Teaching Microsoft Project in the Project Management Classroom: The Dream Home Project Exercise

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ABSTRACT

One of the learning outcomes associated with our course in project management relates to the development of knowledge and skills in the use of technical tools (e.g., software) for project work. As such, we require that our students learn and use Microsoft Project Professional® to plan, schedule and control a simulated project. We developed this project exercise for use as an in-class, instructor-directed learning activity or as a self-directed activity for use in combination with an online video learning platform (e.g., Lynda.com). When used as a framework for discussing project scope, schedule and cost, a simulated "dream home" build allows students to plan, schedule, budget and control a project that can be easily envisioned and understood, yet is customizable to suit individual course and instructor learning outcomes.

Keywords: project management tools, Microsoft Project Professional®, project planning and control; experiential exercise

INTRODUCTION

All organizations face unique challenges when handling complex projects, most notably the need to organize, manipulate, display and communicate project activities for planning and control purposes. The project management discipline has responded to these unique and evolving challenges by developing various tools and techniques to assist project managers in the initiation, planning, execution, control and closing phases of project work (Fox and Spence, 1998; Hebert and Deckro, 2011; Project Management Institute, 2013; Project Management Zone, 2016). In this paper, we develop a project exercise for students that requires the use of one such tool to complete the task of building a dream home.

Our stakeholders tell us, among other things, that they would like our business students to have a fundamental understanding of the typical software applications used in business organizations today (e.g., word processing, database, and spreadsheet applications). In addition, for students in our undergraduate project management career track, our stakeholders have encouraged us to develop students' knowledge and skills in the use of project management software (Poston and Richardson, 2011). Since one goal of our project management career track is to prepare students to excel on the Certified Associate in Project Management (CAPM®) exam offered by the Project Management Institute (PMI) and in the career field upon graduation, we believe that knowledge of, and practice with, project planning and control software is essential to that purpose. Although there are many commercial project management software packages available (i.e., Primavera, Basecamp, Smartsheet), we have chosen Microsoft Project Professional® because it is one of the most popular, widely used project management software packages (Project Management Zone, 2016; Salas-Morera, et al., 2013) and because it is compatible with the other Microsoft Office® applications already in use in our business school.

THE DREAM HOME BUILD

We have heard from our students that project management subject matter can be dry. This experiential exercise was developed to provide a link between course instruction concerning project scope, schedule and cost, and a software application that helps students translate and apply that information to build observable and measureable knowledge and skills. We also think that helping to build a dream home, even for their college instructor, can be interesting and fun for students (the instructor plays the role of the project client). We structure the course that covers this material using the same sequence as that of the knowledge areas in PMI's Project Management Body of Knowledge (PMBOK®), and so we wait until we have introduced project scope management, project time (schedule) management, and project cost management in the course before introducing this exercise. The activities developed as part of the project (e.g., building walls, putting the roof on, plumbing and electrical work) are easy to understand/explain, and the "waterfall" nature of the dream home activities support the traditional, predictive life

cycle approach to project planning outlined in the PMBOK® (Project Management Institute, 2013: 44). We also wanted to develop an experiential activity that could be taught in instructor-led sessions or as a student self-directed learning activity. In our classes, we pair the exercise steps to chapters/sections of video instruction provided by our university online learning platform and video learning aid (Lynda.com). In other words, the instructions for the student self-directed activity would be similar to the exercise instructions given in Appendix 1, but would include a link to chapters/sections of the Lynda.com videos which discuss how to perform the operations requested in each step. In the self-directed version, we instruct the students to view the video associated with each step before attempting to accomplish the step requirements. If you have a similar online video learning resource available, we encourage you to modify the exercise instructions given in Appendix 1 to include those sections of the resource that support learning that material (Nagy and Bernschütz, 2016). Finally, we wanted to develop an exercise that covered the majority of the fundamental features and functions of the project management software in a relatively short time (3 hours) while reinforcing the material covered in our instruction of scope, schedule and cost.

EXERCISE STEPS

The exercise steps listed in Appendix 1 take the students through the fundamental elements of project planning and control, such as creating project tasks, sub-tasks and work packages, developing a work breakdown structure (WBS), sequencing project activities and developing the project schedule, and controlling the budget using earned value management (EVM). If the instructor is familiar with MS Project, the steps are fairly straightforward, and the steps/activities can be easily modified to suit the needs of the course/instructor. However, we detail (below, with screenshots of the MS Project file) the important elements of the project and why we developed the exercise to cover these elements.

Steps 1-5. Steps 1-5 require that the students create/save a Project file, insert the Dream Home task activities and task durations (from Exhibit 1), insert the project start date for the first activity, and indicate the precedence relationships (also from Exhibit 1) between project activities. The operations associated with these steps should be familiar to students who have a working knowledge of MS Excel because the workspace for MS Project looks and operates much like a spreadsheet. Also, as with most Microsoft programs, there is often more than one way to accomplish an operation (for instance, precedence relationships between activities can either be indicated using the "Link" button on the "Task" tab, or by creating a "Predecessors" column in the workspace and indicating the tasks which precede the selected activity). The screenshot shown as Figure 1 displays the MS Project workspace following the completion of Step 5. The project completion date at this point is 11/28/2017 (before the 1 December desired finish date). These activities support learning how to open/save a project file, insert project tasks and durations, and indicate activity precedence relationships.

Step 6. Step 6 is a critical step, as it requires students to insert/create sub-tasks and work packages (from Exhibit 2) into the task listing. This step can negatively affect subsequent steps if students do not properly indent task levels (from task to sub-task to work package level) or indicate the appropriate precedence relationships. This step supports learning about how to indicate summary (aggregation) and sub-task activities (disaggregation) within the project plan and supports the development of an appropriate WBS listing in Step 7. The screenshot shown as Figure 2 displays the MS Project workspace following the completion of Step 6.

