Project Management The Managerial Process 5th Edition Larson Solutions Manual
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Appendix C

COMPUTER PROJECT EXERCISES

POM+ Project
Blue Zuma Project
Conveyor Belt Project

The POM+ Project (POM+) is new to this edition while versions of Blue Zuma Project (BZ) and Conveyor Belt Project (CBP) computer exercises appeared in previous editions. Video tutorials have been created for BZ which detail both how to complete each part of the exercise as well as appropriate answers. These tutorials are available at the publisher's instructor website. Each exercise is designed to help students apply the concepts and principles presented in the textbook. Moreover, students will learn how to use commercial project management software to develop their own project information system.

During the course of the exercises, students have to apply more and more of the concepts which are presented in the textbook. While each exercise introduces those features presented in the accompanying chapter, it also relies on previous work. Eventually, the system gets bigger and more complicated until the student has developed a project information system. This step-by-step method supports gradual understanding of the building blocks for successful application of an integrated project information system. We recommend that instructors use these exercises in parallel to specific chapters and not as a final examination.

Which exercise to use? The POM+ is designed to be less complicated and easier than the CBP. POM+ contains half the number of activities/summary tasks of CBP. While both exercises address similar issues, the resource allocation problems in POM+ are less complex than the CBP. Likewise, POM+ requires only two status reports instead of the four quarterly reports for the CBP.

BZ is similar to POM+ in scale and focus, except it requires only one status report and does not contain a detailed WBS. What makes BZ unique is the availability of video tutorials that detail step-by-step how to use MS Project to complete the assignment as well discusses appropriate answers. These video tutorials were developed to support on-line instruction. They can be used to support completion of BZ project as well as serve as a reference for completing either the POM+ or CBP exercises.

Choice depends upon how confident the instructor is in his/her command of MS Project and the experience of the students. Students with project management experience may find the POM+ or BZ too simple. Instructors who are teaching project management for the first time and/or have little experience with MS Project should probably use the ZP

This sample only, Download all chapters at: alibabadownload.com

exercise. Here they can privately use the video tutorials to master the exercise. The videos can also be used to provide feedback to students. We strongly recommend restricting access to these tutorials to only students registered for a specific course to prevent solutions from leaking out to other students at other universities. When using BZ, instructors should heed the advice given in the review of answers and provide students with additional guidance during the tricky Part 3 section.

POM+ presents similar resource problems as BZ and is recommended if the instructor believes solutions to the older exercises are available through informal student channels.

Another option is to use the cases that require MS Project to solve. These cases include: Nightingale Project, Greendale Stadium Case, Whistler Ski Resort Project, CyClon Project, Optical Disk Preinstallation, Advanced Energy Technology Data Center Migration and/or Whitbread World Sailboat Race.

Each major exercise is discussed in turn. The exercises themselves will not be repeated since they are contained in the textbook. Rather, we will provide hints on how to solve the problems, discuss possible "traps" or questions, and provide examples of successful solutions. Some of the managerial implications will be discussed to provide you with specific thoughts related to each exercise.

Software. Presented solutions were achieved using Microsoft Project. These exercises are, however, not software-dependent. Students should be able to use any of the major project management software programs to complete the exercises. In order to solve the exercises the software should be capable of the following:

- Include up to 30 different activities (including deliverables and the project itself) with name, predecessors, duration, and resources (including hourly rates and capacity constraints)
- Code the project activities
- Schedule a project, using duration, predecessors, and resources
- Develop and print an AON Chart of the project
- Develop and print a Gantt Chart of the project
- Perform a leveling option (resource constrained) for overallocated resources
- Calculate the costs of different activities and resources for different times.

One advantage that Microsoft Project provides is an excellent tutorial program that allows students to learn the program while working on the exercises. This tutorial is supplemented by a set of video tutorials contained in the student CD-ROM which demonstrates the major steps in using MS Project. Our experience suggests that most students are capable of mastering the program to solve the exercises on their own with minimal directions from the instructor if they follow the tutorials. Problems emerge when they deviate from the tutorial and try to use the software on their own.

Relevant copies of MS Project files pertaining to different parts of the exercises are included in the teacher's CD-ROM and noted when relevant. In some cases documents

produced by MS Project are included in the teacher's manual, but for the most part instructors will need to access designated files to obtain specific information. We strongly recommend that you create back-ups for all these files before accessing them just in case they get altered during use.

Check the author's Web site for further hints and advice for using these exercises:

http://www.bus.oregonstate.edu/faculty/bio.htm?UserName=Larson

POM+ PROJECT COMPUTER EXERCISE

Relevant copies of MS Project files pertaining to different parts of the exercise are available from the text instructor Web site (see POM+ folder). Instructors will need to access designated files to obtain specific information and generate documents similar to those presented in the teacher's manual. We strongly recommend that you create back-ups for all these files before accessing them in case they get altered when using them.

Part 1 - FILE: POM1

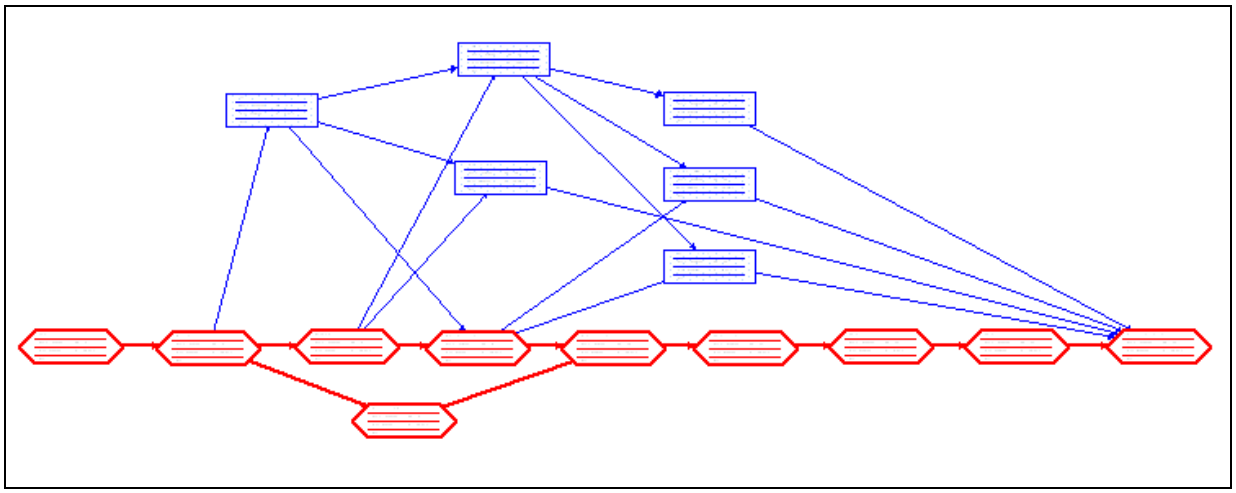
The first step is to insert the WBS into Microsoft Project. Since all of the information is provided there should be no major problems. Figure POM-1 depicts the WBS.

Figure POM-1: WBS

WBS	Task Name
1	**POM+ Project**
1.1	**R & D product development**
1.1.1	Need survey
1.1.2	Set product specs
1.1.3	Shelf life report
1.1.4	Nutrition report
1.2	Select fruit suppliers
1.3	**Initial production**
1.3.1	Equipment rehab
1.3.2	Production trials
1.3.3	Quality trials
1.3.4	Quality metrics
1.3.5	Quality training
1.4	**Distribution**
1.4.1	Market testing
1.4.2	Package design
1.4.3	Select distributors
1.5	**Legal**
1.5.1	Complete FDA certification
1.5.2	Register trademark
1.6	Prepare product launch

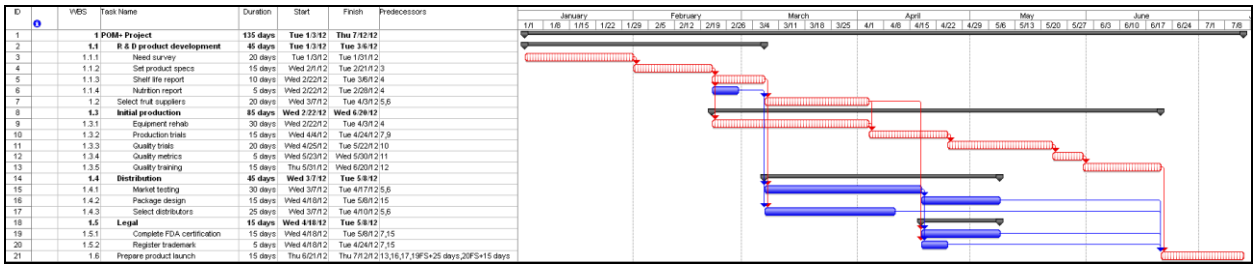
The next step is to enter the estimated durations and predecessor information to create a preliminary schedule for the project. **POM1** contains this file. Figure POM-2 depicts the network diagram while POM-3 contains the Entry Table and Gantt Chart. Figure POM-4 contains the schedule table.

Figure POM-2: Network Diagram



Hint: Students who try to use the "Network" option will be frustrated by the inability to arrange the boxes so that they clearly display the flow of activities. To rectify this problem one can select "Layout" under "Format" and click the "allow manual box positioning" box and shortening the spacing parameters. Students can then proceed to efficiently arrange the boxes and fit it to a page by adjusting % scale or fit to # desired pages in "Page Setup - page". To further help students, it is also possible under the same option window used to "allow manual box positioning" to select a "straight" link style, which will alleviate the links between boxes from overlapping.

Figure POM-3: Entry Table and Gantt Chart



ID	WBS	Task Name	Duration	Start	Finish	Predecessors
1	1	**POM+ Project**	**135 days**	**Tue 1/3/12**	**Thu 7/12/12**	
2	1.1	**R & D product development**	**45 days**	**Tue 1/3/12**	**Tue 3/6/12**	
3	1.1.1	Need survey	20 days	Tue 1/3/12	Tue 1/31/12	
4	1.1.2	Set product specs	15 days	Wed 2/1/12	Tue 2/21/12	3
5	1.1.3	Shelf life report	10 days	Wed 2/22/12	Tue 3/6/12	4
6	1.1.4	Nutrition report	5 days	Wed 2/22/12	Tue 2/28/12	4
7	1.2	Select fruit suppliers	20 days	Wed 3/7/12	Tue 4/3/12	5,6
8	**1.3**	**Initial production**	**85 days**	**Wed 2/22/12**	**Wed 6/20/12**	
9	1.3.1	Equipment rehab	30 days	Wed 2/22/12	Tue 4/3/12	4
10	1.3.2	Production trials	15 days	Wed 4/4/12	Tue 4/24/12	7,9
11	1.3.3	Quality trials	20 days	Wed 4/25/12	Tue 5/22/12	10
12	1.3.4	Quality metrics	5 days	Wed 5/23/12	Wed 5/30/12	11
13	1.3.5	Quality training	15 days	Thu 5/31/12	Wed 6/20/12	12
14	**1.4**	**Distribution**	**45 days**	**Wed 3/7/12**	**Tue 5/8/12**	
15	1.4.1	Market testing	30 days	Wed 3/7/12	Tue 4/17/12	5,6
16	1.4.2	Package design	15 days	Wed 4/18/12	Tue 5/8/12	15
17	1.4.3	Select distributors	25 days	Wed 3/7/12	Tue 4/10/12	5,6
18	**1.5**	**Legal**	**15 days**	**Wed 4/18/12**	**Tue 5/8/12**	
19	1.5.1	Complete FDA certification	15 days	Wed 4/18/12	Tue 5/8/12	7,15
20	1.5.2	Register trademark	5 days	Wed 4/18/12	Wed 4/24/12	7,15
21	1.6	Prepare product launch	15 days	Thu 6/21/12	Thu 7/12/12	13,16,17,19FS+25 days,20FS+15 days

Figure POM-4: Schedule Table

ID	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
1	**POM+ Project**	**Tue 1/3/12**	**Thu 7/12/12**	**Tue 1/3/12**	**Thu 7/12/12**	**0 days**	**0 days**
2	**R & D product development**	**Tue 1/3/12**	**Tue 3/6/12**	**Tue 1/3/12**	**Tue 3/6/12**	**0 days**	**0 days**
3	Need survey	Tue 1/3/12	Tue 1/31/12	Tue 1/3/12	Tue 1/31/12	0 days	0 days
4	Set product specs	Wed 2/1/12	Tue 2/21/12	Wed 2/1/12	Tue 2/21/12	0 days	0 days
5	Shelf life report	Wed 2/22/12	Tue 3/6/12	Wed 2/22/12	Tue 3/6/12	0 days	0 days
6	Nutrition report	Wed 2/22/12	Tue 2/28/12	Wed 2/29/12	Tue 3/6/12	5 days	5 days
7	Select fruit suppliers	Wed 3/7/12	Tue 4/3/12	Wed 3/7/12	Tue 4/3/12	0 days	0 days
8	**Initial production**	**Wed 2/22/12**	**Wed 6/20/12**	**Wed 2/22/12**	**Wed 6/20/12**	**0 days**	**0 days**
9	Equipment rehab	Wed 2/22/12	Tue 4/3/12	Wed 2/22/12	Tue 4/3/12	0 days	0 days
10	Production trials	Wed 4/4/12	Tue 4/24/12	Wed 4/4/12	Tue 4/24/12	0 days	0 days
11	Quality trials	Wed 4/25/12	Tue 5/22/12	Wed 4/25/12	Tue 5/22/12	0 days	0 days
12	Quality metrics	Wed 5/23/12	Wed 5/30/12	Wed 5/23/12	Wed 5/30/12	0 days	0 days
13	Quality training	Thu 5/31/12	Wed 6/20/12	Thu 5/31/12	Wed 6/20/12	0 days	0 days
14	**Distribution**	**Wed 3/7/12**	**Tue 5/8/12**	**Wed 3/14/12**	**Wed 6/20/12**	**5 days**	**5 days**
15	Market testing	Wed 3/7/12	Tue 4/17/12	Wed 3/14/12	Tue 4/24/12	0 days	5 days
16	Package design	Wed 4/18/12	Tue 5/8/12	Thu 5/31/12	Wed 6/20/12	30 days	30 days
17	Select distributors	Wed 3/7/12	Tue 4/10/12	Wed 5/16/12	Wed 6/20/12	50 days	50 days
18	**Legal**	**Wed 4/18/12**	**Tue 5/8/12**	**Wed 4/25/12**	**Wed 5/30/12**	**5 days**	**5 days**
19	Complete FDA certification	Wed 4/18/12	Tue 5/8/12	Wed 4/25/12	Tue 5/15/12	5 days	5 days
20	Register trademark	Wed 4/18/12	Tue 4/24/12	Wed 5/23/12	Wed 5/30/12	25 days	25 days
21	Prepare product launch	Thu 6/21/12	Thu 7/12/12	Thu 6/21/12	Thu 7/12/12	0 days	0 days

a. When is the project estimated to be completed? How many working days will it take?

The project is expected to be completed on July 12, 2012 and will take 135 days to complete.

b. What is the critical path?

There are two interconnected critical paths:

Need survey + Set product specifications + Equipment rehab +Production trials Quality trials + Quality metrics + Quality training + Prepare product launch

Need survey + Set product specifications + Shelf life report + Select fruit suppliers + Production trials + Quality trials + Quality metrics + Quality training +
Prepare product launch

c. Which activity has the most total slack?

Select distributors has 50 days total slack.

d. How sensitive is this network?

Fairly sensitive since there are two interconnected critical paths and 3 non-critical activities have only 5 days of total slack each.

e. Identify two sensible milestones and explain your choice.

Both **Set product specs** and **Select fruit suppliers** are critical burst activities so the completion of each of these activities would be good choices. Students may need to be reminded that a milestone is not a task but an event (i.e., start or finish).

Part 2 - FILE: POM2

At this stage resources and their impact on the project are introduced. Since very few projects do not encounter some sort of resource constraint their consideration is a crucial part of project management.

Note: That when students assign more than one resource to an activity the software automatically divides the duration by the number of resources. They should be reminded to restore the original duration after adding resources.

1. Which if any of the resources are over-allocated?

   Marketing, R&D, and Legal are over-allocated

2. Assume that the project is time constrained and try to resolve any over-allocation problems by leveling within slack. What happens?

   Marketing and Legal are no longer over-allocated. R&D is still over-allocated.

3. What is the impact of leveling within slack on the sensitivity of the network?

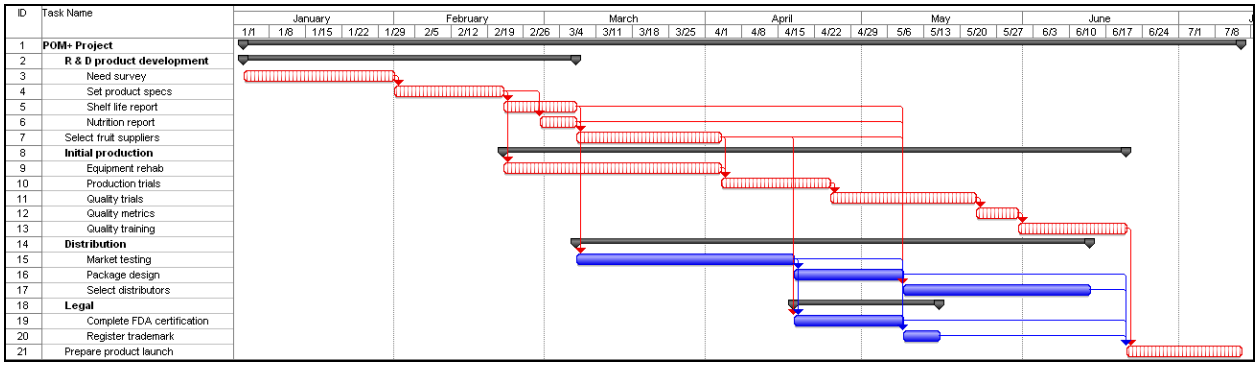
   Due to the unresolved R&D allocation conflict, **Nutrition report** is now part of the original interconnected critical paths. Sensitivity has been furthered increased due to the total slack for **Select distributors** being reduced from 50 days to just 5 days and **Register trademark** being reduced from 25 days to 10 days. These changes illustrate how leveling within slack tends to compress the project network and increase network sensitivity.

