Assigning & Updating Activity Costs in Microsoft Project Pro

Possible Methods for Assigning Costs to Activities:

Consider an activity "A" that has a duration of 4 days, a cost rate of $200/day, and a total cost of $800. What is the best way to assign this cost to activity "A" in Microsoft Project?

MS Project provides two ways to associate an activity with cost:

- Assign a "Fixed Cost" to the activity.
  "Fixed Cost" is meant to be a one-time, miscellaneous cost that's incurred on an activity. However, it is not the best method for assigning cost for cost control because many of the MS Project views and reports report progress using "Work" fields and not just "Cost" fields.
- Define a new "resource", e.g., "$U" (for "Dollar Unit") and its "Standard Rate" (e.g., $1/day) and assign a certain number of "Units" (i.e., "resources per day") to the activity (e.g., 200 Units) to give the desired cost rate (e.g., $200/day) and activity total cost (e.g., $800).
  This is the preferred method because it allows cost control views and reports to have access to both "Work" and "Cost" fields.

The next question is what "type" of resource to use. MS Project supports three "types" of resources:

- Work (intended primarily for labor and equipment)
- Material (intended primarily for material, e.g., steel, concrete, timber, etc.)
- Cost (for other costs like capital expenditures, airfare, lodging, etc.)

Of these three resource types, it might appear that using a "Cost resource" to model activity costs may be a good choice. However, because MS Project does not include "Cost resources" in BCWS and "Earned Value" calculations, using a "Cost resource" is inappropriate for cost control.

Conclusion: In MS Project, as in P6 Pro, the best way to associate each activity with its cost is by using a "Work" resource (e.g., $U) as described below.

Define a Work Resource to represent money:

To define a work resource that represents money, use the ribbon tab "View" > "Resource Sheet".

Important: To allow the definition of a new resource, the "Resource Sheet" must be shown in the top pane. When shown in the lower pane it does not allow the definition of a new resource.

Resource Name	Type	Material Label	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar
$U	Work		$U	Gen Res	5,000	$1/d	$0/d	$0	Prorated	7-Day Workweek

Use the Resource Sheet above, to define a new "Work" resource named "$U" (i.e., "$ unit") with initials "$U". You can use any other descriptive name and initials for this resource to represent money.

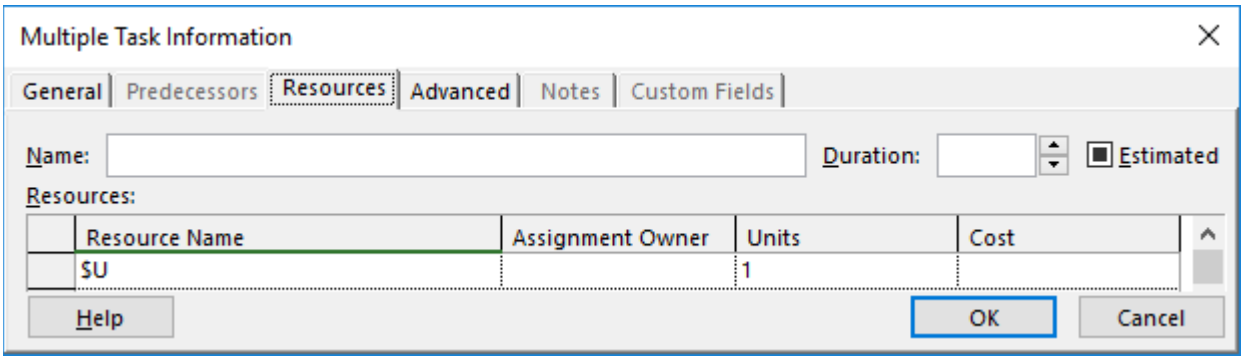
Note that it is very convenient to set the "Std Rate", i.e., the daily cost for this resource, to "$1/day" (if using days for activity durations), or to $1/week (if using weeks for activity durations), etc.

To avoid messages about "overallocated resources", it is also convenient to set "Max. Units" to a very large value that exceeds the maximum $/day that might be needed by the project schedule.

Assign the Resource Representing Cost to Activities

MS Project provides several views, tables and dialog boxes that can be used to enter data and assign resources to activities.