Steps 7-8. Step 7 requires students to insert/create a column with a WBS numbering system. Step 8 requires that students insert project milestones (0 day/time duration activities) into the project file (Exhibit 3). These activities support learning about how to insert information columns into the working file and milestones or stage-gates into the project schedule.

Step 9. We included the requirements of Step 9 to get the students to experiment with the default settings of MS project and to practice changing the project working times (to account for a week of vacation/fishing in the project schedule). The screenshot shown as Figure 3 contains arrows showing the milestones created in Step 8 as well as the dialog box that appears when the "Change Working Time" function of the "Project" tab is selected. As will soon become evident, this change, as well as another project delay (a snow storm) will extend the planned project finish past 1 December. The screenshot shown as Figure 3 displays the MS Project workspace following the completion of Step 9.

Figure 1: Screenshot following Step 5

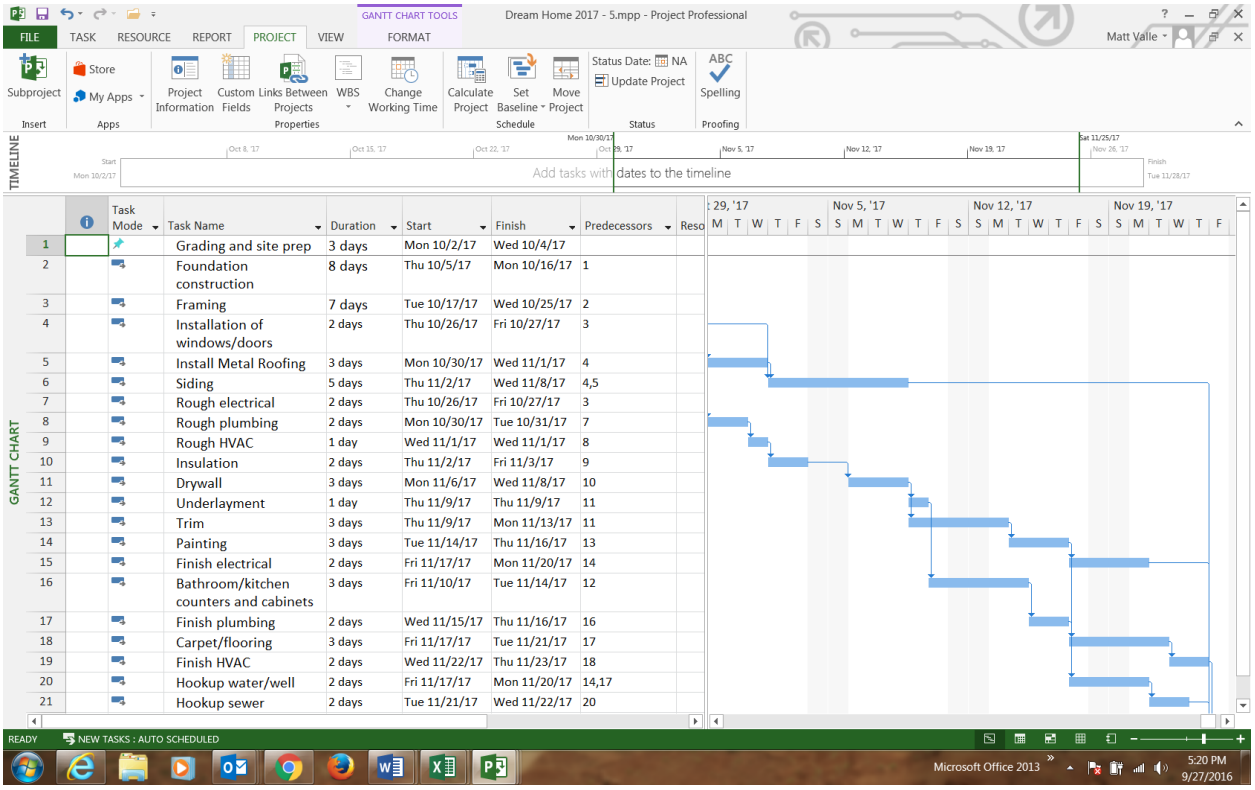


Figure 2: Screenshot following Step 6

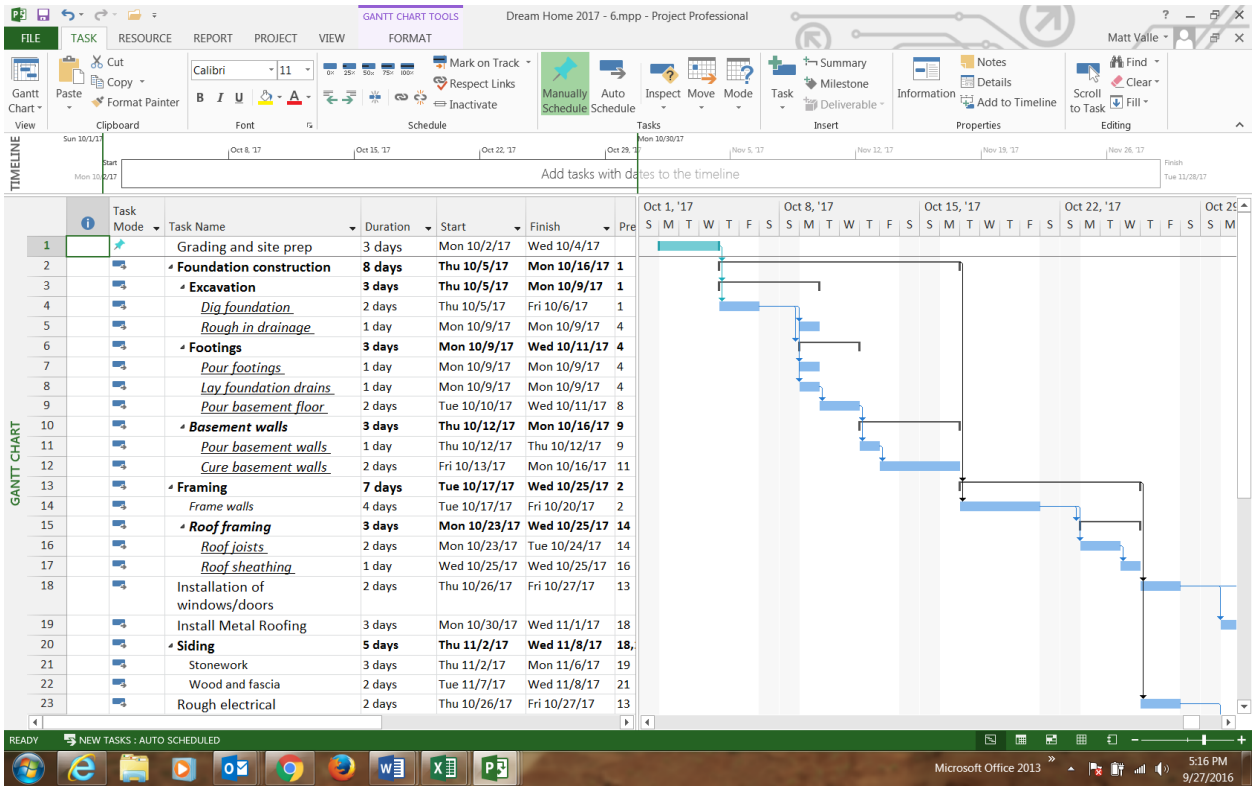
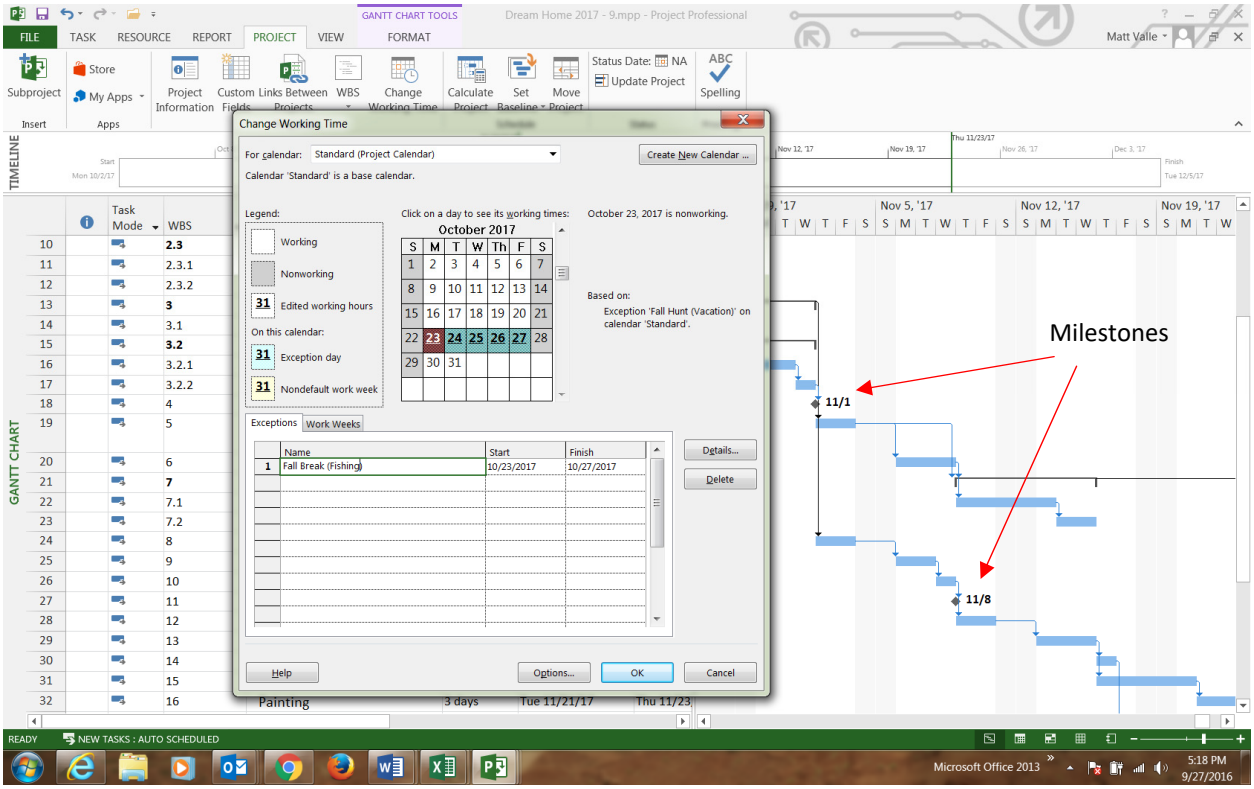
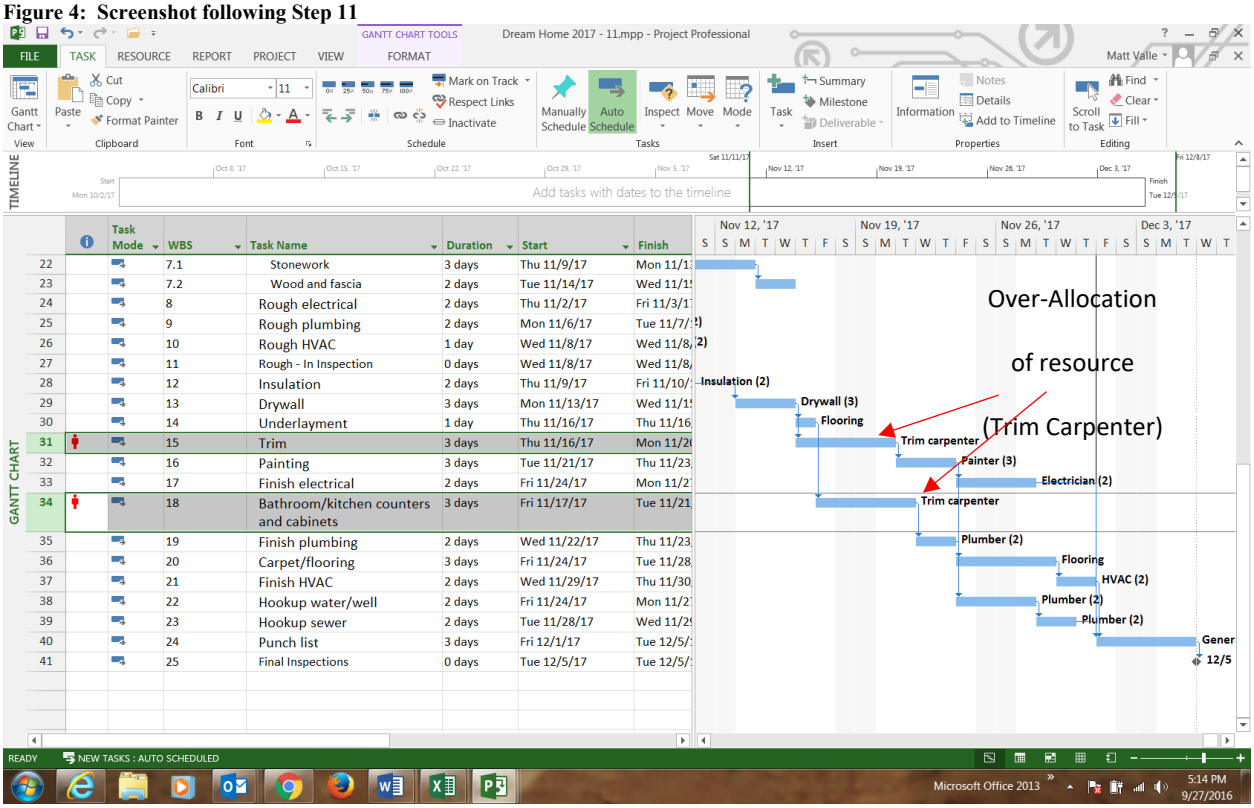


