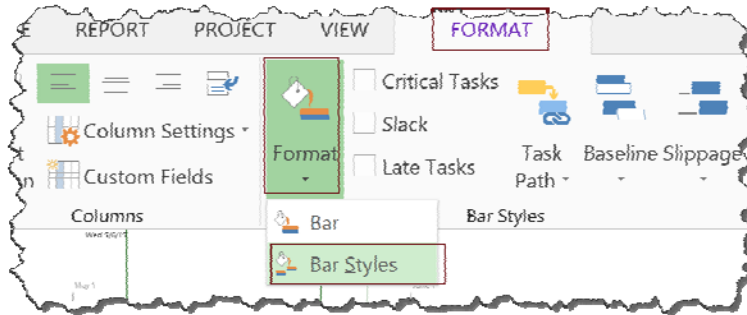


Figure 6 Format Menu Drop Down

The Bar Styles dialog box, Figure 7, provides format information for all bars on the Gantt chart in the selected view.

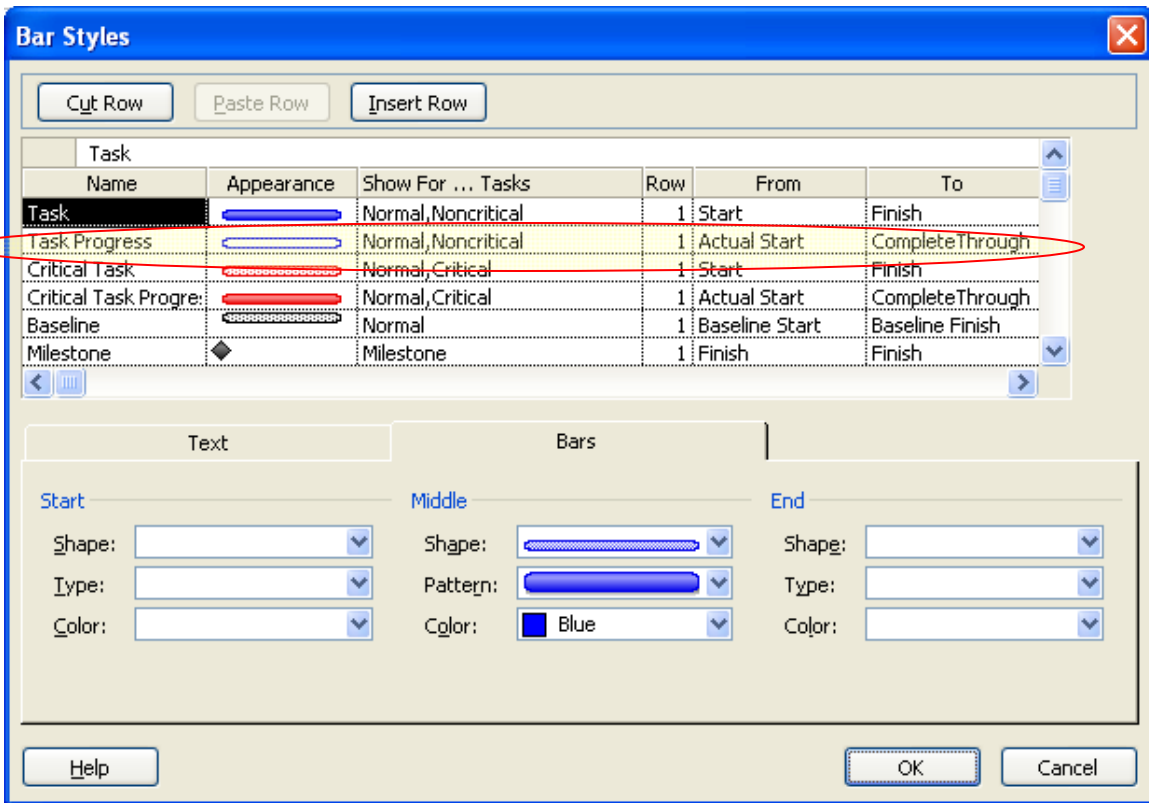


Figure 7 Bar Styles Dialog Box

The real requirement is to have the progress line track from Actual Start Date through the amount of Physical % Complete. Optionally, the Physical % Complete may be shown as a text to the right of the bar.