An easy way to assign the cost resource "$U" to all activities is to use a Gantt chart view to select all activities (using the standard shift-click selection method). Then use the ribbon to select "Task" > "Information" > "Resources Tab" and then choose the resource "$U" from the set of already-defined resources listed in the field "Resource Name" as shown below. Click OK.



Example Project for Entering Activity "Cost Rate" and "Total Cost" into MS Project

Table 9.1 in the CEE536 textbook includes activity cost data for the example project used to describe "Time-Cost S-curves". It is reproduced below to illustrate how to associate activities with their cost.

TABLE 9.1

Sample Project Cost Data

Activity	Duration (Days)	Cost Rate ($/Day)	Total Cost ($)
A	2	500	1,000
B	17	200	3,400
C	3	3,000	9,000
D	5	1,000	5,000
E	6	2,000	12,000
F	2	500	1,000
G	1	1,000	1,000

The Relationship between Work and the Cost of Activities

As mentioned above, it is convenient to set the "Std. Rate" for the cost resource "$U" to "$1/day" (or $1/week, if durations are in weeks). This provides the following relationships between the MS Project fields "Units" and "Work" (see the next section) and the required "Cost Rate" and "Total Cost" for the activities in Table 9.1 (ignoring the units of measurement):

"Units" = The required "Cost Rate" for the activity
"Work" = The required "Total Cost" for the activity

Entering Activity "Cost Rate" and "Total Cost" using the "Resource Form"

Two easy ways to assign the "Cost Rate" to each activity, and to have the "Total Cost" calculated by MS Project automatically, is to use the "Resource Usage" view, or the "Resource Form" (shown below).

Project	ID	Task Name	Units	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
S-Curves-Targ	1	A	500	1,000d	0d	0d	0d	1,000d
S-Curves-Targ	2	B	200	3,400d	0d	0d	0d	3,400d
S-Curves-Targ	3	C	3,000	9,000d	0d	0d	0d	9,000d
S-Curves-Targ	4	D	1,000	5,000d	0d	0d	0d	5,000d
S-Curves-Targ	5	E	2,000	12,000d	0d	0d	0d	12,000d
S-Curves-Targ	6	F	500	1,000d	0d	0d	0d	1,000d
S-Curves-Targ	7	G	1,000	1,000d	0d	0d	0d	1,000d

Enter the "Cost Rate" for activity "A" (i.e., 500) in the "Units" column and press "Enter". The cursor will move to "Units" for activity "B". Repeat this process and enter the "Cost Rate" for all activities. Click on OK and MS Project will calculate all the "Total Cost" amounts (shown in the column "Work") as follows:

"Work" = "Units" * "Activity Duration"
(mandays) = (men) * (days)

For example, for activity "A" MS Project will calculate Work = 500 * 2 = 1,000d, i.e., Total Cost = $1,000.

A Complete Example: Setting and Saving the Budgeted Cost of Work Scheduled (BCWS)

The sample project used in the CEE536 textbook to describe "Time-Cost S-curves" appears in Fig. 9.5 and is reproduced below. It will be used to construct the BCWS in MS Project.