Figure 3: Screenshot following Step 9


Milestones
11/1
11/8
Change Working Time
For calendar: Standard (Project Calendar)
Create New Calendar ...
Calendar 'Standard' is a base calendar.
Legend:
Working
Nonworking
Edited working hours
On this calendar:
Exception day
Nondefault work week
Click on a day to see its working times:
October 2017
October 23, 2017 is nonworking.
Based on:
Exception 'Fall Hunt (Vacation)' on calendar 'Standard'.
Exceptions
Work Weeks
Name
Start
Finish
Fall Break (Fishing)
10/23/2017
10/27/2017
Details...
Delete
Help
Options...
OK
Cancel
Painting
3 days
Tue 11/21/17
Thu 11/23
READY
NEW TASKS : AUTO SCHEDULED
Microsoft Office 2013
5:18 PM
9/27/2016

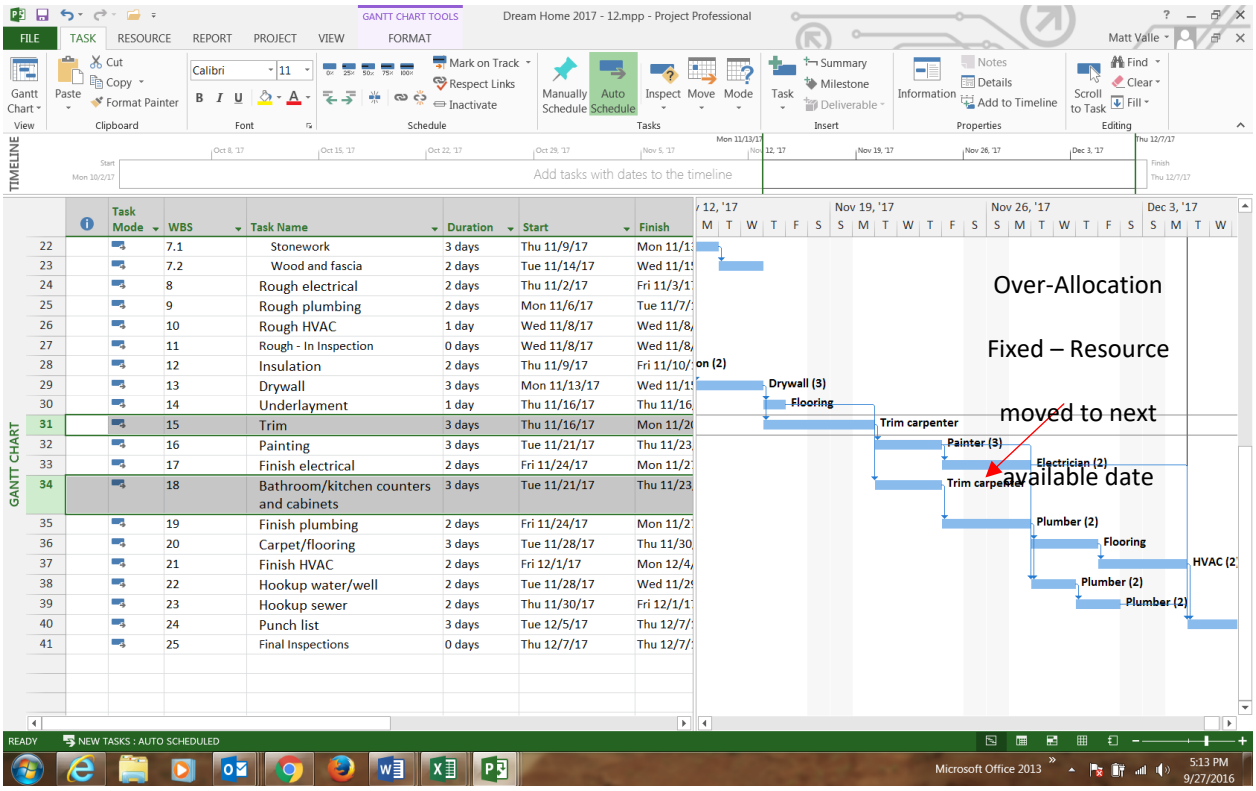
Steps 10-11. Step 10 requires the development of a resource sheet (personnel, material, and cost resources for the project – Exhibit 4). The resource sheet (shown under the "Resource" tab in MS Project) looks very much like an Excel spreadsheet; in fact, students can copy/paste elements of Exhibit 4 into the resource sheet in MS Project. Step 11 requires that the students assign resources (according to Exhibit 5) to project tasks/sub-tasks/work packages. By assigning resources to project activities, the program indicates which resources are assigned to which tasks and also stores cost information for each activity and for the entire project. This cost information (cost baseline) will be used later for control when the project is being executed. The screenshot shown as Figure 4 displays the MS Project workspace following the completion of Step 11. Notice how rows 31 and 34 display red figures (indications that a human resource, the trim carpenter, is incorrectly assigned to two tasks at the same time). This problem requires a subsequent adjustment and teaches the students the importance of understanding potential resource constraints.