For each Progress Bar, change the “To” field from “Complete Through” to “Physical % Complete” as indicated in Figure 8. There will probably be bars for both critical and non-critical tasks, scroll through the entire list to catch all applicable instances.

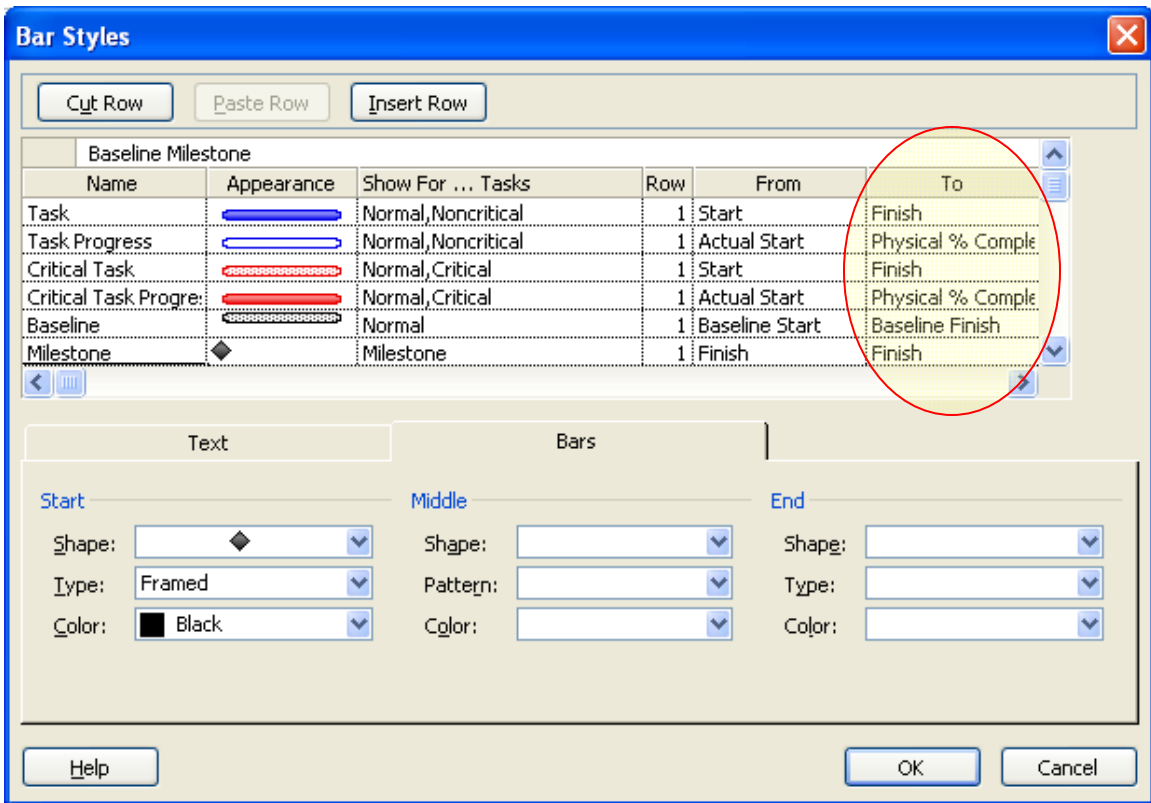


Figure 8 Bar Styles Dialog Box Showing Physical % Complete

If a numeric indicator of Physical % Complete is desired, select the Text tab on the Bar Styles and add the Physical % Complete from the drop down as shown in Figure 9.