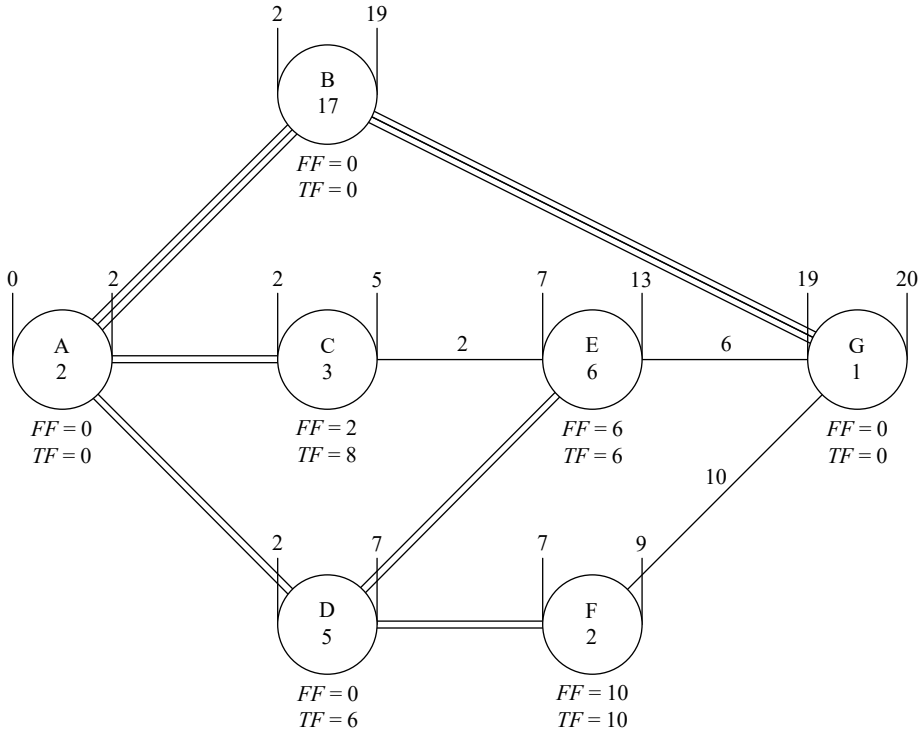


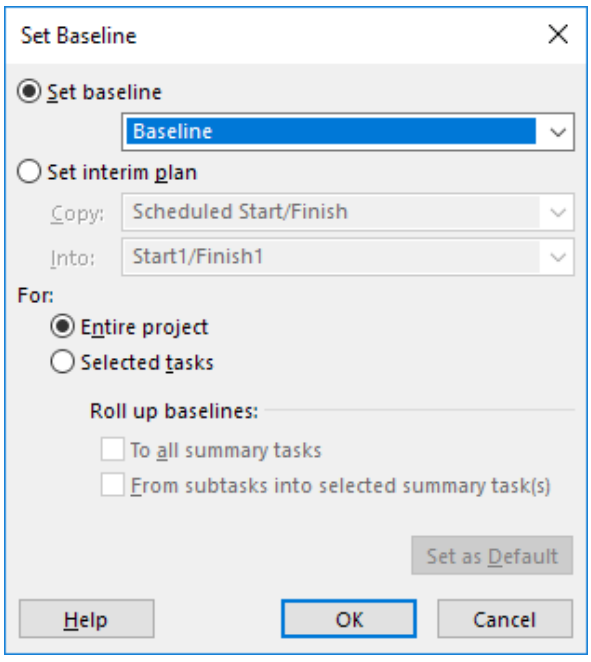
Figure 9.5 Early Start Tree

1. The definition in MS Project of a target schedule (even when activities are associated with costs) starts by entering the activities, their durations and their predecessors. The necessary data are provided by the network in Fig. 9.5.
2. This is followed by the definition of the "work" resource "$U" and the assignment of this resource to activities using resource "Units" equal to their "Cost Rates". The details for associating each activity with its cost using the resource "$U" have been described above.
3. At this point the resulting schedule contains all the necessary logic, time and cost information for the project, as shown in the Gantt Chart custom table below.

	Act	Pred	Dur	ESD	EFD	LSD	LFD	TF	FF	Res Names	Work
1	A		2 d	0	2	0	2	0 d	0 d	$U[500]	1,000 d
2	B	1	17 d	2	19	2	19	0 d	0 d	$U[200]	3,400 d
3	C	1	3 d	2	5	10	13	8 d	2 d	$U[3,000]	9,000 d
4	D	1	5 d	2	7	8	13	6 d	0 d	$U[1,000]	5,000 d
5	E	4,3	6 d	7	13	13	19	6 d	6 d	$U[2,000]	12,000 d
6	F	4	2 d	7	9	17	19	10 d	10 d	$U[500]	1,000 d
7	G	2,5,6	1 d	19	20	19	20	0 d	0 d	$U[1,000]	1,000 d

The above table is sufficient to define the Target (early-start) schedule for this example project.

This project can now be saved as a "Baseline" by selecting In the MS Project ribbon:
"Project" > "Set Baseline" > OK (i.e., accept the default selections)



Setting the Baseline saves the cost and schedule data for the Budgeted Cost of Work Scheduled (BCWS).