Figure 4: Screenshot following Step 11



Step 12. Step 12 requires that the students work through alternatives for resolving the resource over-allocation from Step 11. The screenshot shown as Figure 5 displays the MS Project workspace following the completion of Step 12. We chose to delay the activity on row 34 until the trim carpenter (our good friend, "Bob") had completed the activity on row 31. Notice how the activity timeline bar (the Gantt chart) on row 34 has been moved back (delayed) until the trim carpenter completes the activity in row 31. Alternatively, we could have hired another resource, "Trim Carpenter #2 - Jane", and assigned that resource to the activity on row 34. That would not have delayed the project…but it may have made our friend Bob unhappy. The students should understand that project decisions about constraints are often associated with trade-offs.

Figure 5: Screenshot following Step 12



Step 13. Step 13 requires that the students save a baseline for the project. The baseline assumes that the project plan is essentially "set" (scope, schedule and cost baselines are final). Notice that at the very bottom of the display in Figure 5, row 40 (one of the final project activities, the "punch list") is scheduled to be complete on 12/7, seven days after our requested project completion date. This was due to the fall vacation (fishing) and the resource over-allocation for the Trim Carpenter. The PM is going to have to make some adjustments… Given the project baselines, we then have the students set the status date (simulating that the project is being executed and the current date is 6 November, approximately half-way through the dream home build). As such, we also require the students to indicate activity progress by marking some project activities as 100% complete, while others are less than 100% complete (as of 11/6) due to a snowstorm at the jobsite. It is at this point that we require the students to evaluate project progress using EVM metrics. We require the students to create earned value columns, interpret those values, and create an earned value display (since MS Project is synced to MS Excel, the generation of an EVM chart is easily accomplished). The screenshot shown as Figure 6 shows the dialog box that is displayed when the student requests a "Visual Report" under the "Report" tab. Figure 7 shows the resulting MS Excel chart generated by the "Earned Value Over Time Report" request. Notice how the Actual Cost line (the bottom line) and the Earned Value line (identical to/under the AC line) are below the Planned Value line (the top line). This indicates the project is behind schedule in (calendar) weeks 44 and 45.