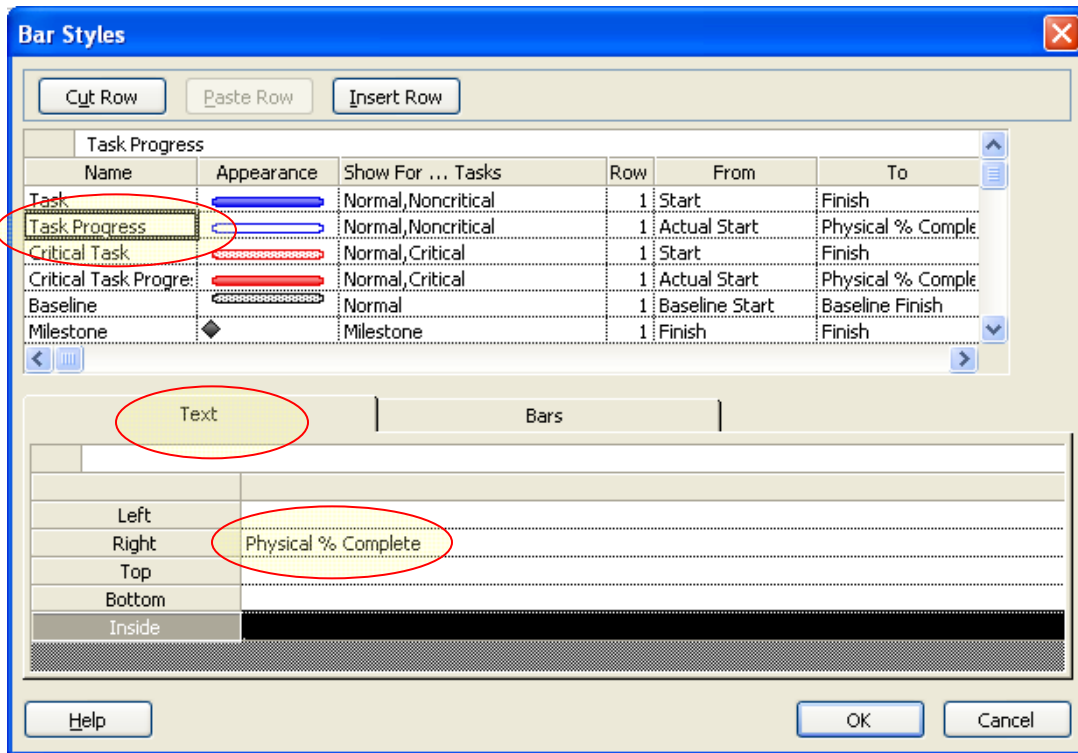


Figure 9 Adding Physical % Complete Text to a Gantt Bar

An appropriately formatted task bar is shown, Figure 10.



Figure 10 Formatted Task Bars

## 8 USING ACWP

Actual Cost of Work Performed, ACWP, is a calculated field not directly entered by the user. However, the Actual Cost field is available to the user and can be modified as required. Insert the Actual Cost field into the file and clear all the values in it.

### 8.1 Insert Cost Accounting Field Column

Insert the column used for labeling the cost account codes (job numbers, etc—In this case Text5). Recall that the cost accounting codes are the lowest level to which costs can be allocated. This allocation may involve multiple task numbers within a Microsoft Project file.

### 8.2 Insert Summary Cost Tasks

Enter new tasks for each cost account number with no resources or other costs assigned. Although it appears helpful to have a summary task “Cost Accounting Inputs” with indented

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tasks for each account number, it is more important to have the costs trace to the correct Work Breakdown Structure (WBS) numbering.

To properly consolidate costs and tasks together, enter a cost accounting code for each job number task line in the cost accounting code column, for example, Text5; baseline these new tasks.