Include a Gantt chart with the schedule table after leveling within slack (see Figure POM-5 and Figure POM-6)

Figure POM-5: Schedule Table after Leveling within Slack

ID	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
1	**POM+ Project**	**Tue 1/3/12**	**Thu 7/12/12**	**Tue 1/3/12**	**Thu 7/12/12**	**0 days**	**0 days**
2	**R & D product development**	**Tue 1/3/12**	**Tue 3/6/12**	**Tue 1/3/12**	**Tue 3/6/12**	**0 days**	**0 days**
3	Need survey	Tue 1/3/12	Tue 1/31/12	Tue 1/3/12	Tue 1/31/12	0 days	0 days
4	Set product specs	Wed 2/1/12	Tue 2/21/12	Wed 2/1/12	Tue 2/21/12	0 days	0 days
5	Shelf life report	Wed 2/22/12	Tue 3/6/12	Wed 2/22/12	Tue 3/6/12	0 days	0 days
6	Nutrition report	Wed 2/29/12	Tue 3/6/12	Wed 2/29/12	Tue 3/6/12	0 days	0 days
7	Select fruit suppliers	Wed 3/7/12	Tue 4/3/12	Wed 3/7/12	Tue 4/3/12	0 days	0 days
8	**Initial production**	**Wed 2/22/12**	**Wed 6/20/12**	**Wed 2/22/12**	**Wed 6/20/12**	**0 days**	**0 days**
9	Equipment rehab	Wed 2/22/12	Tue 4/3/12	Wed 2/22/12	Tue 4/3/12	0 days	0 days
10	Production trials	Wed 4/4/12	Tue 4/24/12	Wed 4/4/12	Tue 4/24/12	0 days	0 days
11	Quality trials	Wed 4/25/12	Tue 5/22/12	Wed 4/25/12	Tue 5/22/12	0 days	0 days
12	Quality metrics	Wed 5/23/12	Wed 5/30/12	Wed 5/23/12	Wed 5/30/12	0 days	0 days
13	Quality training	Thu 5/31/12	Wed 6/20/12	Thu 5/31/12	Wed 6/20/12	0 days	0 days
14	**Distribution**	**Wed 3/7/12**	**Wed 6/13/12**	**Wed 3/14/12**	**Wed 6/20/12**	**5 days**	**5 days**
15	Market testing	Wed 3/7/12	Tue 4/17/12	Wed 3/14/12	Tue 4/24/12	0 days	5 days
16	Package design	Wed 4/18/12	Tue 5/8/12	Thu 5/31/12	Wed 6/20/12	30 days	30 days
17	Select distributors	Wed 5/9/12	Wed 6/13/12	Wed 5/16/12	Wed 6/20/12	5 days	5 days
18	**Legal**	**Wed 4/18/12**	**Tue 5/15/12**	**Wed 4/25/12**	**Wed 5/30/12**	**5 days**	**5 days**
19	Complete FDA certification	Wed 4/18/12	Tue 5/8/12	Wed 4/25/12	Tue 5/15/12	5 days	5 days
20	Register trademark	Wed 5/9/12	Tue 5/15/12	Wed 5/23/12	Wed 5/30/12	10 days	10 days
21	Prepare product launch	Thu 6/21/12	Thu 7/12/12	Thu 6/21/12	Thu 7/12/12	0 days	0 days

Figure POM-6: Gantt Chart after Leveling within Slack



4. Assume the project is resource constrained and resolve any over-allocation problems by leveling outside of slack. What happens?

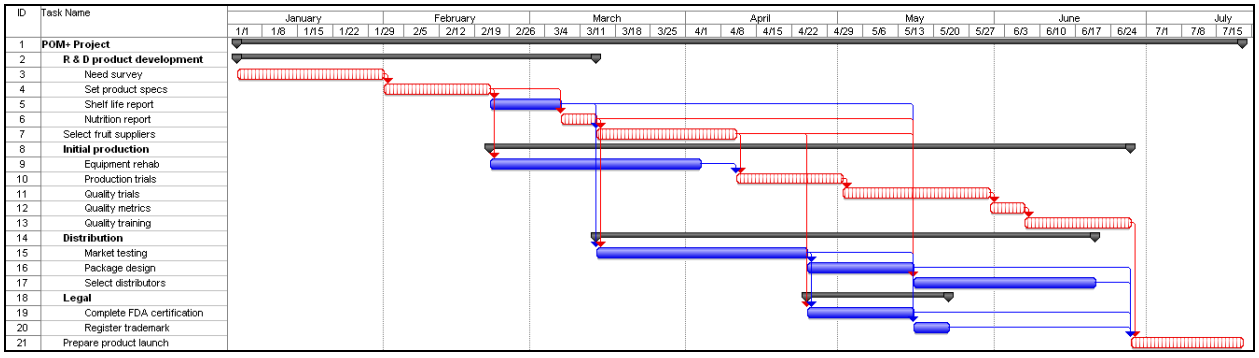
R&D is no longer over-allocated and project completion date has been extended by five days to July 19, 2012. The reduction in total slack in **Register trademark** and **Select distributors** remains. Notice that **Shelf life report** and **Equipment rehab** no longer appear to be marked as a critical activity. In the case, **Equipment rehab** the new schedule has created 5 days of "real" slack. The same is <u>not</u> true for **Shelf life report**! MS Project determines critical paths based solely on technical (predecessor) dependencies. What often emerges when

resources are leveled are resource dependencies. In this case, there is no technical dependency between **Shelf life report** and **Nutrition report**, however, there is a resource dependency. Both activities require the only 3 R&D staff available to the project. Hence, a delay in **Shelf life report** would cause a delay in the start of **Nutrition report** and extend the critical path. This is an important example of the difference between task and resource dependency. Within the Critical Chain Project Management (CCPM), **Shelf life report** would be part of the critical chain of the project.

Figure POM-7: Schedule Table after Leveling outside of Slack

ID	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
1	**POM+ Project**	**Tue 1/3/12**	**Thu 7/19/12**	**Tue 1/3/12**	**Thu 7/19/12**	**0 days**	**0 days**
2	**R & D product development**	**Tue 1/3/12**	**Tue 3/13/12**	**Tue 1/3/12**	**Tue 3/13/12**	**0 days**	**0 days**
3	Need survey	Tue 1/3/12	Tue 1/31/12	Tue 1/3/12	Tue 1/31/12	0 days	0 days
4	Set product specs	Wed 2/1/12	Tue 2/21/12	Wed 2/1/12	Tue 2/21/12	0 days	0 days
5	Shelf life report	Wed 2/22/12	Tue 3/6/12	Wed 2/29/12	Tue 3/13/12	5 days	5 days
6	Nutrition report	Wed 3/7/12	Tue 3/13/12	Wed 3/7/12	Tue 3/13/12	0 days	0 days
7	Select fruit suppliers	Wed 3/14/12	Tue 4/10/12	Wed 3/14/12	Tue 4/10/12	0 days	0 days
8	**Initial production**	**Wed 2/22/12**	**Wed 6/27/12**	**Wed 2/29/12**	**Wed 6/27/12**	**0 days**	**0 days**
9	Equipment rehab	Wed 2/22/12	Tue 4/3/12	Wed 2/29/12	Tue 4/10/12	5 days	5 days
10	Production trials	Wed 4/11/12	Tue 5/1/12	Wed 4/11/12	Tue 5/1/12	0 days	0 days
11	Quality trials	Wed 5/2/12	Wed 5/30/12	Wed 5/2/12	Wed 5/30/12	0 days	0 days
12	Quality metrics	Thu 5/31/12	Wed 6/6/12	Thu 5/31/12	Wed 6/6/12	0 days	0 days
13	Quality training	Thu 6/7/12	Wed 6/27/12	Thu 6/7/12	Wed 6/27/12	0 days	0 days
14	**Distribution**	**Wed 3/14/12**	**Wed 6/20/12**	**Wed 3/21/12**	**Wed 6/27/12**	**5 days**	**5 days**
15	Market testing	Wed 3/14/12	Tue 4/24/12	Wed 3/21/12	Tue 5/1/12	0 days	5 days
16	Package design	Wed 4/25/12	Tue 5/15/12	Thu 6/7/12	Wed 6/27/12	30 days	30 days
17	Select distributors	Wed 5/16/12	Wed 6/20/12	Wed 5/23/12	Wed 6/27/12	5 days	5 days
18	**Legal**	**Wed 4/25/12**	**Tue 5/22/12**	**Wed 5/2/12**	**Wed 6/6/12**	**5 days**	**5 days**
19	Complete FDA certification	Wed 4/25/12	Tue 5/15/12	Wed 5/2/12	Tue 5/22/12	5 days	5 days
20	Register trademark	Wed 5/16/12	Tue 5/22/12	Thu 5/31/12	Wed 6/6/12	10 days	10 days
21	Prepare product launch	Thu 6/28/12	Thu 7/19/12	Thu 6/28/12	Thu 7/19/12	0 days	0 days

Figure POM-8: Gantt Chart after Leveling outside of Slack



Part 3 - FILE: POM3

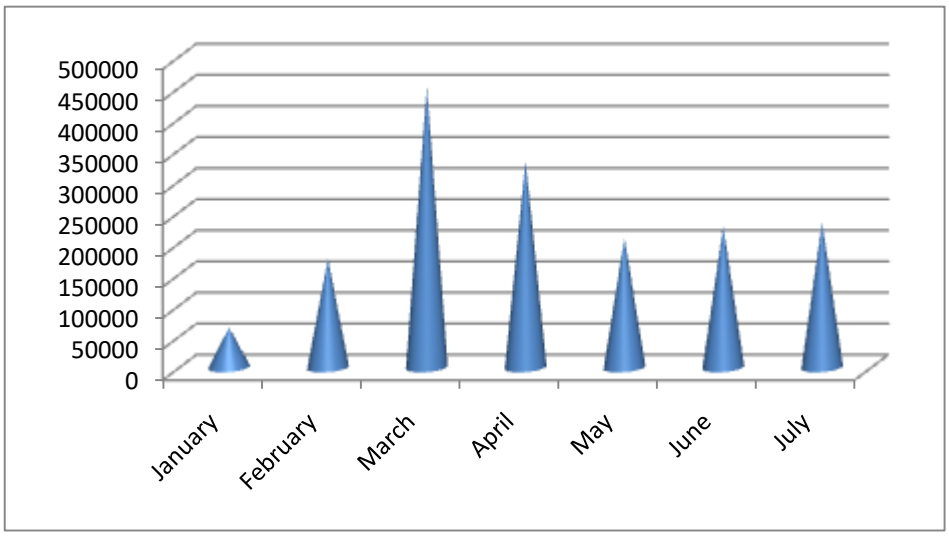
1. How much will the project cost? What is the most expensive activity?

The project is estimated to cost $1,692,000.00.
Equipment rehab is the most expensive activity accounting for roughly 31% of the total cost of the project ($528,000).

2. What does the cash flow statement tell you about how costs are distributed over the lifespan of the project?

Twenty-seven percent of the total costs are expected to occur in March while only six percent of the costs occur during the first month of January (see Figure POM-9).

Figure POM-9: Total Estimated Costs by Month



The monthly cash flow is displayed in Figure POM-10.

Figure POM-10: Monthly Cash Flow

	January	February	March	April	May	June	July
POM + Project							
R & D product development							
Need survey	$64,000.00						
Set product specs		$57,600.00					
Shelf life report		$11,520.00	$7,680.00				
Nutrition report			$9,600.00				
Select fruit suppliers			$6,240.00	$3,360.00			
Initial production							
Equipment rehab		$105,600.00	$387,200.00	$35,200.00			
Production trials				$219,520.00	$15,680.00		
Quality trials					$86,400.00		
Quality metrics					$2,400.00	$9,600.00	
Quality training						$136,800.00	
Distribution							
Market testing			$41,600.00	$54,400.00			
Package design				$8,320.00	$22,880.00		
Select distributors					$35,200.00	$44,800.00	
Legal							
Complete FDA certification				$11,520.00	$31,680.00		
Register trademark					$14,400.00		
Prepare product launch						$35,840.00	$232,960.00
Total	$64,000.00	$174,720.00	$452,320.00	$332,320.00	$208,640.00	$227,040.00	$232,960.00

	Total
POM + Project	
R & D product development	
Need survey	$64,000.00
Set product specs	$57,600.00
Shelf life report	$19,200.00
Nutrition report	$9,600.00
Select fruit suppliers	$9,600.00
Initial production	
Equipment rehab	$528,000.00
Production trials	$235,200.00
Quality trials	$86,400.00
Quality metrics	$12,000.00
Quality training	$136,800.00
Distribution	
Market testing	$96,000.00
Package design	$31,200.00
Select distributors	$80,000.00
Legal	
Complete FDA certification	$43,200.00
Register trademark	$14,400.00
Prepare product launch	$268,800.00
Total	$1,692,000.00

PART 4

Students are asked to generate two status reports and interpret performance indices associated with project progress. Note: there will be a tendency to rely heavily on the earned value statistics generated by the software. While these statistics provide valuable information with regards to costs they are less useful in terms of schedule. Students should be encouraged to assess actual and planned schedule to determine in "real time" how far ahead or behind the project is. The Tracking Gantt chart and the Variance Table are very useful for doing this.

The EAC_f or FAC (Forecast cost at completion) can be found in the Earned Value table as simply EAC.

The CPI and TCPI can be obtained from the Earned Value Cost Indicators Table.

The PCIB and PCIC will have to be calculated by hand.

How many days ahead or behind the project can be obtained from the Variance Table.

Hint: Students should be told to enter the tracking information from the tables presented in the text from left to right. For completed activities, first enter the start date, then the finish date. For incomplete activities, first enter the start date, then the actual duration and lastly the remaining number of days. Students should double check to make sure the information in the Tracking Table is identical to what is in the text.

Students often forget to insert the correct status date in the Project Information box.

A problem that sometimes occurs is that when a file is saved the status report date is not saved and has to be re-entered!

Part 4A - FILE: POM4a

Below is a sample status report. Students should be discouraged from providing information point by point (1…2…3…) and instead submit a coherent report.

During the first three months the project is experiencing cost over-runs and is not on schedule. It is important given the priority matrix for POM+ that students focus on the need for better cost control. At the same time, bright students will identify the potential problems surrounding the delay in **Market testing**.

To: Conner Gage
From: Percy Young
Re: March 31 status report

COST CV= -$73,831 CPI= 0.87

The project is currently 4% over budget. The most significant cost over-runs were **Need survey** (-$6,400) and **Set product specs** (-$11,520). **Equipment rehab** which is not completed is expected to be at least $57,831 over-budget. **Shelf life report** met budget while **Nutrition report** is the only activity to be completed under-budget (+$ 1,920). The POM+ project is only getting 87 cents of planned work for each dollar spent. If this continues, then the EAC_f would be $1,943,164, and POM+ will be $251,164 over budget. The TCPI indicates that that the project will have to earn ($1.07) for each dollar spent to come within budget.

SCHEDULE SV= -$193.671 5 days behind schedule

The project is five days behind schedule and is now expected to be completed on July, 26, 2012. The **Need survey** took 2 days longer than planned while **Set product specs** took an extra 3 days. Both were on the critical path. It is expected that **Equipment rehab** will take 5 days longer than planned. There is $193,671 worth of work that was supposed to have been done by this time that has not been done. This is largely due to the delays in the previously mentioned activities and that **Market testing** has not begun yet. The delay in **Market testing** deserves attention since it originally 5 days of slack has been reduced to one day of slack. The delay in **Market testing** threatens the creation of a new critical path.

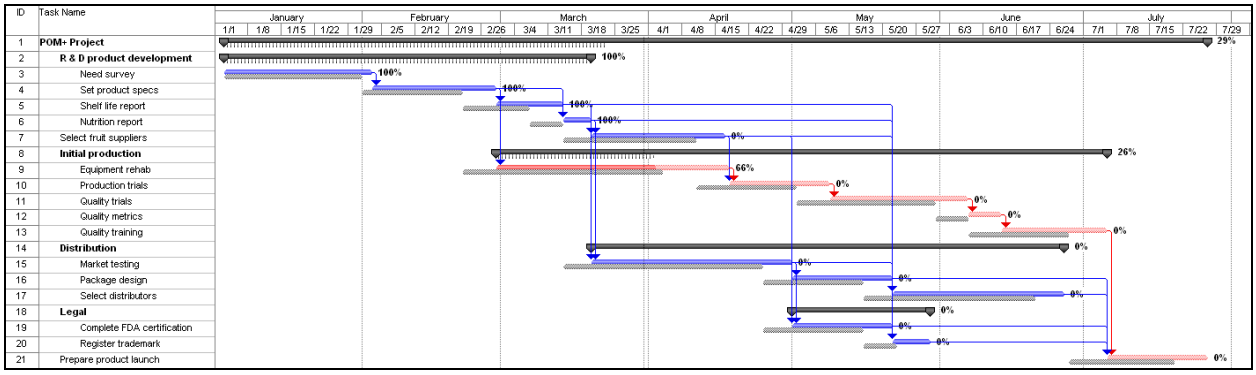
According to both the PCIB and the PCIC the project is roughly 29 percent complete.

Conclusion: The project is both behind schedule and over-budget. The latter is serious since the budget for the project is constrained. Every effort should be made to complete the remaining work more efficiently without compromising quality. Management needs to start **Market testing** soon to reduce further delays.