Figure 6: Screenshot following Step 13

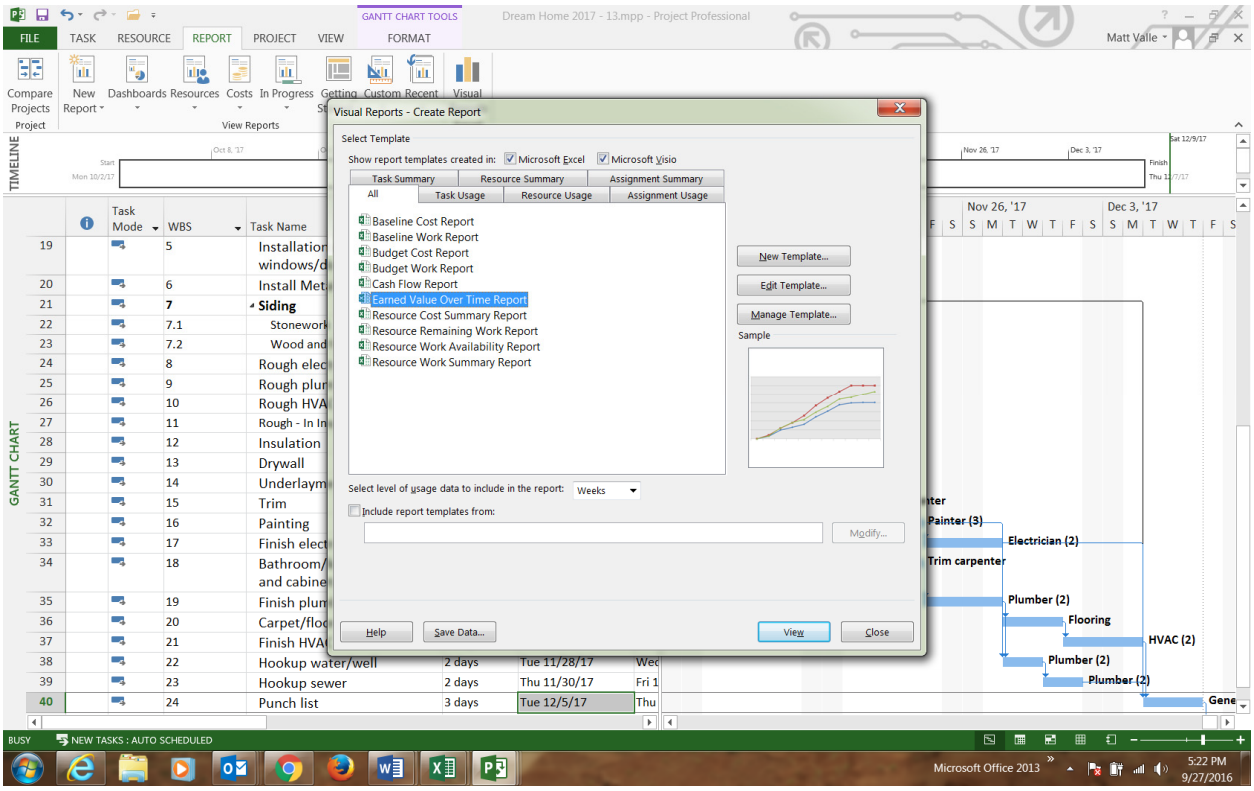
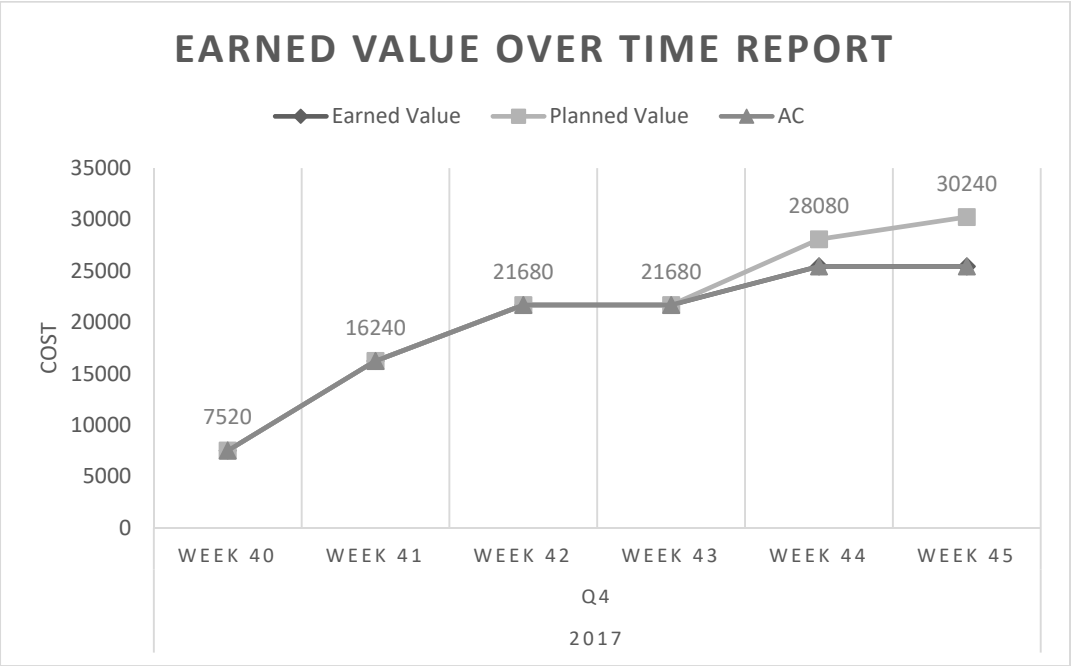


Figure 7: Screenshot of "Earned Value Over Time Report" request



Step 14. Step 14 takes the information from Step 13 (that the schedule variance is negative, and the project is behind schedule) and requires that the students figure out a way to adjust the activities remaining to get the client in the dream home on 1 December. In the past, we required students to compress the remaining project schedule in MS Project so as to speed up the remaining activities. However, if was difficult to review the resulting file and determine what the students had changed. Therefore, we ask the students to tell us (in the email with their file submission) what they would do to compress the remaining activities in the project to meet the planned project finish date. Ideally, students describe how they would note the critical path activities in the project (from 6 November to 7 December) and then "crash" the project by adding to those crews/activities at the lowest cost possible. However, other suitable schedule compression activities are possible, and it is interesting to see how the students meet this typical project challenge.

CONCLUSION

We have found this exercise to be extremely helpful in teaching project planning and control software, and in reinforcing course material about scope management, schedule management and cost management and control. While we did not ask about this exercise specifically, unsolicited student feedback from undergraduates and MBA's (recorded in official student teaching evaluations) suggests that working on this applied exercise was both fun and effective. Student comments included remarks such as "The MS Project exercise was helpful for learning practical, useful software for my industry" and "…Project was immediately applicable in my current job" (verbatim comments from MBA students); "…I appreciated the exercise for MS Project because it allowed me to apply the material from the textbook…" and "…the MS Project exercise was a great way of reinforcing the fundamentals…" (verbatim comments from undergraduate students). Further validation comes from anecdotal reports from undergraduate and MBA students who have interviewed for project management jobs. They tell us that listing experience and proficiency with MS Project Professional on their resume elicits remarks from interviewers and starts conversations about the project software in use at the company. It appears that this indication of skill development (in MS Project) may act as a signal to employers that the candidate is committed to learning the skills necessary to be effective as a project manager. Instructors in project management classes may also find this exercise useful for teaching the fundamental concepts of Microsoft Project in a condensed format, either as an instructor-led learning activity or as a student self-directed learning exercise. Additionally, we would welcome requests from interested instructors for our model project files (the screenshots of which are displayed in this article). As we have found, the essential elements of the project management triangle (scope, schedule and cost) become tangible, and more memorable, to students who envision building this dream home.