When the Cost Accounting system provides summary data for the cost account codes, enter that data to the job codes summary line as “Actual Cost.” Earned value calculations may now be performed for the summary cost accounting codes.

Although MS Project will allow entry of actual costs on a line-by-line basis, this level of detail is rarely available from any cost accounting system. Generally, cost accounting systems allow a group of workers to charge against a specific account to accomplish a group of tasks. Management that wants cost traceability to the lowest possible level needs to establish a sufficient quantity of job numbers for accurate time reporting. However, the probability of incorrect time reporting increases rapidly as the number of choices for Job Number entry increases in a time card system.

Careful placement of a summary actual cost line is necessary. The line must roll-up to the same Work Breakdown Structure (WBS) as the subordinate cost elements. Therefore, it is generally not possible to simply create a group of tasks called “Cost Accounting Actual” with sub tier tasks of all the job numbers.

### **8.2.1 Summary Task Durations**

Microsoft Project has the option to spread incurred costs to the status date; this method was selected in

The duration of these tasks become important to validate the ACWP curve in any graphics generated. Two methods are viable to appropriately spread the ACWP in MS Project:

1. Hard code the duration of the task to cover the appropriate duration. This requires editing of the task any time the duration of the related tasks change. Although this is the simplest method, it requires the user to remember this step.
2. Create a Hammock Task. Hammock tasks start using a given task as predecessor and end concurrently with a final predecessor. Hammock tasks will have “accordion durations.” To create a Hammock task:
  - a. Create the task to become the hammock.
  - b. Go to the task that will drive the start date of the hammock and click on its finish date.
  - c. Copy.
  - d. Go to the start date of the hammock task and Edit > Paste Special... > link.

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- e. Do the same for the start date of the task driving the finish date of the hammock task and copy/paste link its start date to the hammock's finish date.
- f. See also MS knowledge base article: 141733 entitled: How to Build a Hammock Task.

## 9 REMAINING WORK/COST

On a monthly basis, programs are reviewed to determine if they are meeting cost/schedule objectives and if there are any changes needed to budget required to finish the job. Using the techniques identified in this paper, the total remaining work can be entered directly into the Remaining Work field for each task. Since Project will automatically suggest a number for remaining work in that field as  $(1 - [\% \text{Work Complete}]) * [\text{Work}]$ , an update is a simple matter of typing a new value into the field. Since we are using [Physical % Complete] as the measure of EV, it does not change. If we were using the %Complete method, the %Complete would decrease as we enter more work to complete the job. The reverse is also true, should remaining work be entered that is less than the value calculated, %Complete will increase with Physical % Complete remaining stable.

Remaining work may be entered directly into a Gantt view in the [Remaining Work] column, which will divide the remaining work amongst the assigned resources in accordance with their Units% on the task assignments. If there is more than one resource assigned to a task and the remaining work needs to be reallocated, the remaining work can be entered on the Task Entry form to the specific resources that will perform the work. This may also be done in the Task Usage View.

Remaining Cost is automatically calculated from the Remaining Work field. If there are additional fixed cost items, they are handled in a similar manner in the [Fixed Cost] column.

Caution: Without update to %Work Complete, the value of remaining work will never change from the baseline value.

Make sure to use the %Work Complete. Use of Physical % Complete allows tracking % against the baseline. The amount of %Work Complete will vary against total work. Note that total work will change as the remaining work column is manually updated in Project. Generally, %Work Complete and Physical % Complete will be equal until such time as a revised amount is entered into remaining work.

## 10 CREATE ESTIMATE AT COMPLETE FIELDS

EAC will only be valid at the summary job number (Text5) level, and at less detailed levels of summary. This is because costs are only tracked to the job number level, not all the way down to an individual task.

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Insert three custom cost fields, such as cost1, cost2, and cost3 being careful that the fields are not already used for another purpose. Each of these fields must be customized using the following procedure.