Figure POM-11: Earned Value Table for March 31, 2012

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC
1	**POM+ Project**	**$691,040.00**	**$497,369.33**	**$571,200.00**	**($193,670.67)**	**($73,830.67)**	**$1,943,164.44**	**$1,692,000.00**	**($251,164.44)**
2	**R & D product development**	**$150,400.00**	**$150,400.00**	**$166,400.00**	**$0.00**	**($16,000.00)**	**$166,400.00**	**$150,400.00**	**($16,000.00)**
3	Need survey	$64,000.00	$64,000.00	$70,400.00	$0.00	($6,400.00)	$70,400.00	$64,000.00	($6,400.00)
4	Set product specs	$57,600.00	$57,600.00	$69,120.00	$0.00	($11,520.00)	$69,120.00	$57,600.00	($11,520.00)
5	Shelf life report	$19,200.00	$19,200.00	$19,200.00	$0.00	$0.00	$19,200.00	$19,200.00	$0.00
6	Nutrition report	$9,600.00	$9,600.00	$7,680.00	$0.00	$1,920.00	$7,680.00	$9,600.00	$1,920.00
7	Select fruit suppliers	$6,240.00	$0.00	$0.00	($6,240.00)	$0.00	$9,600.00	$9,600.00	$0.00
8	**Initial production**	**$492,800.00**	**$346,969.33**	**$404,800.00**	**($145,830.67)**	**($57,830.67)**	**$1,164,807.03**	**$998,400.00**	**($166,407.03)**
9	Equipment rehab	$492,800.00	$346,969.33	$404,800.00	($145,830.67)	($57,830.67)	$616,003.72	$528,000.00	($88,003.72)
10	Production trials	$0.00	$0.00	$0.00	$0.00	$0.00	$235,200.00	$235,200.00	$0.00
11	Quality trials	$0.00	$0.00	$0.00	$0.00	$0.00	$86,400.00	$86,400.00	$0.00
12	Quality metrics	$0.00	$0.00	$0.00	$0.00	$0.00	$12,000.00	$12,000.00	$0.00
13	Quality training	$0.00	$0.00	$0.00	$0.00	$0.00	$136,800.00	$136,800.00	$0.00
14	**Distribution**	**$41,600.00**	**$0.00**	**$0.00**	**($41,600.00)**	**$0.00**	**$207,200.00**	**$207,200.00**	**$0.00**
15	Market testing	$41,600.00	$0.00	$0.00	($41,600.00)	$0.00	$96,000.00	$96,000.00	$0.00
16	Package design	$0.00	$0.00	$0.00	$0.00	$0.00	$31,200.00	$31,200.00	$0.00
17	Select distributors	$0.00	$0.00	$0.00	$0.00	$0.00	$80,000.00	$80,000.00	$0.00
18	**Legal**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$57,600.00**	**$57,600.00**	**$0.00**
19	Complete FDA certification	$0.00	$0.00	$0.00	$0.00	$0.00	$43,200.00	$43,200.00	$0.00
20	Register trademark	$0.00	$0.00	$0.00	$0.00	$0.00	$14,400.00	$14,400.00	$0.00
21	Prepare product launch	$0.00	$0.00	$0.00	$0.00	$0.00	$268,800.00	$268,800.00	$0.00

Figure POM-12: Tracking Gantt Chart for March 31, 2012



Part 4B - FILE: POM4b

Below is a sample status report. Significant improvement in cost management has occurred since the last report and POM+ is now slightly under budget. Schedule performance is a bit more complex, since there has been a shift in the critical path. Bright students will focus on the consequences of delaying the start of **Market testing**.

To: Conner Gage
From: Percy Young
Re: May 31 status report

COST CV= +$13,949 CPI= 1.01

The project has enjoyed significant cost savings since the March 31st report and is now $13,949 under budget. The CPI of 1.01 suggests that we are on budget. Significant savings across the board have more than made up for the cost over-runs that occurred during the first 3 months. The biggest savings occurred in **Market testing** ($12,800) and **Quality trials** ($8,640), while **Package design** ($6,240), and **Complete FDA certification** ($2,880) were also under budget. It should be noted that work on **Equipment rehab** was turned around and instead of the forecasted $58,000 deficit, it was only $17,600 over budget. The forecasted cost at completion is now $1,672,182 with a projected savings of $19,818. The TCPI indicates that the project will only have to earn 97 cents on each remaining dollar spent to come in on budget.

SCHEDULE SV= -$41,091 6 days behind schedule

The project is currently six days behind schedule and is now expected to be completed on July 27, 2012. Despite time savings recorded across the front, there is roughly $41,000 worth of planned work that has not been accomplished. The source of the problem can be traced to the late start of **Market testing** which eventually caused a delay in the start of **Complete FDA certification** work. Given the 25 day lag for the FDA application to be processed, this link is now predicted to cause the 6 day delay in the start of the final **Prepare product launch** activity. This delay has also given the once critical **Quality Training** activity 5 days of total slack. In essence, the critical path has shifted.

According to both the PCIB and the PCIC the project is 70% complete.

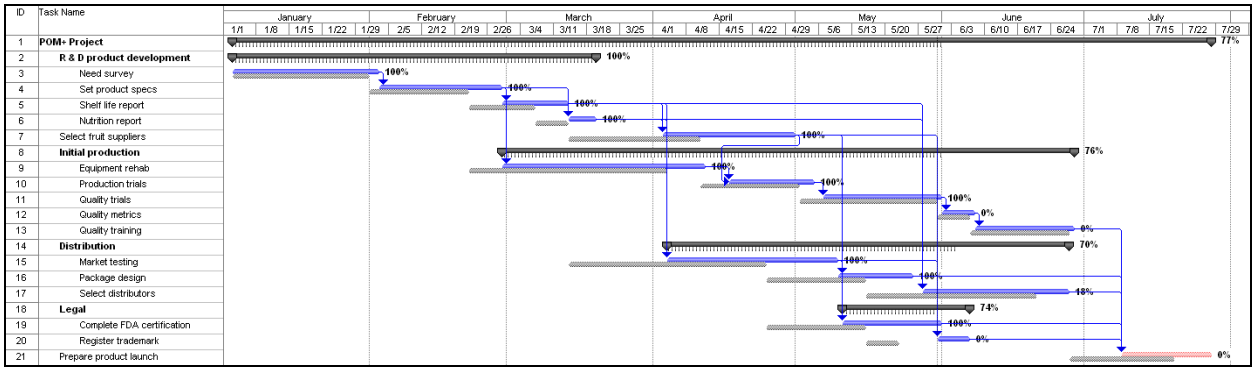
Conclusion: The project team should be commended for its efforts over the past few months to reduce costs. With two-thirds of the project completed the POM+ project stands a good chance of being completed within budget. With regards to schedule, the completion delay is tolerable given the priorities of the project. Every effort should be made to sustain the positive momentum without compromising quality.

It should be pointed out to students that both Complete FDA certification and Register trademark require governmental approval (the source of the FS lags) and is outside the direct control of the project team. Delays in processing could further extend the completion date.

Figure POM-13: Earned Value Table for May 31, 2012

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC
1	**POM+ Project**	**$1,232,000.00**	**$1,190,908.67**	**$1,176,960.00**	**($41,091.33)**	**$13,948.67**	**$1,672,182.24**	**$1,692,000.00**	**$19,817.76**
2	**R & D product development**	**$150,400.00**	**$150,400.00**	**$166,400.00**	**$0.00**	**($16,000.00)**	**$166,400.00**	**$150,400.00**	**($16,000.00)**
3	Need survey	$64,000.00	$64,000.00	$70,400.00	$0.00	($6,400.00)	$70,400.00	$64,000.00	($6,400.00)
4	Set product specs	$57,600.00	$57,600.00	$69,120.00	$0.00	($11,520.00)	$69,120.00	$57,600.00	($11,520.00)
5	Shelf life report	$19,200.00	$19,200.00	$19,200.00	$0.00	$0.00	$19,200.00	$19,200.00	$0.00
6	Nutrition report	$9,600.00	$9,600.00	$7,680.00	$0.00	$1,920.00	$7,680.00	$9,600.00	$1,920.00
7	Select fruit suppliers	$9,600.00	$9,600.00	$9,600.00	$0.00	$0.00	$9,600.00	$9,600.00	$0.00
8	**Initial production**	**$852,000.00**	**$849,600.00**	**$842,880.00**	**($2,400.00)**	**$6,720.00**	**$990,503.05**	**$998,400.00**	**$7,896.95**
9	Equipment rehab	$528,000.00	$528,000.00	$545,600.00	$0.00	($17,600.00)	$545,600.00	$528,000.00	($17,600.00)
10	Production trials	$235,200.00	$235,200.00	$219,520.00	$0.00	$15,680.00	$219,520.00	$235,200.00	$15,680.00
11	Quality trials	$86,400.00	$86,400.00	$77,760.00	$0.00	$8,640.00	$77,760.00	$86,400.00	$8,640.00
12	Quality metrics	$2,400.00	$0.00	$0.00	($2,400.00)	$0.00	$12,000.00	$12,000.00	$0.00
13	Quality training	$0.00	$0.00	$0.00	$0.00	$0.00	$136,800.00	$136,800.00	$0.00
14	**Distribution**	**$162,400.00**	**$138,108.67**	**$117,760.00**	**($24,291.33)**	**$20,348.67**	**$176,671.55**	**$207,200.00**	**$30,528.45**
15	Market testing	$96,000.00	$96,000.00	$83,200.00	$0.00	$12,800.00	$83,200.00	$96,000.00	$12,800.00
16	Package design	$31,200.00	$31,200.00	$24,960.00	$0.00	$6,240.00	$24,960.00	$31,200.00	$6,240.00
17	Select distributors	$35,200.00	$10,908.67	$9,600.00	($24,291.33)	$1,308.67	$70,402.74	$80,000.00	$9,597.26
18	**Legal**	**$57,600.00**	**$43,200.00**	**$40,320.00**	**($14,400.00)**	**$2,880.00**	**$53,760.00**	**$57,600.00**	**$3,840.00**
19	Complete FDA certification	$43,200.00	$43,200.00	$40,320.00	$0.00	$2,880.00	$40,320.00	$43,200.00	$2,880.00
20	Register trademark	$14,400.00	$0.00	$0.00	($14,400.00)	$0.00	$14,400.00	$14,400.00	$0.00
21	Prepare product launch	$0.00	$0.00	$0.00	$0.00	$0.00	$268,800.00	$268,800.00	$0.00

Figure POM-14: Tracking Gantt Chart for May 31, 2012



BLUE ZUMA PROJECT COMPUTER EXERCISE

Relevant copies of MS Project files pertaining to different parts of the exercise are available from the text instructor Web site (see BZ folder). Instructors will need to access designated files to obtain specific information and generate documents similar to those presented in the teacher's manual. We strongly recommend that you create back-ups for all these files before accessing them in case they get altered when using them.

Video tutorials that provide step-by-step instructions for completing the exercise as well answers are also available at the publisher's text instructor Web site (see Blue Zuma video folder). They can be uploaded to course websites to provide additional support and feedback.

Part 1

File: Blue_Zuma_P1

This exercise deals with using software to create a preliminary schedule of the project based on the information provided in Table A2.1 Part 1.

1. *When is the project estimated to be completed? How long will the project take?*

   The project is scheduled to be completed on 12/22/08 and will take 250 days.

2. *What is the critical path for the project?*

   Market analysis → Product design → Product design selection → Detailed product design → Test prototype → Finalized product design → Order production equipment → Install production equipment → Celebrate

3. *What activity has the greatest amount of slack?*

   Detailed marketing plan has 159 days of free slack.

4. *How sensitive is this network?*

   Sensitivity is defined as the likelihood that the critical path(s) will remain stable during the completion of the project. It is a function of the amount of slack non-critical activities has as well as the number of different critical paths.

   The network is not very sensitive. There is only one critical path and free slack ranges from 20 days to 159 days.

5. *Identify two sensible milestones and explain your choices.*

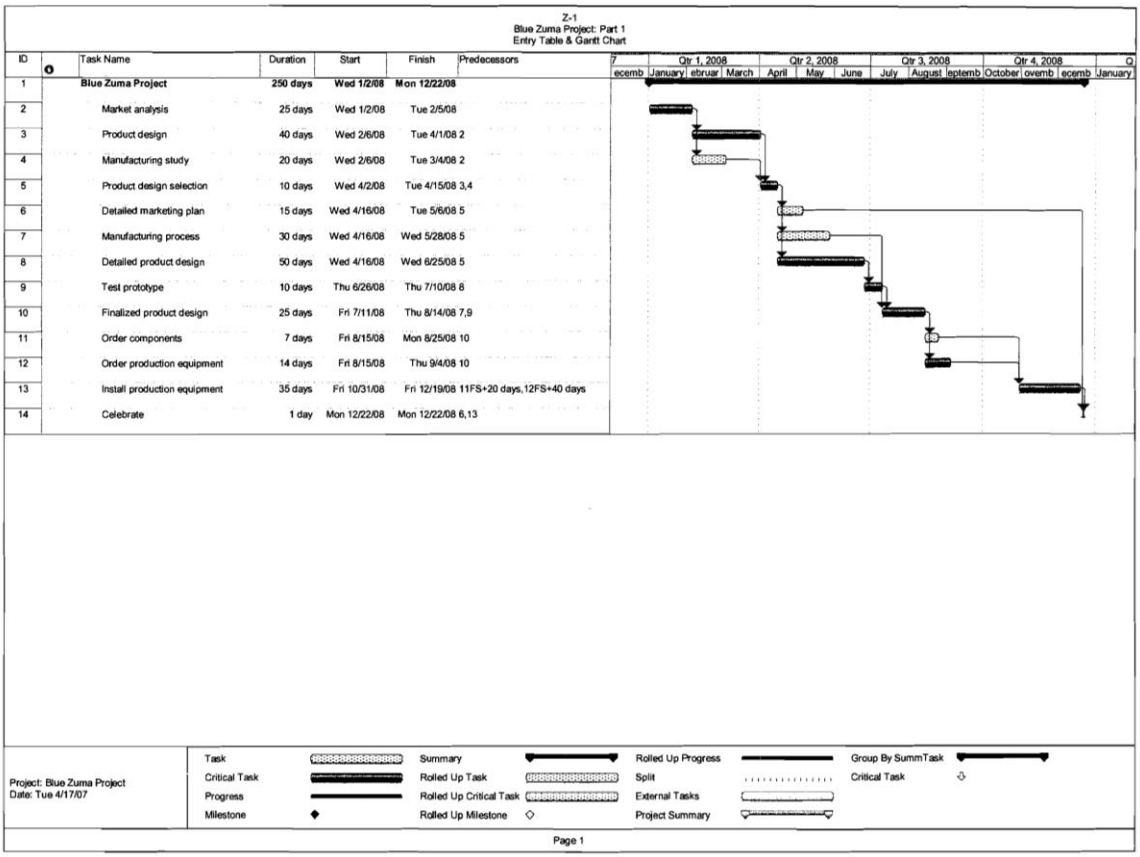
Milestones are appropriate checkpoints that provide an indication of progress on the project. All other things being equal the start of critical merge activities and the completion of critical burst activities are useful milestones. As such we recommend the finish of “Product design selection” and “Finalized product design.” Moreover the names of these activities imply importance by themselves.

6. *Compare the advantages/disadvantages of displaying the schedule as a network versus a Gantt chart.*

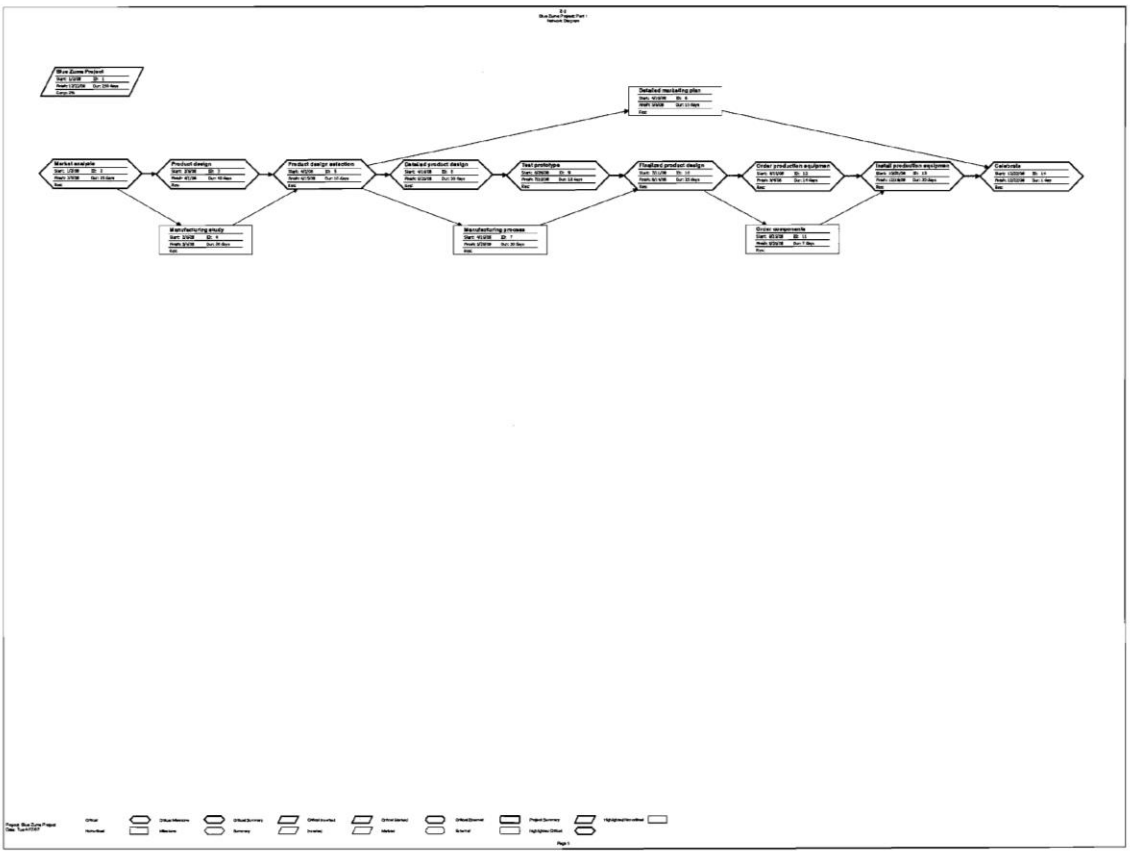
   Network schedules more clearly illustrate the relationship between different activities and the critical path. They can report precise information in each box (i.e., duration, early start, etc.). Gantt charts are easy to understand and provide a clear overview of the project schedule according to calendar dates.

Include the following printouts (see attached figures and tables):

Gantt Chart (see Figure Z-1) – Students will need to change the timescale by clicking "Format" and then "Timescale" and changing the options to quarters and months.



Network Diagram (see Figure Z-2) – Students will need to select the "Format" menu item and then access "Layout" to click the "Allow manual box positioning" option so that they can move the nodes around. In order to get a copy of the network on one page they will have to adjust the page by 35% when selecting the "Page Setup - Page" option. Another useful method to reducing the number of pages in MS Project documents is to go to "Page Setup – Page" and choose the "Fit to # pages" options.