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APPENDIX 1

"Dream Home" Project

Thank you for agreeing to serve as the project manager for the construction of my dream home. We have contracted with ACME Custom Builders, L.L.C., to build the home on a lot that my spouse and I purchased. The builder has given us an estimate of the building task sequence and durations (Exhibit 1). The builder works with a number of trade crews and tells me that she can schedule the crews on an "as needed" basis in order to bring projects in on time. Based on the builder's estimate of work/activity durations, we have set a tentative occupancy date of 1 December, 2017. She suggests a start date of Monday 2 October 2017 (remember, this is a *dream* home!). In any case, you should be able to commence grading and site preparation on 2 October. The builder has given us (you) a list of tasks that need to be accomplished, as well as information on the trade crews she uses, costs, etc. Use the information from the Exhibits provided and MS Project Professional to accomplish the following tasks:

1. Create a MS Project Professional file (.mpp) and name it using the following convention **- ("Your Last Name")(Space)("PM")(Space)("2016")**. An example would be "Smith PM 2016.mpp". If you are new to MS Project, it is suggested that you save successive files of your work with different file names as you proceed – that way, if you make a mistake that you cannot undo, you can go back to a previous file and start from there without having to recreate the entire file from the beginning. You will prompted in these instructions when we think you should save your *working* file. It is also suggested that you follow the sequence provided in steps 2-14 (below) to avoid logic errors in the construction of the MS Project network.
2. Populate the "Task Name" column with the task names provided in Exhibit 1. We will add Subtasks and Work Packages later.
3. Populate the "Duration" column with the activity duration times from Exhibit 1. We will use the default (standard) project calendar in MS Project (5 day work week).
4. Insert the project start date (2 October, 2017) in the "Start" column corresponding to the first task activity ("Grading and site prep"). You can leave this task as "Manually Scheduled." Select "Automatically Scheduled" in the Task Mode column for all successive activities.
5. Exhibit 1 gives you information on the durations and precedence relationships (task dependencies) of the building task activities. For example, the framing must be completed before the windows and doors can be

installed (this makes sense). In your project file, link task activities based on the precedence relationships given in Exhibit 1 (be careful: most task activities have one predecessor, but some task activities have more than one predecessor). **Save a copy of this file as ("Your Last Name")(Space)("PM")(Space) ("2016")(Space)("Task List")**.

6. Exhibit 2 gives you information on the durations and precedence relationships (task dependencies) of the tasks, subtasks and work packages for the Task Activities **foundation construction, framing,** and **siding**. In this exhibit, task activities are listed in **bold** type; subtasks are listed in regular type; work packages are listed in *italics and underlined*. For example, the **foundation construction** task consists of the excavation, footings and basement walls subtasks, and the excavation subtask consists of the *dig foundation* and *rough in drainage* work packages. In your project file, link the subtask and work package activities based on the precedence relationships given in Exhibit 2. Subtasks and work packages should be automatically scheduled based on the precedence relationships. **Save a copy of this file as ("Your Last Name")(Space)("PM")(Space)("2016")(Space)("All Tasks")**.
7. Create a column to the left of the "Task Mode" column and insert WBS codes/field into that column. **Save a copy of this file as ("Your Last Name")(Space)("PM")(Space)("2016")(Space)("WBS")**.
8. Create Milestones in your project file based on the milestone information in Exhibit 3.
9. Your builder (General Contractor) tells you that she and her crews are going to take Fall Break (to go fishing) from Monday, October 23, 2017 to Friday, October 27, 2017. Adjust your project calendar to indicate that that week is a non-working week. **Save a copy of this file as ("Your Last Name")(Space) ("PM")(Space)("2016")(Space) ("Fishing")**.
10. Create a Resource Sheet like the one included as Exhibit 4. Some of the resources are work resources (personnel), some are material resources, and one is a cost resource. Some of the resources are grouped as teams (for example, the "Grading Crew" has 3 individuals assigned to it). If the resource is a team of 2 or more individuals, the standard cost (hourly rate) is based on the cost of all individuals in the team (if you use the Grading Crew for 1 hour, it will cost you $180 - If you work them overtime, it will cost you double time, or $360. Each individual worker on that team is paid $60/hour standard, $120/hour overtime). Some individuals or teams charge double overtime, some time-and-a-half, and so on.
11. Assign the work resources listed in Exhibit 5 to their corresponding tasks. In addition, assign 10 cubic yards of concrete each to the pour footings, poor basement floor and pour basement walls work packages (this is an example of using the assign [materials] resource feature). **Save a copy of this file as ("Your Last Name")(Space)("PM")(Space)("2016")(Space)("Resources Assigned")**.
12. Note where you have over-allocations of resources. Work through your options regarding how to fix these over-allocations. (Hint: You can "add" resources – hire additional crews – to complete the work, assign additional resources to complete the work previously assigned to a single resource, or adjust the schedule – level resources - to allow the assigned work crews the time they need to complete all tasks/subtasks/work packages). Make the changes you think are necessary to resolve the resource over-allocations. **Save a copy of this file as ("Your Last Name")(Space)("PM")(Space)("2016")(Space)("Resources Fixed")**.
13. Save a Baseline for your project file. **Save a copy of this file as ("Your Last Name")(Space)("PM") (Space)("2016")(Space)("Baseline")**. Next, in your project file, set the status date to 11/6/17. Highlight the tasks from "Grading and site prep" to "Roof sheathing" and mark the selected tasks as 100% complete. Assume that there was a bad snowstorm and little work was done on the tasks "Installation of doors/ windows" and "Rough electrical" - mark those tasks 25% complete. Create earned value columns (PV, EV, AC, SV, CV) in your project file. Review those columns and visually determine the differences between the Planned Value and the Earned Value for the two activities that are behind schedule. View the "Earned Value Over Time" visual report. Notice where the Planned Value, Earned Value and Actual Costs lines are/should be (and why they are where they are). Again, since you are only behind on two tasks, the deviation (schedule variance) will be rather small. Question: Is your schedule variance positive or negative, and what does that mean? **Save a copy of this file as ("Your Last Name")(Space)("PM") (Space)("2016")(Space)("EVM")**.
14. Look at your project at the "current" status time (11/6/17). When is the (new) scheduled finish date? Given that the client (me) wants to occupy the house on 1 Dec, what options do you have available in order to meet that schedule? What would you do to meet that schedule (hint: look at the critical path/critical tasks in the network – if you are going to spend money to compress the project schedule, what is the best use of that extra cash?). Tell me what your plans are to meet the project deadline. **Save a copy of this file as ("Your Last Name")(Space)("PM")(Space)("2016")(Space) ("Final")**. Send me this final file as an attachment to email (instructor@university.edu). Include in your email answers to the questions I have

asked in items 13 and 14.