### 10.1 Cost Field Customization

Right click on any of the columns and select Customize Field as shown in Figure 11. A new Dialog box will open, Figure 12, select the Rename button and add a descriptive name such as EAC(1). Note that EAC is already a reserved Project field, so you to uniquely identify your new field.

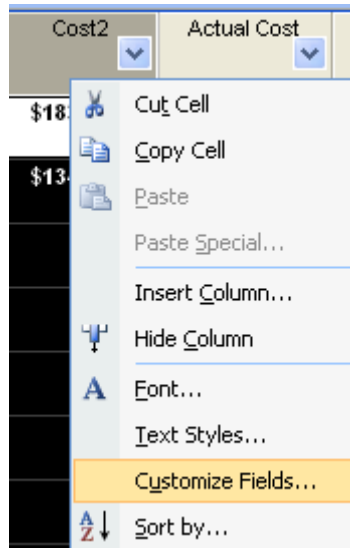


Figure 11 Customizing a Field

Once the field has been renamed, a formula must be entered to properly calculate the Estimate at Complete. These formulas are most like the Latest Revised Estimate (LRE) in ANSI 748 parlance.

From standard EV terminology,  $EAC = ACWP + ETC$ . The way ETC is calculated will drive the total program EAC. In MS Project, the ETC is influenced by the past cost performance on the project, CPI. Although this is a reasonable measure of ETC, most of the estimates obtained from individual resources are closer to a  $CPI = 1$  condition, especially when the remaining work is small and will be completed within 30 days. Therefore, to influence the ETC by CPI after a resource has manually provided a remaining work estimate might be considered too conservative of a measure of EAC.

The following equations will be used for measures of EAC:

$$EAC = ACWP + (\text{Baseline cost} - BCWP) / CPI \quad (\text{as used by Project})$$

$$EAC1 = ACWP + [\text{Remaining Cost}]$$

$$EAC2 = ACWP + [\text{Remaining Cost}] / [CPI]$$

$$EAC3 = ACWP + [\text{Remaining Cost}] / ([CPI] * [SPI])$$

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Each formula will produce a different result. It cannot be said for certain which formula produces the smallest or largest value because this will depend on the values of CPI and SPI and if [Remaining Cost] has been altered by changes to [Remaining Work].

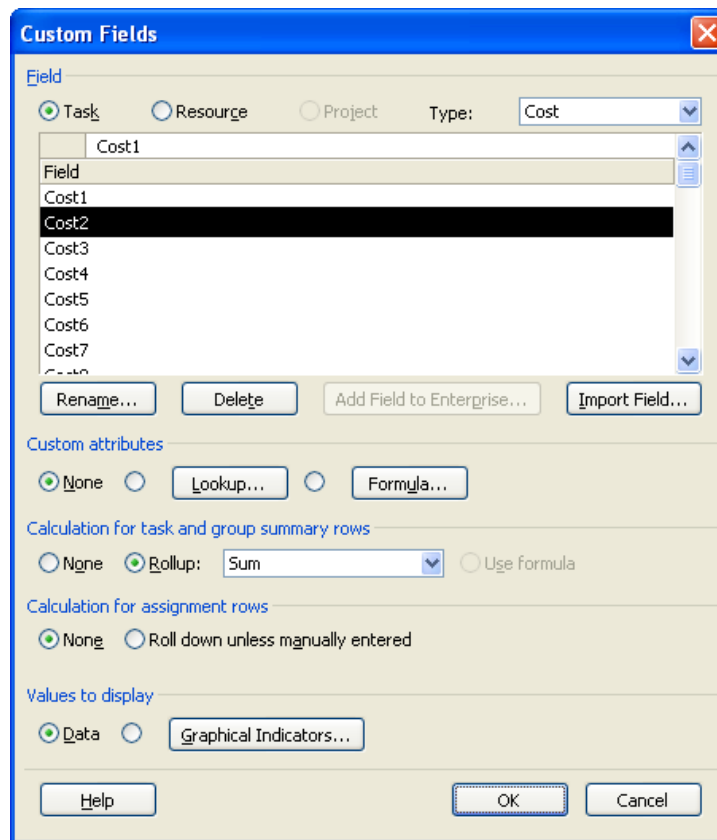


Figure 12 Cost Field Customization

To enter one of the formulas, select the formula button in the Custom Attributes area; accept the warning messages. The formulas are best entered using the drop down menu items. Only one of the entries is shown, all three will follow the same procedure, see Figure 13