Entering Actual Time & Actual Cost Information in "Task Usage View"

	Activity	Pred	BL20 Work	ssgnmn Units ($/d)	Work mandays ($)	ACWP	% Comp	BL Dur	Dur	Act Dur	Rem Dur	Actual Start	Actual Finish	ESD	EFD	LSD	LFD	TF	FF
0	**Lab**		**32,400d**		**30,500d**	**$12,900**	**44%**	**20d**	**19d**	**8.28d**	**10.72d**	**11/1/2018**	**NA**	**0**	**0**	**0**	**0**	**0d**	**0d**
1	A		1,000d		900d	$900	100%	2d	3d	3d	0d	11/1/2018	11/3/2018	0	3	0	3	0d	0d
			1,000d	*300*	*900d*	*$900*						*11/1/2018*	*11/3/2018*	*0*	*0*	*0*	*0*		
2	B	1	3,400d		3,600d	$1,200	33%	17d	15d	5d	10d	11/4/2018	NA	3	18	3	18	0d	0d
			3,400d	*240*	*3,600d*	*$1,200*						*11/4/2018*	*NA*	*0*	*0*	*0*	*0*		
3	C	1	9,000d		7,200d	$6,000	83%	3d	6d	5d	1d	11/4/2018	NA	3	9	3	10	1d	0d
			9,000d	*1,200*	*7,200d*	*$6,000*						*11/4/2018*	*NA*	*0*	*0*	*0*	*0*		
4	D	1	5,000d		4,800d	$4,800	100%	5d	4d	4d	0d	11/5/2018	11/8/2018	4	8	4	8	0d	0d
			5,000d	*1,200*	*4,800d*	*$4,800*						*11/5/2018*	*11/8/2018*	*0*	*0*	*0*	*0*		
5	E	4,3	12,000d		12,000d	$0	0%	6d	8d	0d	8d	NA	NA	9	17	10	18	1d	1d
			12,000d	*1,500*	*12,000d*	*$0*						*NA*	*NA*	*0*	*0*	*0*	*0*		
6	F	4	1,000d		1,200d	$0	0%	2d	2d	0d	2d	NA	NA	8	10	16	18	8d	8d
			1,000d	*600*	*1,200d*	*$0*						*NA*	*NA*	*0*	*0*	*0*	*0*		
7	G	2,5,6	1,000d		800d	$0	0%	1d	1d	0d	1d	NA	NA	18	19	18	19	0d	0d
			1,000d	*800*	*800d*	*$0*						*NA*	*NA*	*0*	*0*	*0*	*0*		

Once a Baseline is saved, the project can be updated to reflect actual time and cost performance as of the Data Date (see also "*Steps to Update a Schedule in Microsoft Project Pro*"). Entering actual cost data is conceptually the same as entering the budget cost data that became part of the baseline and BCWS. The difference is that actual cost data are entered in the "current" project and not the saved baseline.

- Set the Data Date (e.g., set the Status date to 8 days).
- Use the Task Usage View (see above) and show columns for "% Complete", "Durations" "Actual Dates", "Assignment Units" (Act $/d), and "Work" (Act $).
- Consider activities in sequence-step order and enter "Dur" and "Assignment Units" as follows.
- Enter the latest activity "total" durations in the column "Dur".
  Important: Note that entering "Dur", sets "Rem Dur" = "Dur". At this point, Actual Dur = 0.
  - For finished activities, set "Dur" = "actual total activity duration".
  - For ongoing and not-yet-started activities set "Dur" = "estimated total activity duration".
- Enter the "actual/updated cost rates" (i.e., $/day) in the column "Assignment Units".
- MS project calculates automatically: Work = (Assignment Units) * (Dur)
  - This automatic calculation of the updated "Work" (which gives the latest "Total Cost" for the activity) is done only for activities that are still at 0% complete, i.e., activities that have not been marked as started yet.
  - Warning: Once activities are marked as (partially/totally) complete, MS Project no longer calculates the actual/estimated "Work" column in this simple manner. In this case, it is necessary to use the spreadsheet on the right side of the "Task Usage View" to enter manually the desired daily amounts for "Work" (and consequently for "Cost").