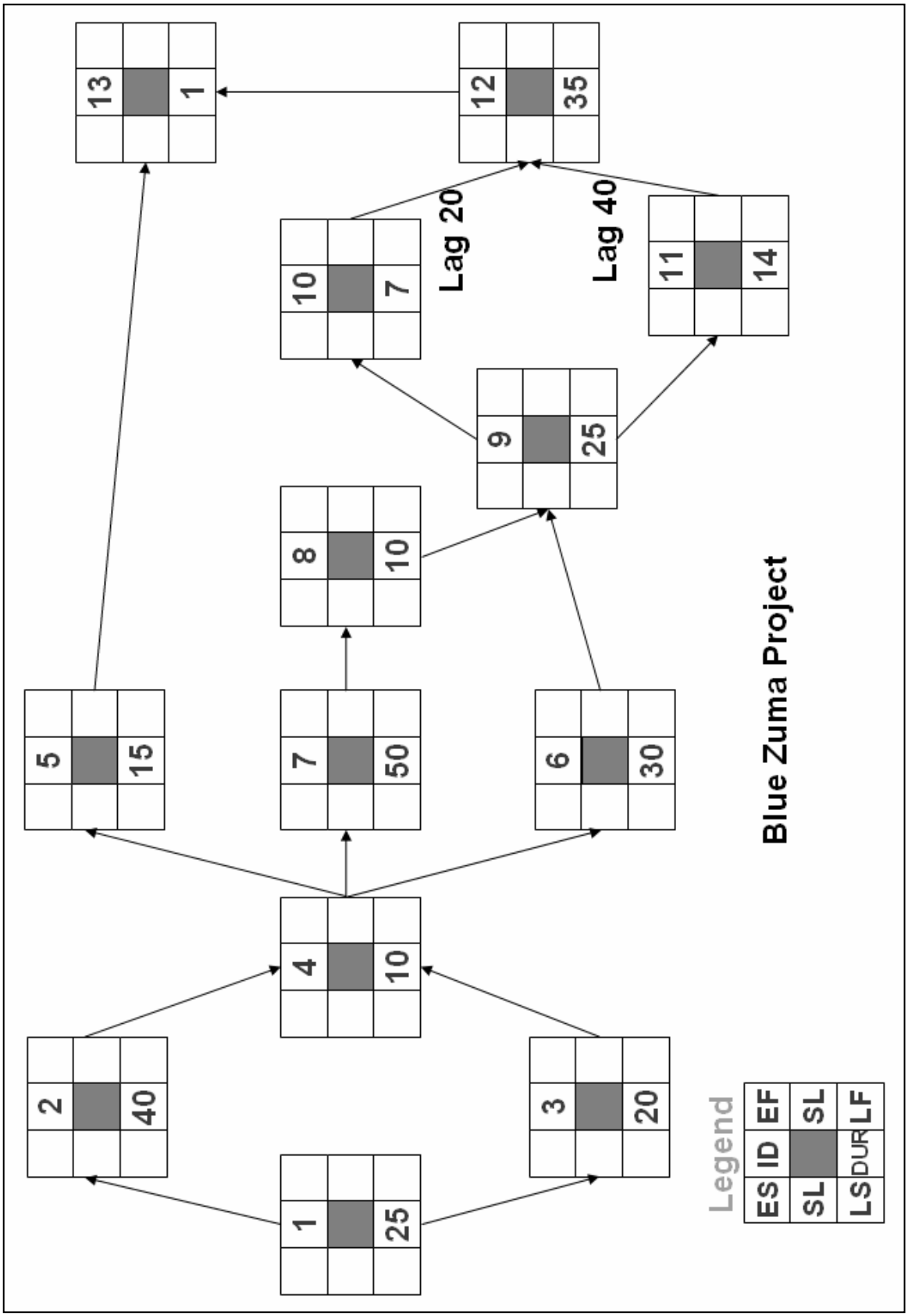
To obtain *a schedule table reporting ES, LS, EF, LF, and slack for each activity* (see Figure Z-3) in the Gantt Chart view select the "View" menu and access "Table" and choose the "Schedule" option.

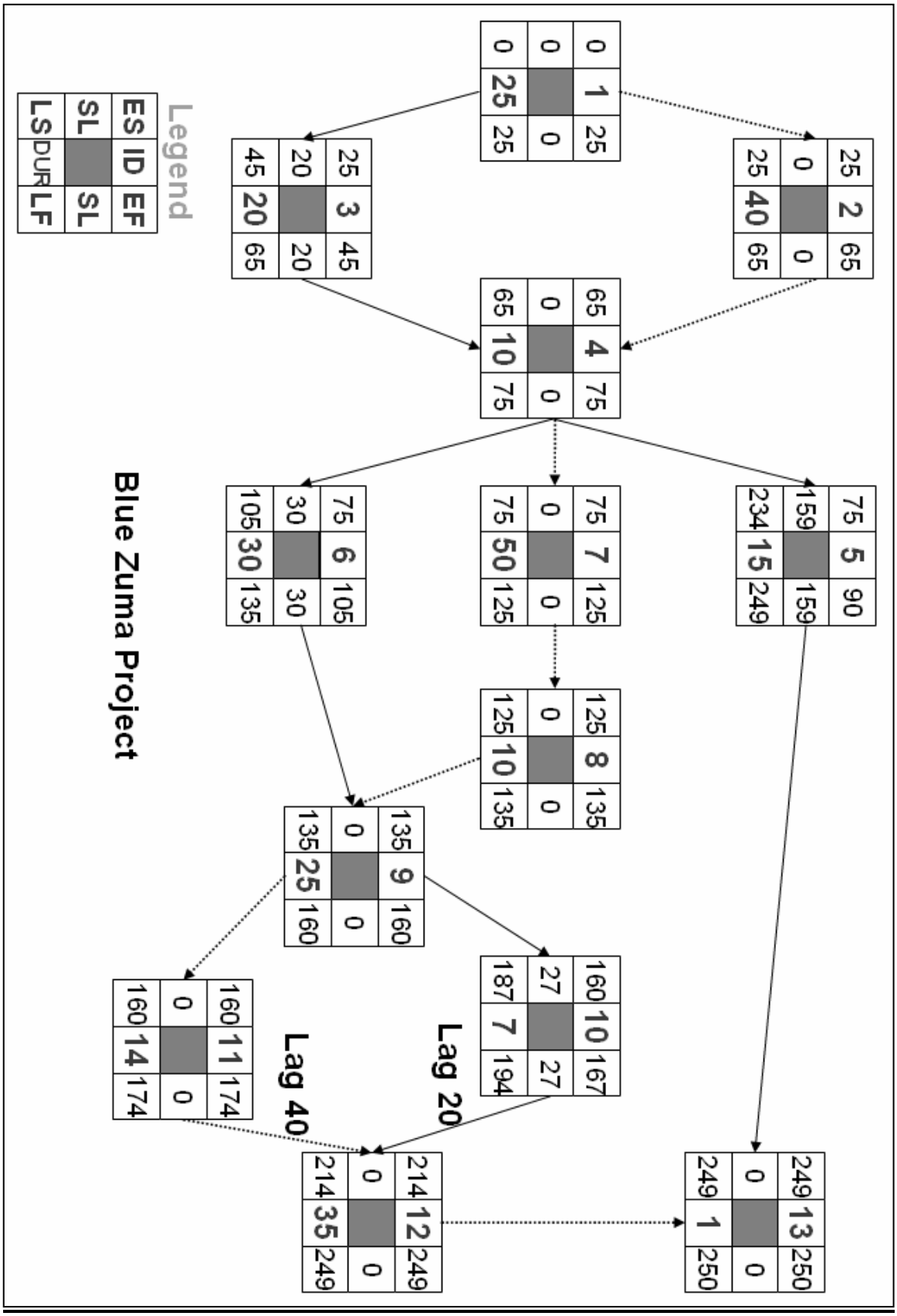
Z-3
Blue Zuma Project: Part 1
Schedule Table

ID	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
1	**Blue Zuma Project**	**Wed 1/2/08**	**Mon 12/22/08**	**Wed 1/2/08**	**Mon 12/22/08**	**0 days**	**0 days**
2	Market analysis	Wed 1/2/08	Tue 2/5/08	Wed 1/2/08	Tue 2/5/08	0 days	0 days
3	Product design	Wed 2/6/08	Tue 4/1/08	Wed 2/6/08	Tue 4/1/08	0 days	0 days
4	Manufacturing study	Wed 2/6/08	Tue 3/4/08	Wed 3/5/08	Tue 4/1/08	20 days	20 days
5	Product design selection	Wed 4/2/08	Tue 4/15/08	Wed 4/2/08	Tue 4/15/08	0 days	0 days
6	Detailed marketing plan	Wed 4/16/08	Tue 5/6/08	Mon 12/1/08	Fri 12/19/08	159 days	159 days
7	Manufacturing process	Wed 4/16/08	Wed 5/28/08	Thu 5/29/08	Thu 7/10/08	30 days	30 days
8	Detailed product design	Wed 4/16/08	Wed 6/25/08	Wed 4/16/08	Wed 6/25/08	0 days	0 days
9	Test prototype	Thu 6/26/08	Thu 7/10/08	Thu 6/26/08	Thu 7/10/08	0 days	0 days
10	Finalized product design	Fri 7/11/08	Thu 8/14/08	Fri 7/11/08	Thu 8/14/08	0 days	0 days
11	Order components	Fri 8/15/08	Mon 8/25/08	Wed 9/24/08	Thu 10/2/08	27 days	27 days
12	Order production equipment	Fri 8/15/08	Thu 9/4/08	Fri 8/15/08	Thu 9/4/08	0 days	0 days
13	Install production equipment	Fri 10/31/08	Fri 12/19/08	Fri 10/31/08	Fri 12/19/08	0 days	0 days
14	Celebrate	Mon 12/22/08	Mon 12/22/08	Mon 12/22/08	Mon 12/22/08	0 days	0 days

Page 1

An AON network for the ZP is included for instructors who wish to have the students compare their computer generated printout with one created by doing the forward and backward pass.


Blue Zuma Project
Lag 20
Lag 40
Legend
ES ID EF
SL SL
LS DUR LF


Legend
ES ID EF
SL SL
LS DUR LF
Blue Zuma Project
Lag 20
Lag 40

Part 2

At this stage resources and their impact on the project are introduced. Since very few projects do not encounter some sort of resource constraint their consideration is a crucial part of project management.

Part A

File: Blue_Zuma_P2A

1. *Which if any of the resources are overallocated?*

   Four resources are overallocated: Marketing specialist, Design engineer, Industrial engineer, and Purchasing agent.

2. *Which activities involve overallocated resources?*

   Marketing specialist: Detailed marketing plan & Detailed product design

   Design engineer: Manufacturing process & Detailed product design

   Industrial engineer: Product design & Manufacturing study,
   Manufacturing process & Detailed product design

   Purchasing agent: Order components & Order production equipment

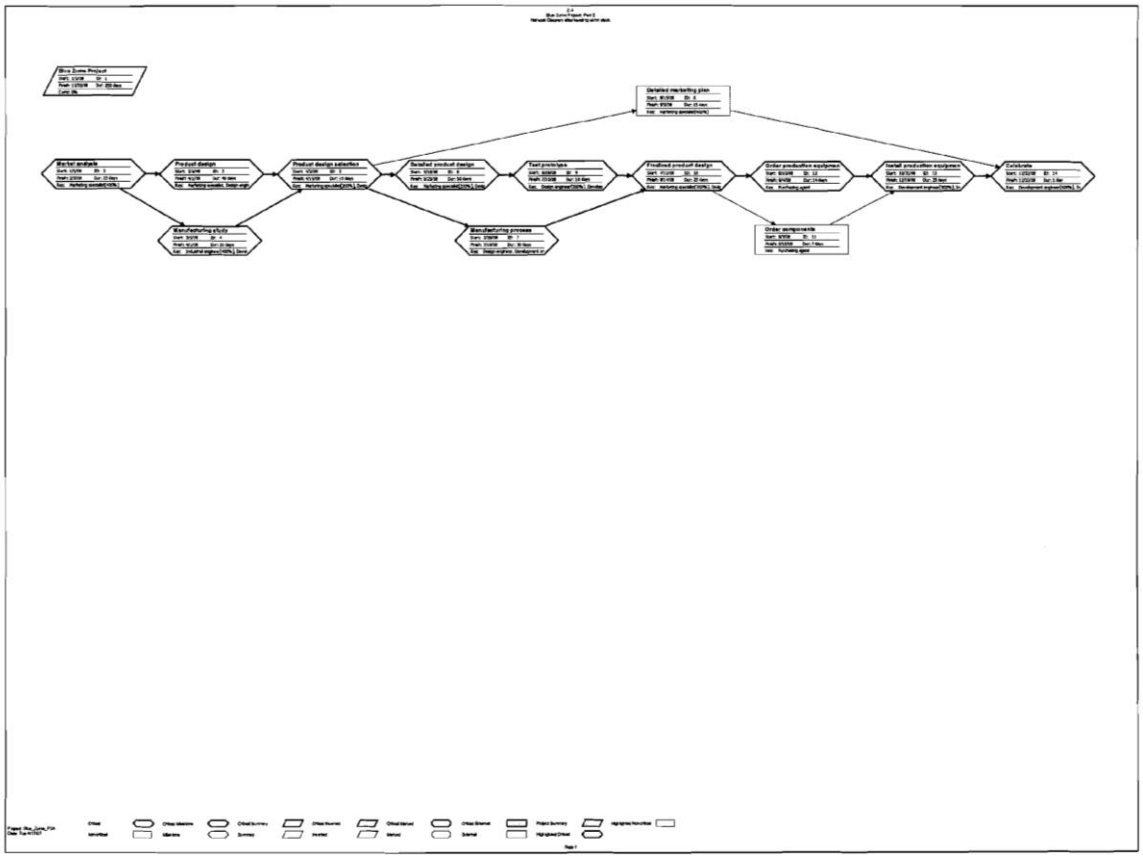
3. *Assume that the project is time constrained and try to resolve any overallocation problems by leveling within slack. What happens?*

   File: Blue_Zuma_P2A_Leveling_Within_Slack

   By leveling only within slack it is possible to eliminate the Marketing specialist and Purchasing agent overallocation problems, but not the Design engineer and Industrial engineer problems. The schedule for Order components and Detailed marketing plan has been changed for later in the project.

4. *What is the impact of leveling within slack on the sensitivity of the network?*

   Students should point out that this comes at a cost of dramatically increasing the sensitivity of the network (see Figure Z-4). Instead of one critical path containing 9 activities there are two interrelated critical paths involving 11 activities. Furthermore, the slack available to many non-critical activities has been reduced. This illustrates the point made in the chapter that using slack to resolve overallocation problems increases the risk of the project ultimately being late.



Part B

File: Blue_Zuma_P2B

1. *Assume that the project is resource constrained and no additional personnel are available. How long will the project take given the resources assigned?*

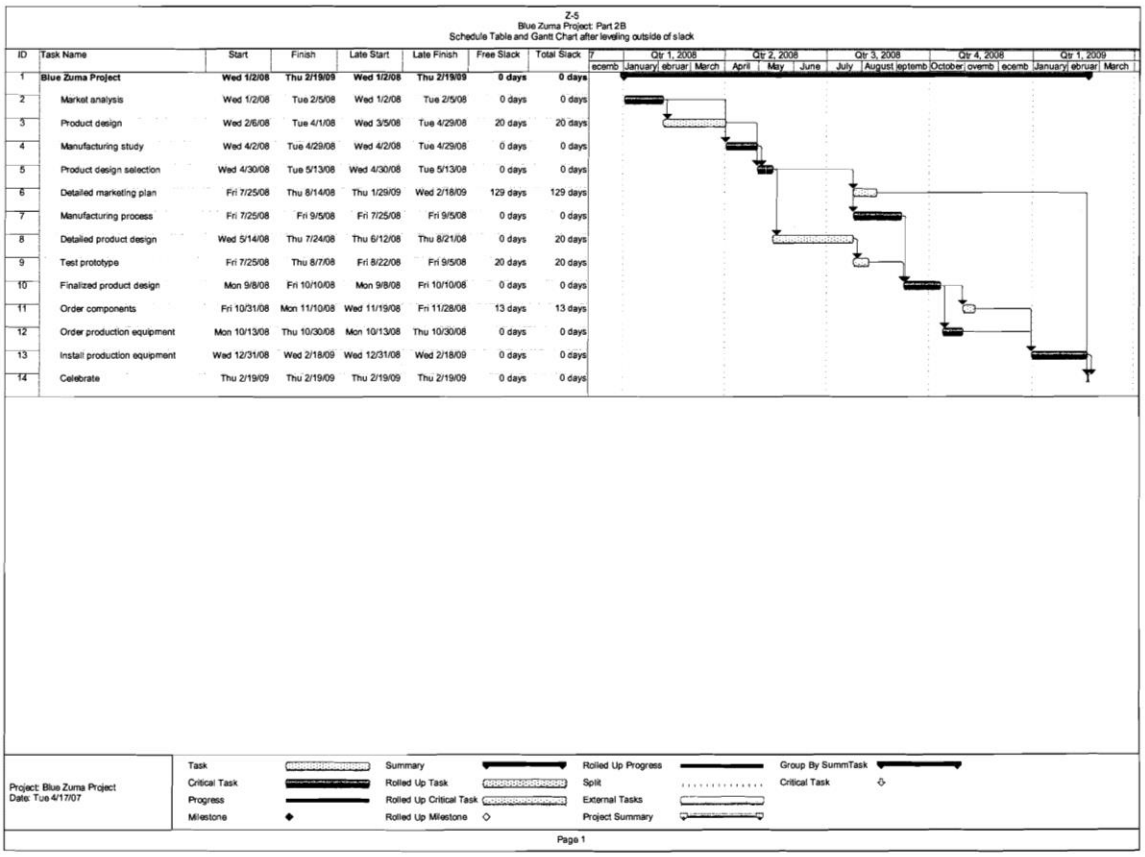
   The project will be completed on 2/19/09 and take 290 days.

2. *How does the new duration compare with the estimated completion date generated from Part 1? What does this tell you about the impact resources can have on a schedule?*

   Instead of being completed on 12/22/08 the project is now estimated to be completed on 2/19/09 and take 40 working days longer.

   The implications are simple – "Project network times are not a schedule until resources have been assigned."

Include a Gantt chart with a schedule table depicting the resource constrained schedule (see Figure Z-5):



The new critical path is Market analysis → Product design → Manufacturing study → Product design selection → Detailed product design → Manufacturing Process → Finalized product design → Order production equipment → Install production equipment → Celebrate.

Warning: MS Project does not identify Product design and Detailed product design as critical activities. Both activities are critical due to resource dependency not a technical dependency. For example, Manufacturing study cannot start until the Development and Industrial engineers have completed the Product design. MS Project only identifies critical activities based on technical dependencies.

This is an important reminder about the difference between resource and task dependency.

Part 3

1. *What options are available to meet this new deadline if the project is not resource constrained?*

   The primary options would be to reduce project duration by assigning additional personnel. Other options would be authorizing paid over-time or outsourcing project activities.

2. *What options are available to meet this deadline if the project is resource constrained?*

   The primary options available include: reduce the scope of the project so that it takes less time to complete or try to reduce project time by altering the structure of the network (i.e., introducing lags).

   You could also reduce the duration of tasks by having engineers work over-time if they are salaried.

File: Blue_Zuma_P3

1. *Which additional personnel assignments would you choose to complete the project within the original deadline? Explain your choices as well as the reasons for not choosing other options.*

   Students should choose to reduce the duration of Install production equipment and Detailed product design. Reducing the duration of Detailed marketing plan has no effect on completion date since it is not on the critical path.