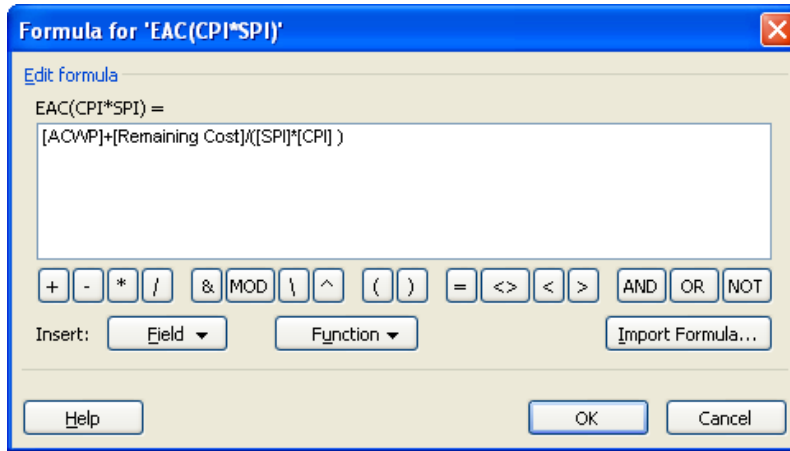
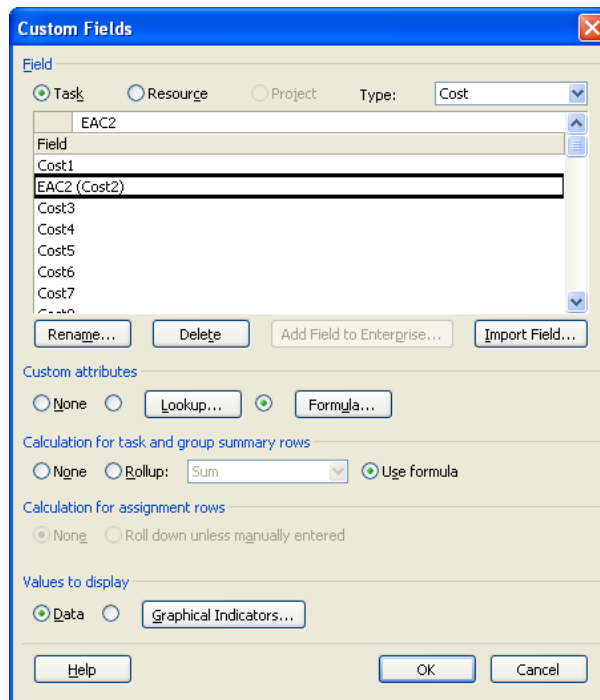


Figure 13 Formula Entry Dialog

Follow the rules of arithmetic, the parenthesis are necessary to make a proper calculation. Once all the proper entries are made, the dialog should look similar to Figure 13. In this case the column name will become EAC(CPI\*SPI) indicating it is the formula containing both SPI and CPI. Also note how the rolled up values are handled for field named EAC, use the formula:



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Figure 14 Completed Field Customization

## 10.2 Data Slicing

The ability for Project to re-arrange the existing data into various formats greatly increases the ability to analyze in progress programs. Use of Custom Outline Groups is available to support this analysis.

## 11 REPORT VALUES

Data can be exported to Excel, Decision Edge, or Kidasa Milestones to report Earned Value.

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