Good luck!

Exhibit 1

Tasks	Task Name	Duration	Follows Task(s)
1	Grading and site prep	3 days	-
2	Foundation construction	8 days	1
3	Framing	7 days	2
4	Installation of windows/doors	2 days	3
5	Install Metal Roofing	3 days	4
6	Siding	5 days	4, 5
7	Rough electrical	2 days	3
8	Rough plumbing	2 days	7
9	Rough HVAC	1 day	8
10	Insulation	2 days	9
11	Drywall	3 days	10
12	Underlayment	1 day	11
13	Trim	3 days	11
14	Painting	3 days	13
15	Finish electrical	2 days	14
16	Bathroom/kitchen counters and cabinets	3 days	12
17	Finish plumbing	2 days	16
18	Carpet/flooring	3 days	17
19	Finish HVAC	2 days	18
20	Hookup water/well	2 days	14, 17
21	Hookup sewer	2 days	20
22	Punch list	3 days	6, 15, 19, 21

Exhibit 2

Task Sub-Task *Work Package*	Duration	Follows Task/Subtask/Work Package(s)
Foundation construction	8 days	Task: Starts when "grading and site prep" task is complete
Excavation	3 days	First Sub-Task: Starts when "grading and site prep" task is complete
Dig foundation	2 days	First Work Package: Starts when "grading and site prep" task is complete
Rough in drainage	1 day	Second Work Package: Starts when "dig foundation" WP is complete
Footings	3 days	Second Sub-Task: Starts when "dig foundation" WP is complete
Pour footings	1 day	First Work Package: Starts when "dig foundation" WP is complete
Lay foundation drains	1 day	Second Work Package: Starts when "dig foundation" WP is complete
Pour basement floor	2 days	Third Work Package: Starts when "lay foundation drains" WP is complete
Basement walls	3 days	Third Sub-Task: Starts when "pour basement floor" WP is complete
Pour basement walls	1 day	First Work Package: Starts when "pour basement floor" WP is complete
Cure basement walls	2 days	Second Work Package: Starts when "pour basement walls" WP is complete
Framing	7 days	Task: Starts when "Foundation construction" task is complete
Frame walls	4 days	First Sub-Task: Starts when "Foundation construction" task is complete
Roof framing	3 days	Second Sub-Task: Starts when "frame walls" sub-task is complete
Roof joists	2 days	First Work Package: Starts when "frame walls" sub-task is complete
Roof sheathing	1 day	Second Work Package: Starts when "roof joists" WP is complete
Siding	5 days	Task: Starts when "Installation of windows/doors" and "Install metal roofing" tasks are complete
Stonework	3 days	First Sub-Task: Starts when "Installation of windows/doors" and "Install metal roofing" tasks are complete
Wood and fascia	2 days	Second Sub-Task: Starts when "Stonework" sub-task is complete

Exhibit 3

Milestones for CO Project House

Milestone 1	Dry In - Inspection	Link to completion of "Roof sheathing" WP
Milestone 2	Rough-in Inspection	Link to completion of "Rough HVAC" task
Milestone 3	Final Inspections	Link to completion of "Punch list" task

Exhibit 4

Project Resources

Resource Name	Type	Initials	Max. Units	Std. Rate	Ovt. Rate
Grading crew (3)	Work	Grade	100%	$180.00/hr	$360.00/hr
Concrete crew (4)	Work	Concrete	100%	$200.00/hr	$300.00/hr
Framing crew (4)	Work	Framers	100%	$120.00/hr	$180.00/hr
Roofing crew (3)	Work	Roofers	100%	$150.00/hr	$225.00/hr
Electrician (2)	Work	Elec	100%	$100.00/hr	$200.00/hr
Plumber (2)	Work	Plumb	100%	$120.00/hr	$240.00/hr
HVAC (2)	Work	HVAC	100%	$80.00/hr	$160.00/hr
Insulation (2)	Work	Insul	100%	$60.00/hr	$90.00/hr
Drywall (3)	Work	Drywall	100%	$75.00/hr	$150.00/hr
Flooring	Work	Flooring	100%	$25.00/hr	$25.00/hr
Painter (3)	Work	Paint	100%	$90.00/hr	$135.00/hr
Trim carpenter	Work	Trim	100%	$50.00/hr	$75.00/hr
Concrete mix	Material	Mix		$24.00	
2x4x8	Material	lumber		$3.00	
4x8 OSB	Material	OSB		$12.00	
Nails	Material	Nails		$4.00	
Catering	Cost	Cater			
General Contractor	Work	GC	100%	$200.00/hr	$200.00/hr

Exhibit 5

Grading and site prep	Grading crew (3)
Foundation construction	Concrete crew (4)
Framing	Framing crew (4)
Installation of windows/doors	Framing crew (4)
Install Metal Roofing	Roofing crew (3)
Siding	Framing crew (4)
Rough electrical	Electrician (2)
Rough plumbing	Plumber (2)
Rough HVAC	HVAC (2)
Insulation	Insulation (2)
Drywall	Drywall (3)
Underlayment	Flooring
Trim	Trim carpenter
Painting	Painter (3)
Finish electrical	Electrician (2)
Bathroom/kitchen counters and cabinets	Trim carpenter
Finish plumbing	Plumber (2)
Carpet/flooring	Flooring
Finish HVAC	HVAC (2)
Hookup water/well	Plumber (2)
Hookup sewer	Plumber (2)
Punch list	General Contractor