   The new completion date is 1/28/09.

   Most students will pick reducing Install production equipment since it is visibly on the critical path—but choosing only this activity will not meet the deadline. You also have to reduce Detailed product design (see "Warning").

   Students should list the additional resources separately in the Resource Sheet (i.e., DevelopmentX, IndustrailX) since they are only available to work on designated tasks. When adding the resource to a task the software will automatically adjust the duration. Students should be reminded to readjust the duration to the proper time.

   Warning: As noted at the end of Part 2 when the schedule becomes resource constrained the software loses the ability to identify the critical path and make appropriate calculations. For example, after leveling outside of slack the software does not identify Detailed product design as a critical activity but does identify Manufacturing process. Upon closer examination, they are both critical! Even though there is not a task related dependency between the two activities there is a resource dependency since Manufacturing process can not start until the Industrial engineers have completed the Detailed product design. The software only recognizes task dependency so that when you reduce Product design to 42 days there is no change in the completion date. You have to manually change the start of Manufacturing process to appreciate the savings of crashing Detailed product design. This is another important reminder about the difference between resource and task dependency.

The new schedule created a one day resource overallocation problem for the Purchasing agent. In order to resolve this conflict the Order components activity start date must be moved forward to 10/21/08.

You should tell student to check the schedule dates to verify the critical path and appropriate start dates of activities.

Also some students will come up with a slightly different results if they disregard the note regarding not to relevel resources. You can get the same completion date by (1) unleveling the resources, (2) reducing both the Detailed product design and Install production equipment tasks, and (3) leveling resources outside of slack. Tasks like Detailed marketing plan will have different start dates. This will produce different results when generating cash flow statements and status reports.

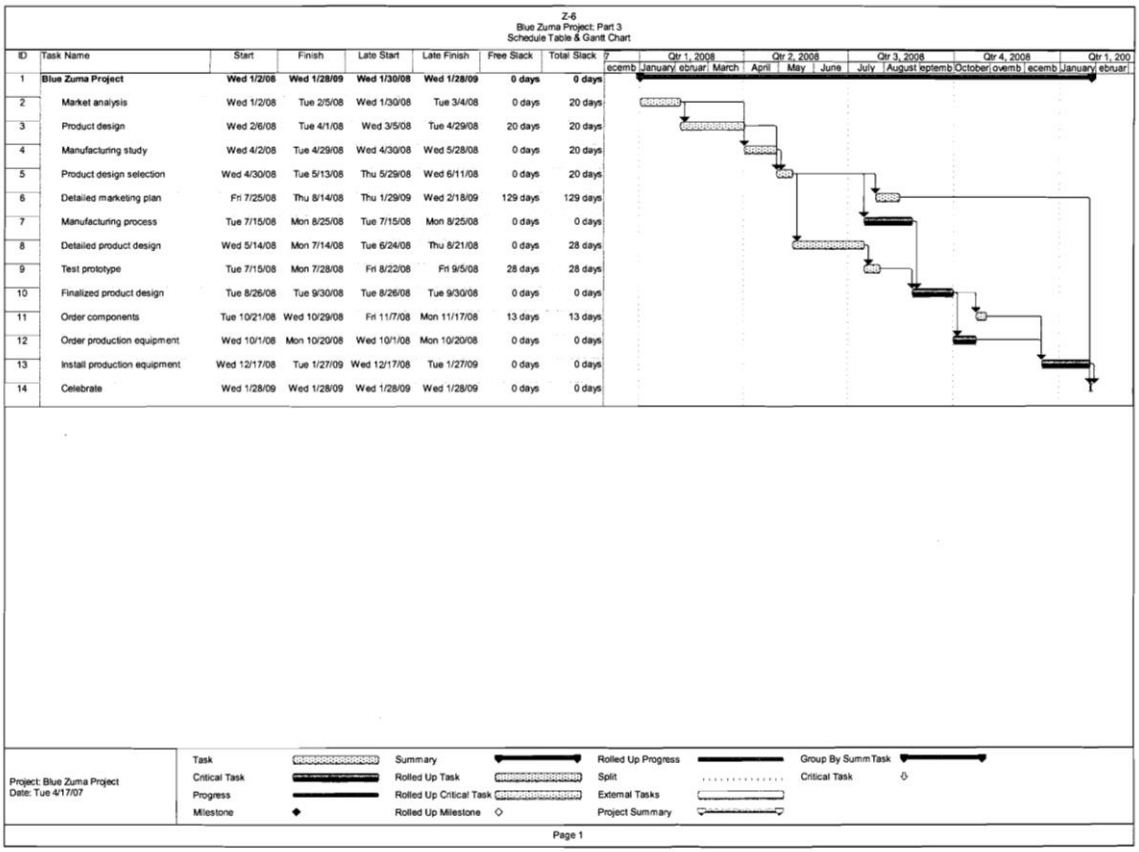
Students should be caution to heed the note in the case and work off of the schedule generated at the end of Part 2.

2. *How have these changes affected the sensitivity of the network?*

   These changes have reduced the sensitivity of the network. The original, single critical path is restored and the slack on non-critical activities ranges from 12 to 97 days.

Include a Gantt chart with a schedule table presenting the new schedule (see Figure Z-6):

Note that the software has lost the ability to designate the complete critical path since tasks like Market analysis are obviously on the critical path. Students should be reminded that MS Project is a tool and an imperfect one at that.



Part 4

File: Blue_Zuma_P4_Baseline

1. *How much is the project estimated to cost?*

   Total cost is estimated to be $1,260,000.

2. *What activity is estimated to cost the most to complete?*

   Detailed product design: $330,120.

3. *What resource commands the greatest total cost?*

   Design engineer: $377,280.

4. *During which month of the project are the highest and lowest costs expected to occur? What are those costs?*

   July: $169,860

   November: $0

5. What likely costs are not contained in this budget?

All indirect costs, material costs.

Include a table containing the estimated costs for each activity and a cash flow schedule for each month of the project (see Figure Z-7):

Z-7
Blue Zuma Part 4
Monthly Cash Flow

	January	February	March	April	May	June	July	A
Blue Zuma Project								
Market analysis	$42,240.00	$5,760.00						
Product design		$100,800.00	$117,600.00	$5,600.00				
Manufacturing study				$70,400.00				
Product design selection				$5,620.00	$50,580.00			
Detailed marketing plan							$9,600.00	
Manufacturing process							$55,120.00	
Detailed product design					$94,320.00	$165,060.00	$70,740.00	
Test prototype							$34,400.00	
Finalized product design								
Order components								
Order production equipment								
Install production equipment								
Celebrate								
Total	$42,240.00	$106,560.00	$117,600.00	$81,620.00	$144,900.00	$165,060.00	$169,860.00	

Z-7
Blue Zuma Part 4
Monthly Cash Flow

	August	September	October	November	December	January	February	Total
Blue Zuma Project								
Market analysis								$48,000.00
Product design								$224,000.00
Manufacturing study								$70,400.00
Product design selection								$56,200.00
Detailed marketing plan	$19,200.00							$28,800.00
Manufacturing process	$72,080.00							$127,200.00
Detailed product design								$330,120.00
Test prototype								$34,400.00
Finalized product design	$24,640.00	$129,360.00						$154,000.00
Order components			$2,800.00					$2,800.00
Order production equipment			$5,600.00					$5,600.00
Install production equipment					$56,160.00	$112,320.00		$168,480.00
Celebrate						$10,000.00		$10,000.00
Total	$115,920.00	$129,360.00	$8,400.00		$56,160.00	$122,320.00		$1,260,000.00

Note: Students will need to customize the cash flow schedule since the default is by week. Choose the custom option with the Report menu and then select Cash Flow option to change the time frame.

Part 5

File: Blue_Zuma_P5

Figure Z-8 contains the Tracking table with the progress information recorded up to August 16, 2008.

Z-8
Blue Zuma Project: Part 5
Tracking Table - August 16, 2008

ID	Task Name	Act. Start	Act. Finish	% Comp.	Phys. % Comp.	Act. Dur.	Rem. Dur.	Act. Cost	Act. Work
1	**Blue Zuma Project**	**Wed 1/2/08**	**NA**	**60%**	**0%**	**176.21 days**	**116.79 days**	**$916,600.00**	**11,844 hrs**
2	Market analysis	Wed 1/2/08	Fri 2/1/08	100%	0%	23 days	0 days	$44,160.00	736 hrs
3	Product design	Mon 2/4/08	Thu 3/20/08	100%	0%	34 days	0 days	$190,400.00	2,448 hrs
4	Manufacturing study	Fri 3/21/08	Tue 4/22/08	100%	0%	23 days	0 days	$80,960.00	1,104 hrs
5	Product design selection	Wed 4/23/08	Tue 5/13/08	100%	0%	15 days	0 days	$84,300.00	1,110 hrs
6	Detailed marketing plan	NA	NA	0%	0%	0 days	15 days	$0.00	0 hrs
7	Manufacturing process	Fri 8/1/08	NA	31%	0%	11 days	25 days	$46,640.00	616 hrs
8	Detailed product design	Wed 5/14/08	Thu 7/31/08	100%	0%	55 days	0 days	$432,300.00	5,390 hrs
9	Test prototype	Fri 8/1/08	Fri 8/15/08	100%	0%	11 days	0 days	$37,840.00	440 hrs
10	Finalized product design	NA	NA	0%	0%	0 days	25 days	$0.00	0 hrs
11	Order components	NA	NA	0%	0%	0 days	7 days	$0.00	0 hrs
12	Order production equipment	NA	NA	0%	0%	0 days	14 days	$0.00	0 hrs
13	Install production equipment	NA	NA	0%	0%	0 days	27 days	$0.00	0 hrs
14	Celebrate	NA	NA	0%	0%	0 days	1 day	$0.00	0 hrs

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1. *Your status report should include a table containing the PV, EV, AC, BAC, EAC_f, SV, CV, and CPI for each activity and the whole project. The report should also address the following questions:*

   a. *How is the project progressing in terms of cost and schedule?*
   b. *What activities have gone well? What activities have not gone well?*
   c. *What do the PCIB and PCIC indicate in terms of how much of the project has been accomplished to date?*
   d. *What is the forecasted cost at completion (EAC_f)? What is the predicted VAC_f?*
   e. *Report and interpret the TCPI for the project at this point in time.*
   f. *What is the estimated date of completion?*
   g. *How well is the project doing in terms of its priorities?*

   Try to present the above information in a form worthy of consideration by top management.

   Include a Tracking Gantt chart with your report.

Here is an example from one of our students:

To: Robin Lane
From: Alice Johnson
Re: Blue Zuma Project Status Report 8-16-08

Cost: CV = -$114,613 CPI = .87

The project is currently 9 percent over budget. The most significant cost over-runs occurred while completing the Detailed product design (-$102,180). Smaller cost over-runs occurred with Product design selection (-$28,100), Manufacturing study (-$10,560), Manufacturing process (-$7,773) and Test prototype (-$3,440). Significant savings were obtained for Product design (+$33,600) while a modest saving was gained while completing Market analysis (+$3,840).

We are currently getting 87 cents of planned work for each dollar spent.

The EAC_f is currently $1,440,069 with a VAC_f = -$180,069. So if continue to get only 87 cents on the dollar worth of work the project will be roughly 180,000 dollars over budget.

The TCPI suggest that we have to earn $1.33 for each dollar spent on the remaining work if we are going to accomplish the project within budget. This is unlikely.

Schedule: 19 days behind schedule Estimated completion date: 2/24/09

At this point in time there is $91,693 worth of scheduled work that has not been completed.

The project started off well with both Market analysis and Product design being completed ahead of schedule. The schedule slippage began with Manufacturing study taking 3 days longer than planned. The Product design selection process took 5 days longer than planned (50 percent longer!). At this point the project was right on schedule, but Detailed product design took 13 days longer than expected and Manufacturing process which is only 31 percent complete is expected to take 6 days longer than planned.

The Detailed marketing plan has yet to be started, but should not impact the schedule given the slack it has.

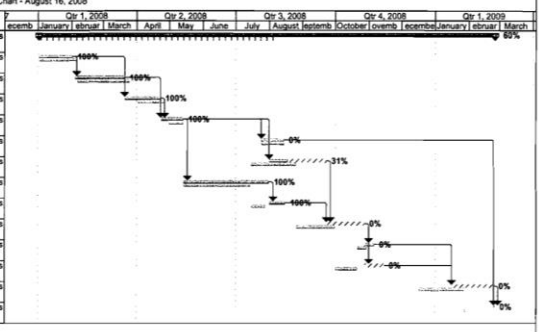
The project is roughly about two-thirds complete (PCIB = .64 / PCIC = .64).

Conclusion: The project is behind schedule and over budget. The former is a serious concern given the importance of completing the project before February 1st. Every effort should be made to get back on schedule without compromising quality and performance of the scooter.

Figure Z-9 contains the Variance Table and the Tracking Gantt Chart. Figure Z-10 contains the earned value using MS Project. Students should extract the earned value information and insert it in a table with the new acronyms (i.e., BCWS = PV).

Z-9
Blue Zuma Project: Part 5
Variance Table & Tracking Gantt Chart - August 16, 2008

ID	Task Name	Start	Finish	Baseline Start	Baseline Finish	Start Var.	Finish Var.
1	**Blue Zuma Project**	**Wed 1/2/08**	**Tue 2/24/09**	**Wed 1/2/08**	**Wed 1/28/09**	**0 days**	**19 days**
2	Market analysis	Wed 1/2/08	Fri 2/1/08	Wed 1/2/08	Tue 2/5/08	0 days	-2 days
3	Product design	Mon 2/4/08	Thu 3/20/08	Wed 2/6/08	Tue 4/1/08	-2 days	-8 days
4	Manufacturing study	Fri 3/21/08	Tue 4/22/08	Wed 4/2/08	Tue 4/29/08	-8 days	-5 days
5	Product design selection	Wed 4/23/08	Tue 5/13/08	Wed 4/30/08	Tue 5/13/08	-5 days	0 days
6	Detailed marketing plan	Fri 7/25/08	Thu 8/14/08	Fri 7/25/08	Thu 8/14/08	0 days	0 days
7	Manufacturing process	Fri 8/1/08	Mon 9/22/08	Tue 7/15/08	Mon 8/25/08	13 days	19 days
8	Detailed product design	Wed 5/14/08	Thu 7/31/08	Wed 5/14/08	Mon 7/14/08	0 days	13 days
9	Test prototype	Fri 8/1/08	Fri 8/15/08	Tue 7/15/08	Mon 7/28/08	13 days	14 days
10	Finalized product design	Tue 9/23/08	Mon 10/27/08	Tue 8/26/08	Tue 9/30/08	19 days	19 days
11	Order components	Tue 10/28/08	Wed 11/5/08	Tue 10/21/08	Wed 10/29/08	5 days	5 days
12	Order production equipment	Tue 10/28/08	Fri 11/14/08	Wed 10/1/08	Mon 10/20/08	19 days	19 days
13	Install production equipment	Fri 1/16/09	Mon 2/23/09	Wed 12/17/08	Tue 1/27/09	19 days	19 days
14	Celebrate	Tue 2/24/09	Tue 2/24/09	Wed 1/28/09	Wed 1/28/09	19 days	19 days



Project: Blue Zuma Project
Date: Tue 4/17/07

Critical, Critical Split, Critical Progress, Task, Split, Task Progress, Baseline, Baseline Split, Baseline Milestone, Milestone, Summary Progress, Summary, Project Summary, Critical Split, Critical Progress, Task, Split, Baseline Milestone, Milestone, Summary Progress, Summary

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Z-10
Blue Zuma Project: Part 5
Earned Value Table - August 16, 2008

ID	Task Name	BCWS	BCWP	ACWP	SV	CV	EAC	BAC	VAC
1	**Blue Zuma Project**	**$893,680.00**	**$801,986.67**	**$916,600.00**	**($91,693.33)**	**($114,613.33)**	**$1,440,068.83**	**$1,260,000.00**	**($180,068.83)**
2	Market analysis	$48,000.00	$48,000.00	$44,160.00	$0.00	$3,840.00	$44,160.00	$48,000.00	$3,840.00
3	Product design	$224,000.00	$224,000.00	$190,400.00	$0.00	$33,600.00	$190,400.00	$224,000.00	$33,600.00
4	Manufacturing study	$70,400.00	$70,400.00	$80,960.00	$0.00	($10,560.00)	$80,960.00	$70,400.00	($10,560.00)
5	Product design selection	$56,200.00	$56,200.00	$84,300.00	$0.00	($28,100.00)	$84,300.00	$56,200.00	($28,100.00)
6	Detailed marketing plan	$28,800.00	$0.00	$0.00	($28,800.00)	$0.00	$28,800.00	$28,800.00	$0.00
7	Manufacturing process	$101,760.00	$38,866.67	$46,640.00	($62,893.33)	($7,773.33)	$152,640.00	$127,200.00	($25,440.00)
8	Detailed product design	$330,120.00	$330,120.00	$432,300.00	$0.00	($102,180.00)	$432,300.00	$330,120.00	($102,180.00)
9	Test prototype	$34,400.00	$34,400.00	$37,840.00	$0.00	($3,440.00)	$37,840.00	$34,400.00	($3,440.00)
10	Finalized product design	$0.00	$0.00	$0.00	$0.00	$0.00	$154,000.00	$154,000.00	$0.00
11	Order components	$0.00	$0.00	$0.00	$0.00	$0.00	$2,800.00	$2,800.00	$0.00
12	Order production equipment	$0.00	$0.00	$0.00	$0.00	$0.00	$5,600.00	$5,600.00	$0.00
13	Install production equipment	$0.00	$0.00	$0.00	$0.00	$0.00	$168,480.00	$168,480.00	$0.00
14	Celebrate	$0.00	$0.00	$0.00	$0.00	$0.00	$10,000.00	$10,000.00	$0.00

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Note: The software will suggest that marketing specialist and purchasing agent are overallocated, but this is not really true since the Detailed marketing plan has not even started.

Based on our experience you may have to insert 8/16/08 date as the current date under the Project menu each time you open the file.