- Consider activities in sequence-step order again and enter actual time data as follows.
- Enter Actual Start/Finish Dates only when different from those scheduled automatically.
  For example, set activity D to start on the 5th day (not the 4th day) while all activities are still 0% complete.
- Enter "actual" durations in the column "Act Dur".
  For activities that have finished, "Act Dur" = "Dur" = actual duration before the Data Date.

For activities still going on, "Act Dur" = "actual activity duration up-to the Data Date".
Entering "Act Dur" automatically updates the following:

- Sets the date in the "Actual Start" column
- Sets "Rem Dur" = "Dur"- "Act Dur", and
- If "Rem Dur" = 0, calculates the date in the "Actual Finish" column.

- Have MS Project calculate % complete for only those activities that proceed as scheduled, i.e.,
  1. Have started and are either finished or still going on, and
  2. Whose durations have not changed from the baseline.
  - This marks some activities as started and sets their % complete > 0%. If you make a mistake, set all activities to 0% complete, make corrections, and repeat this step.

How to Correct Mistakes in the "Work" for Each Activity

Important: The spreadsheet at the right of the "Task Usage view" allows complete control over the amount of "Work" that is planned or accomplished every day for each activity. Thus, if MS Project does not automatically produce the correct total "Work" for an activity, it is possible to make any desired corrections by entering a different amount of daily "Work" (i.e., the "Cost Rate") for each day of an activity in the spreadsheet so that the sum of all daily "Work" equals the desired total "Work" value.

Cost-loaded Bar Charts

Both the "Task Usage" view and the "Resource Usage" view include a spreadsheet on the right-hand side that shows "activity daily work" as a bar chart.

Shown below, as an example, is the "Resource Usage" view with the updated activity cost information on the left and bar chart showing "daily work" on the right. The numbers in the bar chart cells show resource "Units" = "Daily Work" = "Cost Rate" for the activity.

Resource Name	Work	Assigni Units	Details	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Lump Sum Cost	30,500 d		Work	300d	300d	300d	1,440d	2,640d	2,640d	2,640d	2,640d	2,040d	2,340d	1,740d	1,740d	1,740d	1,740d	1,740d	1,740d	1,740d	240d	800d
A	*900 d*	*300*	Work	300d	300d	300d																
B	*3,600 d*	*240*	Work				240d	240d	240d	240d	240d	240d	240d	240d	240d	240d	240d	240d	240d	240d	240d	
C	*7,200 d*	*1,200*	Work				1,200d	1,200d	1,200d	1,200d	1,200d	1,200d										
D	*4,800 d*	*1,200*	Work					1,200d	1,200d	1,200d	1,200d											
E	*12,000 d*	*1,500*	Work										1,500d	1,500d	1,500d	1,500d	1,500d	1,500d	1,500d	1,500d		
F	*1,200 d*	*600*	Work									600d	600d									
G	*800 d*	*800*	Work																			800d

The second row of numbers with a gray background (immediately below the timeline in the spreadsheet) shows the actual (or estimated) daily work (daily cost) for all activities on that day.

For example, the Data Date is DD=8 days. Thus, the cumulative form of this row up to DD=8d would represent the "Actual Cost of Work Performed" (ACWP) which is calculated as follows:

ACWP (@DD=8d) = 300+300+300+1440+2640+2640+2640+2640 = $12,900

Beyond the Data Date, DD=8 days, the cumulative form of this row represents the "estimated" AWCP to the end of the project (based on all current information).

The sum of all the total daily cost rates is the Estimate at Completion (EAC):

EAC = 300+300+300+1440+2640+2640+2640+2640+
+2040+2340+1740+1740+1740+1740+1740+1740+1740+240+800 = $30,500

How to enter *Integer* Total Costs ($) for Activities when they have *Non-Integer* Cost Rates ($/d)

In some cases, such as the Woodstock Sawmill Project, we are given the total cost of each activity ($) but not its cost rate ($/d or $/w). One way around this would be to calculate the missing cost rates ($/d or $/w) by dividing the given total cost for each activity ($) by the activity's duration (d or w) and then enter the activity costs by entering the calculated cost rates ($/d or $/w) as described above.