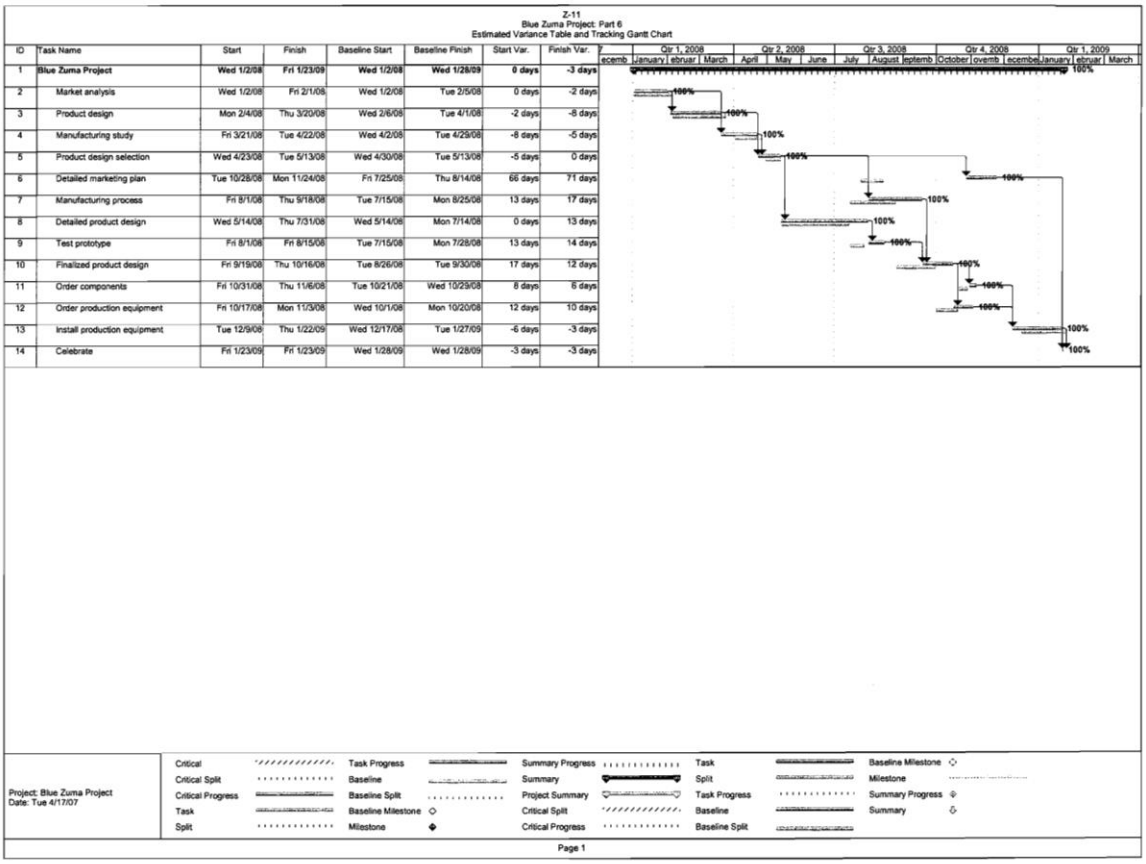
2. *While preparing your report you receive a phone call from Jim Keltner, a fellow project manager. He is calling to see if one of the industrial engineers assigned to your project would be available to work on his project from August 22 to 27, 2008. What would you tell him?*

   No, all of your Industrial engineers are tied up.

Part 6

File: Blue_Zuma_P6

See Figure Z-11 Estimated Variance Table and Tracking Gantt chart and Figure Z-12 Estimated Completion Cost Table.



ID	Task Name	Start	Finish	Baseline Start	Baseline Finish	Start Var.	Finish Var.
1	**Blue Zuma Project**	**Wed 1/2/08**	**Fri 1/23/09**	**Wed 1/2/08**	**Wed 1/28/09**	**0 days**	**-3 days**
2	Market analysis	Wed 1/2/08	Fri 2/1/08	Wed 1/2/08	Tue 2/5/08	0 days	-2 days
3	Product design	Mon 2/4/08	Thu 3/20/08	Wed 2/6/08	Tue 4/1/08	-2 days	-8 days
4	Manufacturing study	Fri 3/21/08	Tue 4/22/08	Wed 4/2/08	Tue 4/29/08	-8 days	-5 days
5	Product design selection	Wed 4/23/08	Tue 5/13/08	Wed 4/30/08	Tue 5/13/08	-5 days	0 days
6	Detailed marketing plan	Tue 10/28/08	Mon 11/24/08	Fri 7/25/08	Thu 8/14/08	66 days	71 days
7	Manufacturing process	Fri 8/1/08	Thu 9/18/08	Tue 7/15/08	Mon 8/25/08	13 days	17 days
8	Detailed product design	Wed 5/14/08	Thu 7/31/08	Wed 5/14/08	Mon 7/14/08	0 days	13 days
9	Test prototype	Fri 8/1/08	Fri 8/15/08	Tue 7/15/08	Mon 7/28/08	13 days	14 days
10	Finalized product design	Fri 9/19/08	Thu 10/16/08	Tue 8/26/08	Tue 9/30/08	17 days	12 days
11	Order components	Fri 10/31/08	Thu 11/6/08	Tue 10/21/08	Wed 10/29/08	8 days	6 days
12	Order production equipment	Fri 10/17/08	Mon 11/3/08	Wed 10/1/08	Mon 10/20/08	12 days	10 days
13	Install production equipment	Tue 12/9/08	Thu 1/22/09	Wed 12/17/08	Tue 1/27/09	-6 days	-3 days
14	Celebrate	Fri 1/23/09	Fri 1/23/09	Wed 1/28/09	Wed 1/28/09	-3 days	-3 days

Z-12
Blue Zuma Project: Part 6
Estimated Completion Cost Table

ID	Task Name	Fixed Cost	Fixed Cost Accrual	Total Cost	Baseline	Variance	Actual	Remaining
1	**Blue Zuma Project**	**$0.00**	**Prorated**	**$1,429,720.00**	**$1,260,000.00**	**$169,720.00**	**$1,429,720.00**	**$0.00**
2	Market analysis	$0.00	Prorated	$44,160.00	$48,000.00	($3,840.00)	$44,160.00	$0.00
3	Product design	$0.00	Prorated	$190,400.00	$224,000.00	($33,600.00)	$190,400.00	$0.00
4	Manufacturing study	$0.00	Prorated	$80,960.00	$70,400.00	$10,560.00	$80,960.00	$0.00
5	Product design selection	$0.00	Prorated	$84,300.00	$56,200.00	$28,100.00	$84,300.00	$0.00
6	Detailed marketing plan	$0.00	Prorated	$38,400.00	$28,800.00	$9,600.00	$38,400.00	$0.00
7	Manufacturing process	$0.00	Prorated	$144,160.00	$127,200.00	$16,960.00	$144,160.00	$0.00
8	Detailed product design	$0.00	Prorated	$432,300.00	$330,120.00	$102,180.00	$432,300.00	$0.00
9	Test prototype	$0.00	Prorated	$37,840.00	$34,400.00	$3,440.00	$37,840.00	$0.00
10	Finalized product design	$0.00	Prorated	$123,200.00	$154,000.00	($30,800.00)	$123,200.00	$0.00
11	Order components	$0.00	Prorated	$2,000.00	$2,800.00	($800.00)	$2,000.00	$0.00
12	Order production equipment	$50,000.00	Prorated	$54,800.00	$5,600.00	$49,200.00	$54,800.00	$0.00
13	Install production equipment	$0.00	Prorated	$187,200.00	$168,480.00	$18,720.00	$187,200.00	$0.00
14	Celebrate	$0.00	Prorated	$10,000.00	$10,000.00	$0.00	$10,000.00	$0.00

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Note: Students will have to manually add $50,000 to the cost of Order production equipment to reflect the cost of expediting shipments.

1. *When will the project be completed? How does this compare with the baseline completion date?*

   The project should be completed ahead of schedule by 3 working days on 1/23/09.

2. *What is the new estimated cost at completion (EAC)? What is the new VAC? How does this compare with VAC based on the EAC_f generated in Part 5? Which of the two VACs would you have the greatest confidence in and why?*

   The new EAC_{re} is $1,429,720 with a -$169,720 VAC_{re} that is $10,349 less than the VAC_f generated from the EAC_f calculated at 8/16/08. So despite incurring the additional $50,000 shipping cost, work is predicted to be more efficient during the last third of the project.

   One could argue that one should have greater confidence with the VAC_{re} since the engineers should have more confidence in their ability to predict how long things will take and cost after completing roughly two thirds of the project.

Robin and top management should be happy because while we are currently behind schedule the project team predicts that they will complete the project ahead of schedule and before the crucial February 1st deadline.

CONVEYOR BELT PROJECT COMPUTER EXERCISE

Relevant copies of MS Project files pertaining to different parts of the exercise are available from the text Web site (see Conveyor Belt Project 2010 folder). Instructors will need to access designated files to obtain specific information and generate documents similar to those presented in the teacher's manual. We strongly recommend that you create back-ups for all these files before accessing them just in case they get altered when using them.

Part 1

This first exercise is nothing more than the design of the WBS from the given information. Since all the deliverables are given there should be no major problems. Figure CEX-1 depicts the simple WBS outline. Only the Task Name is necessary at this point.

CEX-1
Conveyor Belt Project -- Part 1

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	**1 Conveyor Belt Project**	**1 day?**	**Mon 1/4/10**	**Mon 1/4/10**		
2	**1.1 Hardware**	**1 day?**	**Mon 1/4/10**	**Mon 1/4/10**		
3	1.1.1 Hardware specifications	1 day?	Mon 1/4/10	Mon 1/4/10		
4	1.1.2 Hardware design	1 day?	Mon 1/4/10	Mon 1/4/10		
5	1.1.3 Hardware documentation	1 day?	Mon 1/4/10	Mon 1/4/10		
6	1.1.4 Prototypes	1 day?	Mon 1/4/10	Mon 1/4/10		
7	1.1.5 Order circuit boards	1 day?	Mon 1/4/10	Mon 1/4/10		
8	1.1.6 Assemble preproduction models	1 day?	Mon 1/4/10	Mon 1/4/10		
9	**1.2 Operating system**	**1 day?**	**Mon 1/4/10**	**Mon 1/4/10**		
10	1.2.1 Kernel specifications	1 day?	Mon 1/4/10	Mon 1/4/10		
11	**1.2.2 Drivers**	**1 day?**	**Mon 1/4/10**	**Mon 1/4/10**		
12	1.2.2.1 Disk drivers	1 day?	Mon 1/4/10	Mon 1/4/10		
13	1.2.2.2 Serial I/O drivers	1 day?	Mon 1/4/10	Mon 1/4/10		
14	1.2.3 Memory management	1 day?	Mon 1/4/10	Mon 1/4/10		
15	1.2.4 Operating system documentation	1 day?	Mon 1/4/10	Mon 1/4/10		
16	1.2.5 Network interface	1 day?	Mon 1/4/10	Mon 1/4/10		
17	**1.3 Utilities**	**1 day?**	**Mon 1/4/10**	**Mon 1/4/10**		
18	1.3.1 Utilities specifications	1 day?	Mon 1/4/10	Mon 1/4/10		
19	1.3.2 Routine utilities	1 day?	Mon 1/4/10	Mon 1/4/10		
20	1.3.3 Complex utilities	1 day?	Mon 1/4/10	Mon 1/4/10		
21	1.3.4 Utilities documentation	1 day?	Mon 1/4/10	Mon 1/4/10		
22	1.3.5 Shell	1 day?	Mon 1/4/10	Mon 1/4/10		
23	**1.4 System integration**	**1 day?**	**Mon 1/4/10**	**Mon 1/4/10**		
24	1.4.1 Architectural decisions	1 day?	Mon 1/4/10	Mon 1/4/10		
25	1.4.2 Integration first phase	1 day?	Mon 1/4/10	Mon 1/4/10		
26	1.4.3 System hard/software test	1 day?	Mon 1/4/10	Mon 1/4/10		
27	1.4.4 Project documentation	1 day?	Mon 1/4/10	Mon 1/4/10		
28	1.4.5 Integration acceptance testing	1 day?	Mon 1/4/10	Mon 1/4/10		

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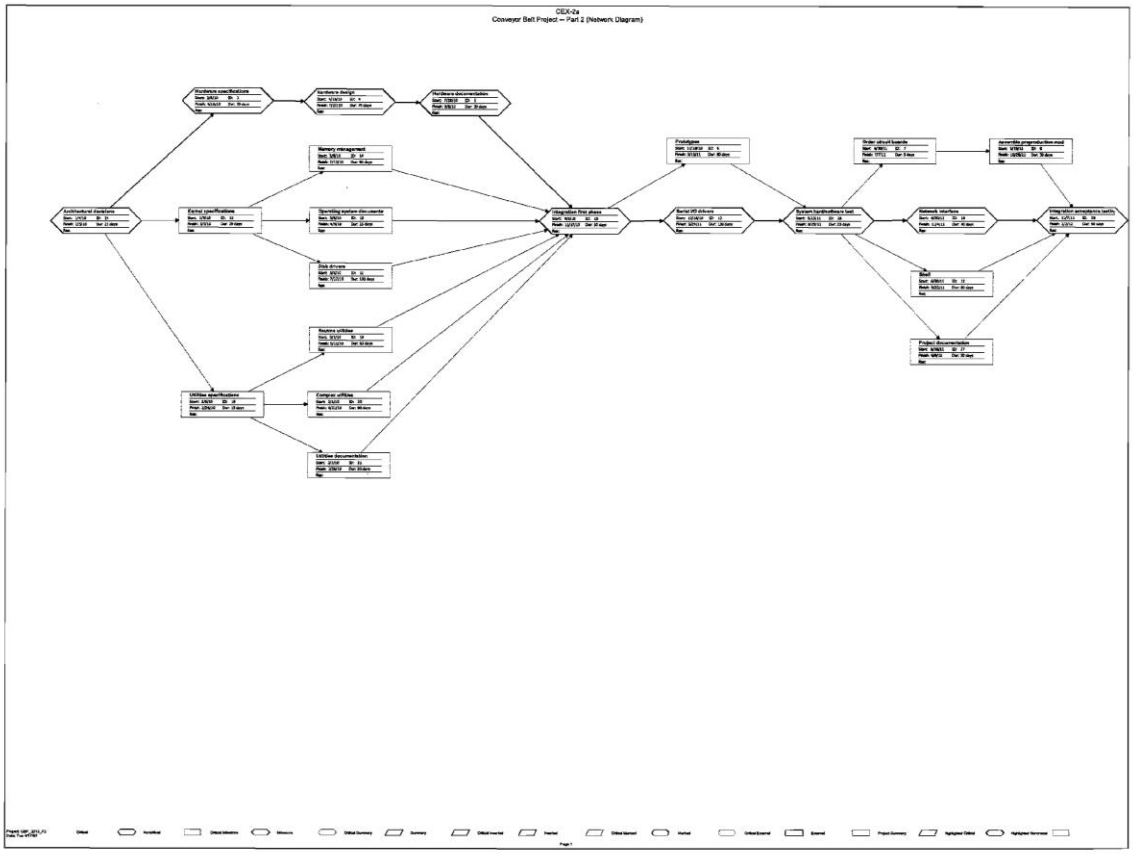
The file is **CBP_P1**.

Does this information (WBS) allow you to define any milestones of the project? Why or why not? What are they?

Most students will say no, since the WBS does not include any aspects of the sequence or interrelationships of activities. Some will argue that you can infer from the title of the task that the completion of activities like Integration first phase or System hard/software test would be significant accomplishments.

Part 2

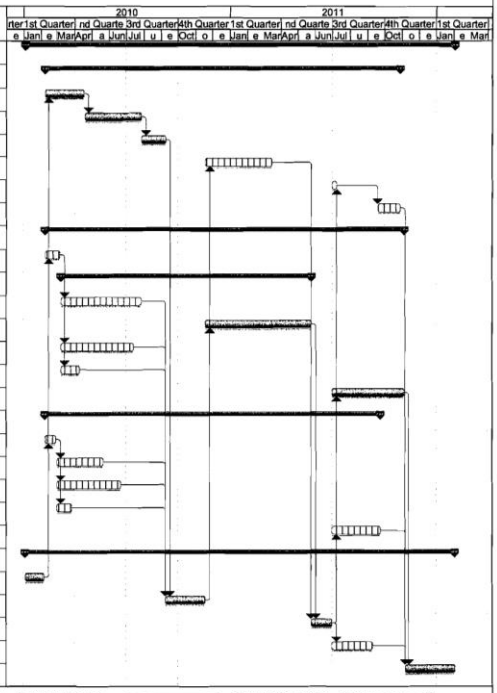
This exercise deals with using software to create a preliminary schedule of the project based on the information provided in Part 1. **CBP_P2** contains this file. Figure CEX-2a depicts the Network Diagram while CEX-2b is a copy of the Entry Table and the Gantt Chart. CEX-2c contains the Schedule Table.



Hint: Students who try to use the "Network Diagram" option will be frustrated by the inability to arrange the boxes so that they clearly display the flow of activities. To rectify this problem one can select "Layout" under "Format" and click the "Allow manual box positioning" box and shortening the spacing parameters. Students can then proceed to efficiently arrange the boxes and fit it to a page by adjusting % scale or fit to # desired pages in "Page Setup – Page." To further help students, it is also possible under the same option window used to "Allow manual box positioning" to select a "Straight" link style, which will alleviate the links between boxes from overlapping.

CEX-2b
Conveyor Belt Project – Part 2
Entry Table & Gantt Chart

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Conveyor Belt Project**	**530 days**	**Mon 1/4/10**	**Thu 2/2/12**	
2	**Hardware**	**440 days**	**Mon 2/8/10**	**Fri 10/28/11**	
3	Hardware specifications	50 days	Mon 2/8/10	Fri 4/16/10	24
4	Hardware design	70 days	Mon 4/19/10	Tue 7/27/10	3
5	Hardware documentation	30 days	Wed 7/28/10	Wed 9/8/10	4
6	Prototypes	80 days	Thu 11/18/10	Tue 3/15/11	25
7	Order circuit boards	5 days	Thu 6/30/11	Thu 7/7/11	26
8	Assemble preproduction models	30 days	Mon 9/19/11	Fri 10/28/11	7FS+50 days
9	**Operating system**	**445 days**	**Mon 2/8/10**	**Fri 11/4/11**	
10	Kernel specifications	20 days	Mon 2/8/10	Fri 3/5/10	24
11	**Drivers**	**310 days**	**Mon 3/8/10**	**Tue 5/24/11**	
12	Disk drivers	100 days	Mon 3/8/10	Tue 7/27/10	10
13	Serial I/O drivers	130 days	Thu 11/18/10	Tue 5/24/11	25
14	Memory management	90 days	Mon 3/8/10	Tue 7/13/10	10
15	Operating system documentation	25 days	Mon 3/8/10	Fri 4/9/10	10
16	Network interface	90 days	Thu 6/30/11	Fri 11/4/11	26
17	**Utilities**	**415 days**	**Mon 2/8/10**	**Fri 9/23/11**	
18	Utilities specifications	15 days	Mon 2/8/10	Fri 2/26/10	24
19	Routine utilities	60 days	Mon 3/1/10	Fri 5/21/10	18
20	Complex utilities	80 days	Mon 3/1/10	Mon 6/21/10	18
21	Utilities documentation	20 days	Mon 3/1/10	Fri 3/26/10	18
22	Shell	60 days	Thu 6/30/11	Fri 9/23/11	26
23	**System integration**	**530 days**	**Mon 1/4/10**	**Thu 2/2/12**	
24	Architectural decisions	25 days	Mon 1/4/10	Fri 2/5/10	
25	Integration first phase	50 days	Thu 9/9/10	Wed 11/17/10	5,12,14,15,19,20,21
26	System hard/software test	25 days	Wed 5/25/11	Wed 6/29/11	6,13
27	Project documentation	50 days	Thu 6/30/11	Fri 9/9/11	26
28	Integration acceptance testing	60 days	Mon 11/7/11	Thu 2/2/12	8,16,22,27



Project: Conveyor Belt Project
Date: Tue 4/17/07

Task | Summary | Rolled Up Progress | Group By Summ Task
Critical Task | Rolled Up Task | Split | Critical Task
Progress | Rolled Up Critical Task | External Tasks
Milestone | Rolled Up Milestone | Project Summary

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CEX-2c
Conveyor Belt Project -- Part 2
Schedule Table

ID	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
1	**Conveyor Belt Project**	**Mon 1/4/10**	**Thu 2/2/12**	**Mon 1/4/10**	**Thu 2/2/12**	**0 days**	**0 days**
2	**Hardware**	**Mon 2/8/10**	**Fri 10/28/11**	**Mon 2/8/10**	**Fri 11/4/11**	**0 days**	**0 days**
3	Hardware specifications	Mon 2/8/10	Fri 4/16/10	Mon 2/8/10	Fri 4/16/10	0 days	0 days
4	Hardware design	Mon 4/19/10	Tue 7/27/10	Mon 4/19/10	Tue 7/27/10	0 days	0 days
5	Hardware documentation	Wed 7/28/10	Wed 9/8/10	Wed 7/28/10	Wed 9/8/10	0 days	0 days
6	Prototypes	Thu 11/18/10	Tue 3/15/11	Wed 2/2/11	Tue 5/24/11	50 days	50 days
7	Order circuit boards	Thu 6/30/11	Thu 7/7/11	Fri 1/27/12	Thu 2/2/12	145 days	145 days
8	Assemble preproduction models	Mon 9/19/11	Fri 10/28/11	Mon 9/26/11	Fri 11/4/11	5 days	5 days
9	**Operating system**	**Mon 2/8/10**	**Fri 11/4/11**	**Mon 3/22/10**	**Fri 11/4/11**	**0 days**	**0 days**
10	Kernel specifications	Mon 2/8/10	Fri 3/5/10	Thu 9/9/10	Wed 10/6/10	0 days	150 days
11	**Drivers**	**Mon 3/8/10**	**Tue 5/24/11**	**Mon 4/19/10**	**Tue 5/24/11**	**0 days**	**0 days**
12	Disk drivers	Mon 3/8/10	Tue 7/27/10	Thu 10/7/10	Tue 3/1/11	150 days	150 days
13	Serial I/O drivers	Thu 11/18/10	Tue 5/24/11	Thu 11/18/10	Tue 5/24/11	0 days	0 days
14	Memory management	Mon 3/8/10	Tue 7/13/10	Thu 10/21/10	Tue 3/1/11	160 days	160 days
15	Operating system documentation	Mon 3/8/10	Fri 4/9/10	Wed 1/26/11	Tue 3/1/11	225 days	225 days
16	Network interface	Thu 6/30/11	Fri 11/4/11	Thu 6/30/11	Fri 11/4/11	0 days	0 days
17	**Utilities**	**Mon 2/8/10**	**Fri 9/23/11**	**Mon 4/26/10**	**Fri 11/4/11**	**30 days**	**30 days**
18	Utilities specifications	Mon 2/8/10	Fri 2/26/10	Thu 10/14/10	Wed 11/3/10	0 days	175 days
19	Routine utilities	Mon 3/1/10	Fri 5/21/10	Fri 12/3/10	Tue 3/1/11	195 days	195 days
20	Complex utilities	Mon 3/1/10	Mon 6/21/10	Thu 11/4/10	Tue 3/1/11	175 days	175 days
21	Utilities documentation	Mon 3/1/10	Fri 3/26/10	Wed 2/2/11	Tue 3/1/11	235 days	235 days
22	Shell	Thu 6/30/11	Fri 9/23/11	Fri 8/12/11	Fri 11/4/11	30 days	30 days
23	**System integration**	**Mon 1/4/10**	**Thu 2/2/12**	**Mon 1/4/10**	**Thu 2/2/12**	**0 days**	**0 days**
24	Architectural decisions	Mon 1/4/10	Fri 2/5/10	Mon 1/4/10	Fri 2/5/10	0 days	0 days
25	Integration first phase	Thu 9/9/10	Wed 11/17/10	Thu 9/9/10	Wed 11/17/10	0 days	0 days
26	System hard/software test	Wed 5/25/11	Wed 6/29/11	Wed 5/25/11	Wed 6/29/11	0 days	0 days
27	Project documentation	Thu 6/30/11	Fri 9/9/11	Fri 8/26/11	Fri 11/4/11	40 days	40 days
28	Integration acceptance testing	Mon 11/7/11	Thu 2/2/12	Mon 11/7/11	Thu 2/2/12	0 days	0 days

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1. *When is the project estimated to be completed? How long will the project take?*

   The project is expected to be completed on 2/2/12 and will take 530 working days to complete.

2. *What is the critical path(s) for the project?*

   Architectural decisions → Hardware specifications → Hardware design → Hardware documentation → Integration first phase → Serial I/O drivers → System hard/software test → Network interface → Integrated acceptance test

3. *Which activity has the greatest amount of slack?*

   Utilities documentation has 235 days of slack.

4. *How sensitive is this network?*

   Sensitivity has been defined as the likelihood that the critical path will remain stable during the completion of the project. It is a function of the amount of slack non-critical activities has as well as the number of different critical paths. Upon analysis one should argue that the network is not very sensitive with the exception that there is only 5 days of slack shared between the Order circuit boards and Assemble preproduction models activities.

5. *Identify two sensible milestones and explain your choices.*

   Milestones are appropriate checkpoints that provide an indication of progress on the project. All other things being equal the start of critical merge activities and the completion of critical burst activities are useful milestones. As such we recommend that the start of Integration first phase (Act. 1.4.2) and the finish of System hard/software test (Act. 1.4.3) would be appropriate candidates for milestones. Moreover, the names of these activities imply importance by themselves.

6. *Compare the advantages/disadvantages of displaying the schedule as a network versus a Gantt chart.*

   Network schedules more clearly illustrate the relationship between different activities and the critical path. They can report precise information in each box (i.e., duration, early start, etc). Gantt charts are easy to understand and provide a clear overview of the project schedule across a timeline. It is easy to identify which activities are supposed to be occurring on specific dates.

Part 3

Part A

At this stage resources and their impact on the project are introduced. Since very few projects do not encounter some sort of resource constraint their consideration is a crucial part of project management.

Note that when students assign more than one resource to an activity the software automatically divides the duration by the number of resources. They should be reminded to restore the original duration after adding resources.

CBP_P3A contains the file that should be created.

1. *Which if any of the resources are overallocated?*

   Three resources are overallocated: Design, Development, and Documentation.

2. *Assume that the project is time constrained and try to resolve any overallocation problems by leveling within slack. What happens?*

   By leveling only within slack it is possible to eliminate the Design and Documentation overallocation problems, but not the Development problem (**File: CBP_P3A_Within_Slack**).

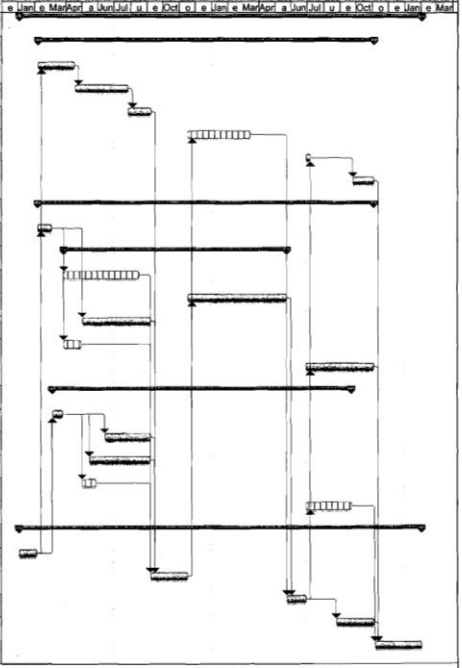
3. *What is the impact of leveling within slack on the sensitivity of the network?*

   See Figure CEX-3 a Gantt chart with the schedule table after leveling within slack.

   Students should point out that leveling within slack comes at a cost of dramatically increasing the sensitivity of the network (see Figure CEX-3a). Instead of one critical path containing 9 activities, there are multiple overlapping critical paths. Furthermore, the slack available to many non-critical activities has been reduced. This illustrates the point made in the chapter that using slack to resolve overallocation problems increases the risk of the project ultimately being late.

CEX-3
Conveyor Belt Project – Part 3A
Schedule Table and Gantt Chart after leveling within slack

ID	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
1	**Conveyor Belt Project**	**Mon 1/4/10**	**Thu 2/2/12**	**Mon 1/4/10**	**Thu 2/2/12**	**0 days**	**0 days**
2	**Hardware**	**Mon 2/8/10**	**Fri 11/4/11**	**Mon 2/8/10**	**Fri 11/4/11**	**0 days**	**0 days**
3	Hardware specifications	Mon 2/8/10	Fri 4/16/10	Mon 2/8/10	Fri 4/16/10	0 days	0 days
4	Hardware design	Mon 4/19/10	Tue 7/27/10	Mon 4/19/10	Tue 7/27/10	0 days	0 days
5	Hardware documentation	Wed 7/28/10	Wed 9/8/10	Wed 7/28/10	Wed 9/8/10	0 days	0 days
6	Prototypes	Thu 11/18/10	Tue 3/15/11	Wed 2/2/11	Tue 5/24/11	50 days	50 days
7	Order circuit boards	Thu 6/30/11	Thu 7/7/11	Thu 6/30/11	Thu 7/7/11	0 days	0 days
8	Assemble preproduction models	Mon 9/26/11	Fri 11/4/11	Mon 9/26/11	Fri 11/4/11	0 days	0 days
9	**Operating system**	**Mon 2/8/10**	**Fri 11/4/11**	**Mon 2/8/10**	**Fri 11/4/11**	**0 days**	**0 days**
10	Kernel specifications	Mon 2/8/10	Fri 3/5/10	Mon 2/8/10	Fri 3/5/10	0 days	0 days
11	**Drivers**	**Mon 3/29/10**	**Tue 5/24/11**	**Mon 4/19/10**	**Tue 5/24/11**	**0 days**	**0 days**
12	Disk drivers	Mon 3/29/10	Tue 8/17/10	Mon 4/19/10	Wed 9/8/10	15 days	15 days
13	Serial I/O drivers	Thu 11/18/10	Tue 5/24/11	Thu 11/18/10	Tue 5/24/11	0 days	0 days
14	Memory management	Mon 5/3/10	Wed 9/8/10	Mon 5/3/10	Wed 9/8/10	0 days	0 days
15	Operating system documentation	Mon 3/29/10	Fri 4/30/10	Wed 8/4/10	Wed 9/8/10	90 days	90 days
16	Network interface	Thu 6/30/11	Fri 11/4/11	Thu 6/30/11	Fri 11/4/11	0 days	0 days
17	**Utilities**	**Mon 3/8/10**	**Fri 9/23/11**	**Mon 3/8/10**	**Fri 11/4/11**	**0 days**	**0 days**
18	Utilities specifications	Mon 3/8/10	Fri 3/26/10	Mon 3/8/10	Fri 3/26/10	0 days	0 days
19	Routine utilities	Tue 6/15/10	Wed 9/8/10	Tue 6/15/10	Wed 9/8/10	0 days	0 days
20	Complex utilities	Mon 5/17/10	Wed 9/8/10	Mon 5/17/10	Wed 9/8/10	0 days	0 days
21	Utilities documentation	Mon 5/3/10	Fri 5/28/10	Wed 8/11/10	Wed 9/8/10	70 days	70 days
22	Shell	Thu 6/30/11	Fri 9/23/11	Fri 8/12/11	Fri 11/4/11	30 days	30 days
23	**System integration**	**Mon 1/4/10**	**Thu 2/2/12**	**Mon 1/4/10**	**Thu 2/2/12**	**0 days**	**0 days**
24	Architectural decisions	Mon 1/4/10	Fri 2/5/10	Mon 1/4/10	Fri 2/5/10	0 days	0 days
25	Integration first phase	Thu 9/9/10	Wed 11/17/10	Thu 9/9/10	Wed 11/17/10	0 days	0 days
26	System hard/software test	Wed 5/25/11	Wed 6/29/11	Wed 5/25/11	Wed 6/29/11	0 days	0 days
27	Project documentation	Fri 8/26/11	Fri 11/4/11	Fri 8/26/11	Fri 11/4/11	0 days	0 days
28	Integration acceptance testing	Mon 11/7/11	Thu 2/2/12	Mon 11/7/11	Thu 2/2/12	0 days	0 days



Project: Conveyor Belt Project
Date: Tue 4/17/07

Task | Summary | Rolled Up Progress | Group By SummTask
Critical Task | Rolled Up Task | Split | Critical Task
Progress | Rolled Up Critical Task | External Tasks
Milestone | Rolled Up Milestone | Project Summary

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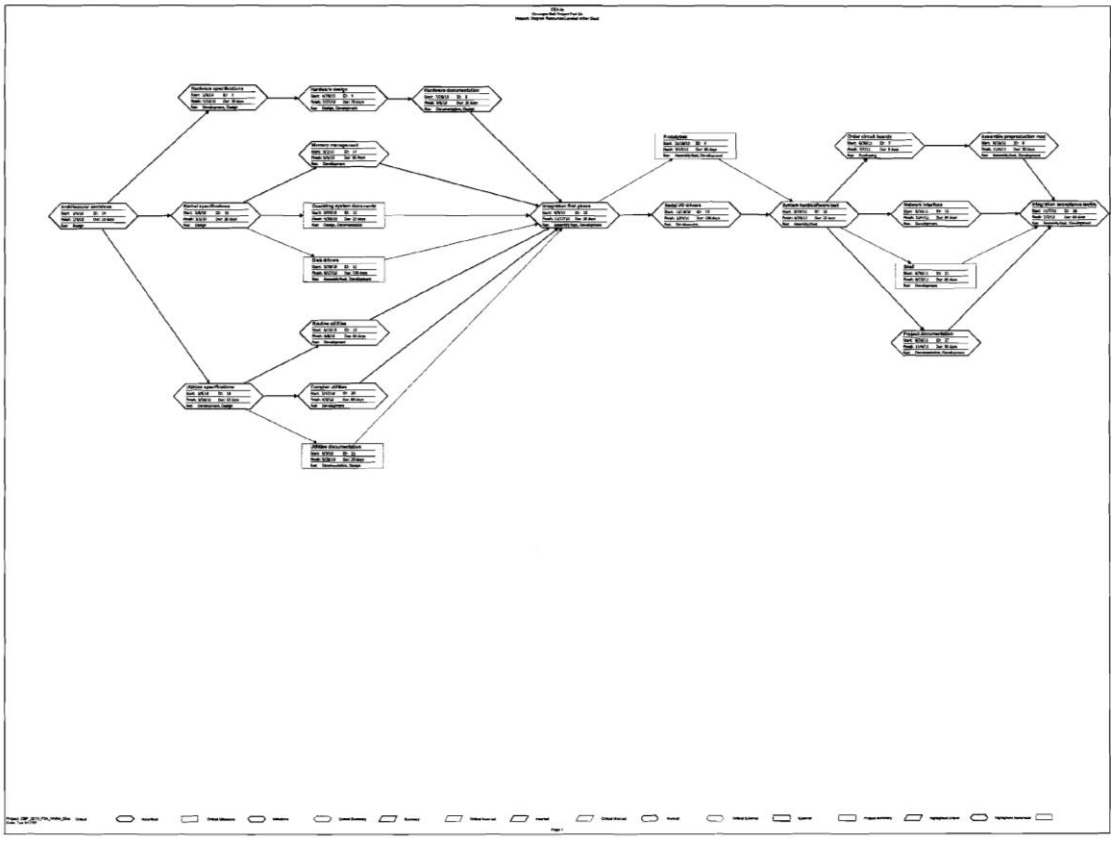


4. *Assume the project is resource constrained and resolve any overallocation problems by leveling outside of slack. What happens? What are the managerial implications?*

   Resolving the entire overallocation problems by leveling outside of slack extends the project (**File: CBP_P3A_Outside_Slack**) by over 170 working days with a new completion date of 10/2/12!

   The implications are simple – "Project network times are not a schedule until resources have been assigned."

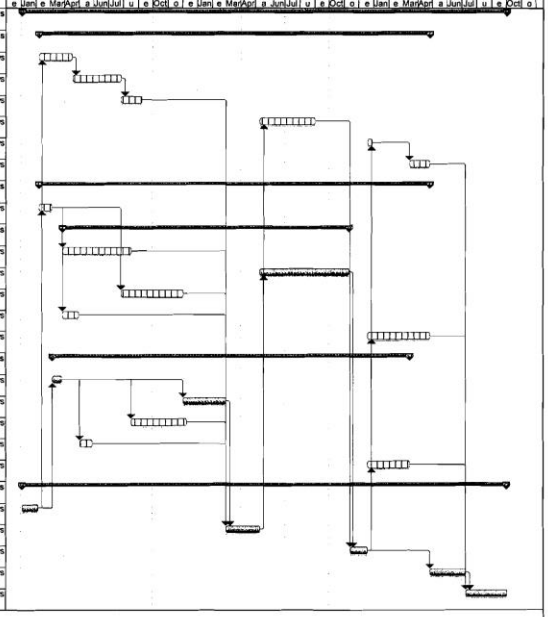
5. *What options are available at this point in time?*

   The options available at this point include: a) accept the new schedule and completion date, b) obtain additional resources and reduce project time by assigning them to activities (especially those with overallocated resources), c) schedule over-time to reduce completion dates, d) reduce the scope of the project so that it takes less time to complete, and e) try to reduce project time by altering the structure of the network (i.e., introducing lags).