When a resource, such as $U, is assigned to an activity with *Fixed Duration* and we enter the number of assigned resources in the field "Assignment Units" and click OK, MS Project (as expected) will automatically calculate the field "Work" (which also gives the total cost) for that activity as follows:

"Work" = "Assignment Units" * "Activity Duration"
(mandays) = (men) * (days)

The problem is that the division of the activity total cost ($) by the activity duration (d or w) may give non-integer cost rates, such as 3.33… ($/d or $/w). If we then enter these non-integer cost rates as "Assignment Units", MS Project will multiply them by the activity duration to calculate the field "Work" and the result will not be the original integer cost but rather a non-integer number, such as 9.99…

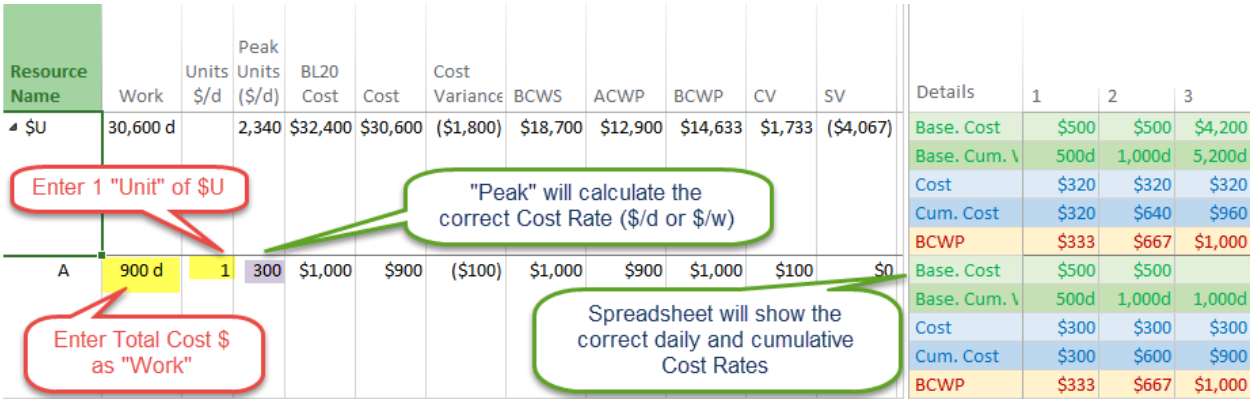
To avoid having non-integer costs, we should not calculate and enter non-integer "Assignment Units". Instead, we can enter directly the total cost of each activity in the field "Work". When we do so, MS Project will NOT recalculate the resource field "Assignment Units" to match "Work". It will leave the current value of the field "Assignment Units" for the activity unchanged (and incorrect).

We can use this MS Project behavior to enter an integer cost for activity A (dur 3d, cost $900) as follows:

- Assign to activity A the resource $U as described above.
- In the Resource Usage table show the fields "Work", "Assignment Units" and "Peak".
- **First**, in column "Assignment Units", assign to activity A exactly 1 "Unit" of resource $U.
- **Then**, in column "Work" enter the Total Cost for activity A, e.g., 900d. The field "Assignment Units" will not change and will continue to show the number 1. The correct Cost Rate ($/d or $/w), e.g., $900/3d=$300/d, will be shown by the back-calculated field "Peak".

Even though the field "Assignment Units" will show the number 1, which is clearly incorrect, all other fields, such as the spreadsheet on the right-hand side of the Resource Usage view (shown below) will show the correct daily Cost Rates ($/d or $/w) and cumulative Cost Rates ($) for the activities.

This provides an effective way to enter integer costs when only the total costs of activities are given.



Resource Name	Work	Units $/d	Peak Units ($/d)	BL20 Cost	Cost	Cost Variance	BCWS	ACWP	BCWP	CV	SV
$U	30,600 d		2,340	$32,400	$30,600	($1,800)	$18,700	$12,900	$14,633	$1,733	($4,067)
A	900 d	1	300	$1,000	$900	($100)	$1,000	$900	$1,000	$100	$0

Details	1	2	3
Base. Cost	$500	$500	$4,200
Base. Cum. V	500d	1,000d	5,200d
Cost	$320	$320	$320
Cum. Cost	$320	$640	$960
BCWP	$333	$667	$1,000
Base. Cost	$500	$500	
Base. Cum. V	500d	1,000d	1,000d
Cost	$300	$300	$300
Cum. Cost	$300	$600	$900
BCWP	$333	$667	$1,000

How to schedule Uncompleted Work to start after the Status Date (i.e., after the Data Date)

When we enter actual progress data into MS Project as of a certain Data Date, some activities that have not started (or finished) by the Data Date may be allowed by their predecessor activities to start (or continue) in the past, before the Data Date (i.e., before the Status Date). We encounter this situation, for example, when we enter progress data for the Woodstock Sawmill Project at the Data Date of 21 weeks. For that project, there are several activities that should have started before 21 weeks, but did not, and moreover, these activities are still allowed by their predecessors to start before the Status Date of 21 weeks. In this situation, MS Project will indeed schedule these activities to start *before the Status Date* even though they did not do so in real life. That would clearly be a mistake.

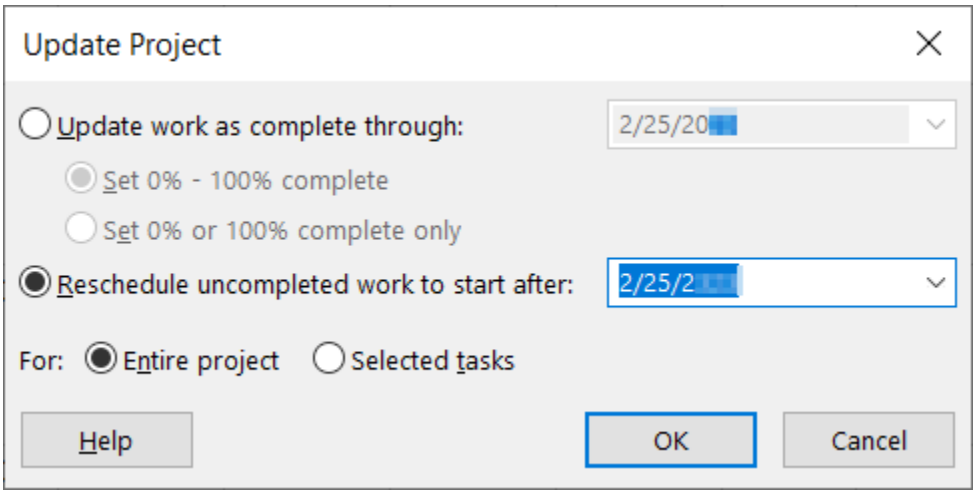
To overcome this problem for the Woodstock Sawmill Project, for example, we should first mark the activities that were completed by the Data Date of 21 weeks (e.g., 2/25/20XX) as 100% complete.

Then, to correctly schedule the remaining activities (some of which are scheduled by MS Project to start incorrectly *before* the Data Date of 21 weeks (2/25/20XX)), we should proceed as follows:

- Ribbon: Project > Update Project

And on the "Update Project" dialog box that shows up (see screen shot below) we should select:

- Reschedule uncompleted work to start after 2/25/20XX (i.e., after the Data Date of 21 weeks)
- For: Entire project



This will force all remaining activities to start (or continue) after the Data Date (Status Date) using their Remaining Duration(s) and may increase project duration (if some of the delayed activities are critical).

NOTE: MS Project forces activities to start no earlier than the Data Date (and later than their predecessors would allow) by introducing a “constraint” for each of these activities as shown below.

Start no earlier than 2/25/20XX (where 2/25/20XX is the Status Date)

To see these constraints, enter a new column for the field “Constraint Type” in the Gantt chart table. Alternatively, right-click an activity, select “Information” and then click on the “Advanced” tab.

Notice that this is not an issue in Primavera P6 Pro because of the way P6 schedules activities. P6 always starts scheduling from the current Data Date (and not “the start of the project” or “the finish dates of completed predecessors”) and always uses only the Remaining Duration of the remaining activities. Thus, in P6 it is not possible for future activities to be scheduled to start before the Data Date.