   Figure CEX-3b contains the Schedule Table and Gantt Chart when resources are leveled outside of slack. Notice that the software is unable to identify one continuous critical path. This is because the dependencies that dictate the sequence of activities are now just not technical (Finish to Start) but also are based on resources. Students should be encouraged to examine closely both kinds of dependencies and their impact on the project schedule.

CEX-3b
Conveyor Belt Project – Part 3A
Schedule Table and Gantt Chart after leveling outside of slack

ID	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
1	**Conveyor Belt Project**	**Mon 1/4/10**	**Tue 10/2/12**	**Mon 1/4/10**	**Tue 10/2/12**	**0 days**	**0 days**
2	**Hardware**	**Mon 2/8/10**	**Thu 4/26/12**	**Wed 7/28/10**	**Mon 7/9/12**	**50 days**	**50 days**
3	Hardware specifications	Mon 2/8/10	Fri 4/16/10	Wed 7/28/10	Wed 10/6/10	0 days	120 days
4	Hardware design	Mon 4/19/10	Tue 7/27/10	Thu 10/7/10	Tue 1/18/11	0 days	120 days
5	Hardware documentation	Wed 7/28/10	Wed 9/8/10	Wed 1/19/11	Tue 3/1/11	120 days	120 days
6	Prototypes	Wed 5/11/11	Thu 9/1/11	Fri 7/22/11	Fri 11/11/11	50 days	50 days
7	Order circuit boards	Tue 12/20/11	Wed 12/28/11	Fri 3/2/12	Thu 3/8/12	0 days	50 days
8	Assemble preproduction models	Fri 3/16/12	Thu 4/26/12	Fri 5/25/12	Mon 7/9/12	50 days	50 days
9	**Operating system**	**Mon 2/8/10**	**Thu 4/26/12**	**Mon 5/3/10**	**Mon 7/9/12**	**50 days**	**50 days**
10	Kernel specifications	Mon 2/8/10	Fri 3/5/10	Mon 5/3/10	Fri 5/28/10	0 days	60 days
11	**Drivers**	**Mon 3/29/10**	**Fri 11/11/11**	**Thu 10/7/10**	**Fri 11/11/11**	**0 days**	**0 days**
12	Disk drivers	Mon 3/29/10	Tue 8/17/10	Thu 10/7/10	Tue 3/1/11	135 days	135 days
13	Serial I/O drivers	Wed 5/11/11	Fri 11/11/11	Wed 5/11/11	Fri 11/11/11	0 days	0 days
14	Memory management	Wed 7/28/10	Thu 12/2/10	Thu 10/21/10	Tue 3/1/11	60 days	60 days
15	Operating system documentation	Mon 3/29/10	Fri 4/30/10	Wed 1/26/11	Tue 3/1/11	210 days	210 days
16	Network interface	Tue 12/20/11	Thu 4/26/12	Fri 3/2/12	Mon 7/9/12	50 days	50 days
17	**Utilities**	**Mon 3/8/10**	**Thu 3/15/12**	**Mon 3/8/10**	**Mon 7/9/12**	**0 days**	**0 days**
18	Utilities specifications	Mon 3/8/10	Fri 3/26/10	Mon 3/8/10	Fri 3/26/10	0 days	0 days
19	Routine utilities	Fri 12/3/10	Tue 3/1/11	Fri 12/3/10	Tue 3/1/11	0 days	0 days
20	Complex utilities	Wed 8/18/10	Thu 12/9/10	Thu 11/4/10	Tue 3/1/11	55 days	55 days
21	Utilities documentation	Mon 5/3/10	Fri 5/28/10	Wed 2/2/11	Tue 3/1/11	190 days	190 days
22	Shell	Tue 12/20/11	Thu 3/15/12	Fri 4/13/12	Mon 7/9/12	80 days	80 days
23	**System Integration**	**Mon 1/4/10**	**Tue 10/2/12**	**Mon 1/4/10**	**Tue 10/2/12**	**0 days**	**0 days**
24	Architectural decisions	Mon 1/4/10	Fri 2/5/10	Mon 1/4/10	Fri 2/5/10	0 days	0 days
25	Integration first phase	Wed 3/2/11	Tue 5/10/11	Wed 3/2/11	Tue 5/10/11	0 days	0 days
26	System hard/software test	Mon 11/14/11	Mon 12/19/11	Mon 11/14/11	Mon 12/19/11	0 days	0 days
27	Project documentation	Fri 4/27/12	Mon 7/9/12	Fri 4/27/12	Mon 7/9/12	0 days	0 days
28	Integration acceptance testing	Tue 7/10/12	Tue 10/2/12	Tue 7/10/12	Tue 10/2/12	0 days	0 days



Project: Conveyor Belt Project
Date: Tue 4/17/07

Task
Critical Task
Progress
Milestone
Summary
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Rolled Up Critical Task
Rolled Up Milestone
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Part B

The second part of the assignment introduces a time constraint (February 2, 2012 deadline) and students have access to two more Development teams as well as the option of outsourcing Development work at an additional cost.

Hint: Students should be reminded to assign each team 100%; no partial assignments (i.e., 50%).

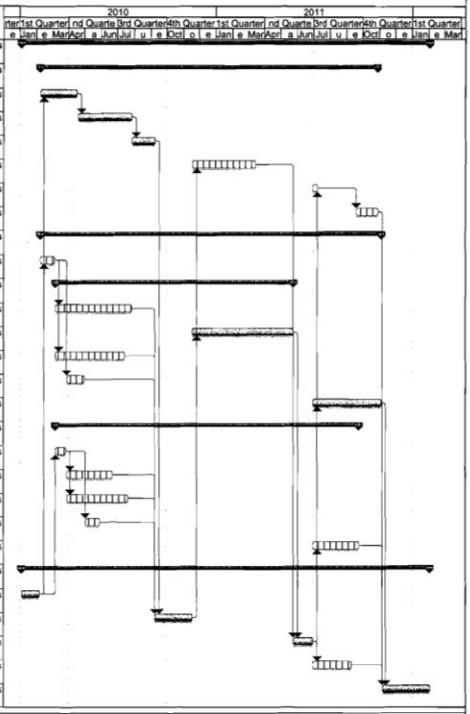
Students should try to resolve the Development overallocation as cheaply as possible. Ultimately they will find that the best solution is to add the two additional in-house Development teams and hire an external Development team to perform the Routine utilities activity.

Note: Some students will make the mistake of leveling first within slack to eliminate the overallocation problems with Documentation and Design and then add the Development teams. While such a solution will achieve the same completion date and at the same cost it will greatly increase the sensitivity of the network.

The recommended schedule is contained in **CBP_P3B** file and the revised schedule is presented in Figure CEX-3c.

CEX-3c
Conveyor Belt Project -- Part 3B
Schedule Table and Gantt Chart for Revised Schedule

ID	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
1	**Conveyor Belt Project**	**Mon 1/4/10**	**Thu 2/2/12**	**Mon 1/4/10**	**Thu 2/2/12**	**0 days**	**0 days**
2	**Hardware**	**Mon 2/8/10**	**Fri 10/28/11**	**Mon 2/8/10**	**Fri 11/4/11**	**0 days**	**0 days**
3	Hardware specifications	Mon 2/8/10	Fri 4/16/10	Mon 2/8/10	Fri 4/16/10	0 days	0 days
4	Hardware design	Mon 4/19/10	Tue 7/27/10	Mon 4/19/10	Tue 7/27/10	0 days	0 days
5	Hardware documentation	Wed 7/28/10	Wed 9/8/10	Wed 7/28/10	Wed 9/8/10	0 days	0 days
6	Prototypes	Thu 11/18/10	Tue 3/15/11	Wed 2/2/11	Tue 5/24/11	50 days	50 days
7	Order circuit boards	Thu 6/30/11	Thu 7/7/11	Fri 7/8/11	Thu 7/14/11	0 days	5 days
8	Assemble preproduction models	Mon 9/19/11	Fri 10/28/11	Mon 9/26/11	Fri 11/4/11	5 days	5 days
9	**Operating system**	**Mon 2/8/10**	**Fri 11/4/11**	**Mon 3/22/10**	**Fri 11/4/11**	**0 days**	**0 days**
10	Kernel specifications	Mon 2/8/10	Fri 3/5/10	Mon 3/22/10	Fri 4/16/10	0 days	30 days
11	**Drivers**	**Mon 3/8/10**	**Tue 5/24/11**	**Mon 4/19/10**	**Tue 5/24/11**	**0 days**	**0 days**
12	Disk drivers	Mon 3/8/10	Tue 7/27/10	Mon 4/19/10	Wed 9/8/10	30 days	30 days
13	Serial I/O drivers	Thu 11/18/10	Tue 5/24/11	Thu 11/18/10	Tue 5/24/11	0 days	0 days
14	Memory management	Mon 3/8/10	Tue 7/13/10	Mon 5/3/10	Wed 9/8/10	40 days	40 days
15	Operating system documentation	Mon 3/29/10	Fri 4/30/10	Wed 8/4/10	Wed 9/8/10	90 days	90 days
16	Network interface	Thu 6/30/11	Fri 11/4/11	Thu 6/30/11	Fri 11/4/11	0 days	0 days
17	**Utilities**	**Mon 3/8/10**	**Fri 9/23/11**	**Mon 4/26/10**	**Fri 11/4/11**	**30 days**	**30 days**
18	Utilities specifications	Mon 3/8/10	Fri 3/26/10	Mon 4/26/10	Fri 5/14/10	0 days	35 days
19	Routine utilities	Mon 3/29/10	Mon 6/21/10	Tue 6/15/10	Wed 9/8/10	55 days	55 days
20	Complex utilities	Mon 3/29/10	Tue 7/20/10	Mon 5/17/10	Wed 9/8/10	35 days	35 days
21	Utilities documentation	Mon 5/3/10	Fri 5/28/10	Wed 8/11/10	Wed 9/8/10	70 days	70 days
22	Shell	Thu 6/30/11	Fri 9/23/11	Fri 8/12/11	Fri 11/4/11	30 days	30 days
23	**System integration**	**Mon 1/4/10**	**Thu 2/2/12**	**Mon 1/4/10**	**Thu 2/2/12**	**0 days**	**0 days**
24	Architectural decisions	Mon 1/4/10	Fri 2/5/10	Mon 1/4/10	Fri 2/5/10	0 days	0 days
25	Integration first phase	Thu 9/9/10	Wed 11/17/10	Thu 9/9/10	Wed 11/17/10	0 days	0 days
26	System hard/software test	Wed 5/25/11	Wed 6/29/11	Wed 5/25/11	Wed 6/29/11	0 days	0 days
27	Project documentation	Thu 6/30/11	Fri 9/9/11	Fri 8/26/11	Fri 11/4/11	40 days	40 days
28	Integration acceptance testing	Mon 11/7/11	Thu 2/2/12	Mon 11/7/11	Thu 2/2/12	0 days	0 days



Project: Conveyor Belt Project
Date: Tue 4/17/07

Task | Summary | Rolled Up Progress | Group By Summ Task
Critical Task | Rolled Up Task | Split | Critical Task
Progress | Rolled Up Critical Task | External Tasks
Milestone | Rolled Up Milestone | Project Summary

Page 1

This schedule is based on adding both additional development teams as well as outsourcing Routine utilities at a cost of $120/hour. Routine utilities was chosen as the cheapest alternative to meeting the deadline and also fit the desired goal of having outsource work independent of internal teams. Students should note that it is not possible to achieve the deadline by simply adding two more internal development teams.

1. *What changes did you make and why?*

   Students should submit a report summarizing the decisions and their consequences in narrative form. The report should include the original schedule created as Part 2 as well as the final schedule produced by completing Part 3. Differences between the two should be highlighted and explained.

   The following schedule changes were made to resolve Documentation and Design overallocation problems.

Activity	Original			Final		
	Start	Finish	Slack	Start	Finish	Slack
Operating system documentation	3/8/10	4/9/10	225 days	3/29/10	4/30/10	90 days
Utilities specifications	2/8/10	2/26/10	175 days	3/8/10	3/26/10	35 days
Routine utilities	3/1/10	5/21/10	195 days	3/29/10	6/21/10	55 days
Complex utilities	3/1/10	6/21/10	175 days	3/29/10	7/20/10	35 days
Utilities documentation	3/1/10	3/26/10	235 days	5/3/10	5/28/10	70 days

2. *How long will the project take?*

   The new completion date is 2/2/12.

3. *How did these changes affect the sensitivity of the network?*

   While the changes resulted in a reduction in slack of a few non-critical activities (see table above), as a whole the changes did not increase the sensitivity of the network that much. Furthermore, by adding Development teams a very sensitive resource constrained network was avoided.

Part 4

Students should use the schedule they created as a result of Part 3 (B) to create a cash flow statement for the project (see Figure CEX-4).

CEX-4
Conveyor Belt Project
Monthly Cash Flow Statement

	January	February	March	April	May	June	July	August	September
Conveyor Belt Project									
Hardware									
Hardware specifications		$20,400.00	$31,280.00	$16,320.00					
Hardware design				$13,600.00	$27,200.00	$29,920.00	$24,480.00		
Hardware documentation							$3,840.00	$28,160.00	$6,400.00
Prototypes									
Order circuit boards									
Assemble preproduction models									
Operating system									
Kernel specifications		$12,000.00	$4,000.00						
Drivers									
Disk drivers			$20,160.00	$24,640.00	$22,400.00	$24,640.00	$20,160.00		
Serial I/O drivers									
Memory management			$10,080.00	$12,320.00	$11,200.00	$12,320.00	$4,480.00		
Operating system documentation			$3,840.00	$28,160.00					
Network interface									
Utilities									
Utilities specifications			$20,400.00						
Routine utilities			$2,880.00	$21,120.00	$19,200.00	$14,400.00			
Complex utilities			$1,680.00	$12,320.00	$11,200.00	$12,320.00	$7,280.00		
Utilities documentation					$25,600.00				
Shell									
System integration									
Architectural decisions	$16,000.00	$4,000.00							
Integration first phase									$17,920.00
System hard/software test									
Project documentation									
Integration acceptance testing									
Total	$16,000.00	$36,400.00	$94,320.00	$128,480.00	$116,800.00	$93,600.00	$60,240.00	$28,160.00	$24,320.00

CEX-4
Conveyor Belt Project
Monthly Cash Flow Statement

	October	November	December	January	February	March	April	May	June	Ju
Conveyor Belt Project										
Hardware										
Hardware specifications										
Hardware design										
Hardware documentation										
Prototypes		$8,960.00	$23,520.00	$22,400.00	$22,400.00	$12,320.00				
Order circuit boards									$320.00	
Assemble preproduction models										
Operating system										
Kernel specifications										
Drivers										
Disk drivers										
Serial I/O drivers		$4,480.00	$11,760.00	$11,200.00	$11,200.00	$12,880.00	$11,760.00	$9,520.00		
Memory management										
Operating system documentation										
Network interface									$560.00	
Utilities										
Utilities specifications										
Routine utilities										
Complex utilities										
Utilities documentation										
Shell									$560.00	
System integration										
Architectural decisions										
Integration first phase	$23,520.00	$14,560.00								
System hard/software test								$2,240.00	$11,760.00	
Project documentation									$1,040.00	
Integration acceptance testing										
Total	$23,520.00	$28,000.00	$35,280.00	$33,600.00	$33,600.00	$25,200.00	$11,760.00	$11,760.00	$14,240.00	

CEX-4
Conveyor Belt Project
Monthly Cash Flow Statement

	July	August	September	October	November	December	January	February	March	Total
Conveyor Belt Project										
Hardware										
Hardware specifications										$68,000.00
Hardware design										$95,200.00
Hardware documentation										$38,400.00
Prototypes										$89,600.00
Order circuit boards	$1,280.00									$1,600.00
Assemble preproduction models			$11,200.00	$22,400.00						$33,600.00
Operating system										
Kernel specifications										$16,000.00
Drivers										
Disk drivers										$112,000.00
Serial I/O drivers										$72,800.00
Memory management										$50,400.00
Operating system documentation										$32,000.00
Network interface	$11,200.00	$12,880.00	$11,760.00	$11,760.00	$2,240.00					$50,400.00
Utilities										
Utilities specifications										$20,400.00
Routine utilities										$57,600.00
Complex utilities										$44,800.00
Utilities documentation										$25,600.00
Shell	$11,200.00	$12,880.00	$8,960.00							$33,600.00
System integration										
Architectural decisions										$20,000.00
Integration first phase										$56,000.00
System hard/software test										$14,000.00
Project documentation	$20,800.00	$23,920.00	$6,240.00							$52,000.00
Integration acceptance testing					$19,040.00	$22,400.00	$23,520.00	$2,240.00		$67,200.00
Total	$44,480.00	$49,680.00	$38,160.00	$34,160.00	$21,280.00	$22,400.00	$23,520.00	$2,240.00		$1,051,200.00

Hint: The default option in MS Project for cash flow is by week. You can generate a monthly cash flow statement by using the "Edit" function in the Custom option under Reports.

The project saved as a baseline file is contained in **CBP_P4_Baseline**.

1. *How much will the project cost?*

   The project is expected to cost $1,051,200.

2. *What does the cash flow statement tell you about how costs are distributed over the life span of the project?*

   Roughly half of the costs are expected to occur during the first seven months of a 26-month project, $545,840.

Instructors need to make sure that all the students are working off of the same schedule at this point in the exercises. In the past, we have made our schedule (**File: CBP_P4_Baseline**) available electronically so that students can make appropriate changes in the schedule they created at the end of Part 3.

Part 5

Your status report should include a table containing the PV, EV, AC, BAC, EAC, SV, CV, and CPI for each activity and the whole project. The report should also address the follow questions:

1. *How is the project progressing in terms of cost and schedule?*
2. *What activities have gone well? What activities have not gone well?*
3. *What do the PCIB and PCIC indicate in terms of how much of the project has been accomplished to date?*
4. *What is the forecasted cost at completion (EAC_f)? What is the predicted VAC_f?*
5. *Report and interpret the TCPI for the project at this point in time.*
6. *What is the estimated date of completion?*
7. *How well is the project doing in terms of its priorities?*

Try to present the above information in a form worthy of consideration by top management.

Include a Tracking Gantt chart with each report.

Students are asked to generate a series of quarterly reports to calculate and interpret performance indices associated with project progress. Note: There will be a tendency to rely heavily on the earned value statistics generated by the software. While these statistics provide valuable information with regards to costs they are less useful in terms of schedule. Students should be encouraged to assess actual and planned schedule to determine in "real time" how far ahead or behind the project is. The Tracking Gantt feature in MS Project is very useful for doing this.

The EAC_f or FAC (Forecasted cost at completion) can be found in the Earned Value Table as simply EAC.

The CPI and TCPI can be obtained from the Earned Value Cost Indicators Table.

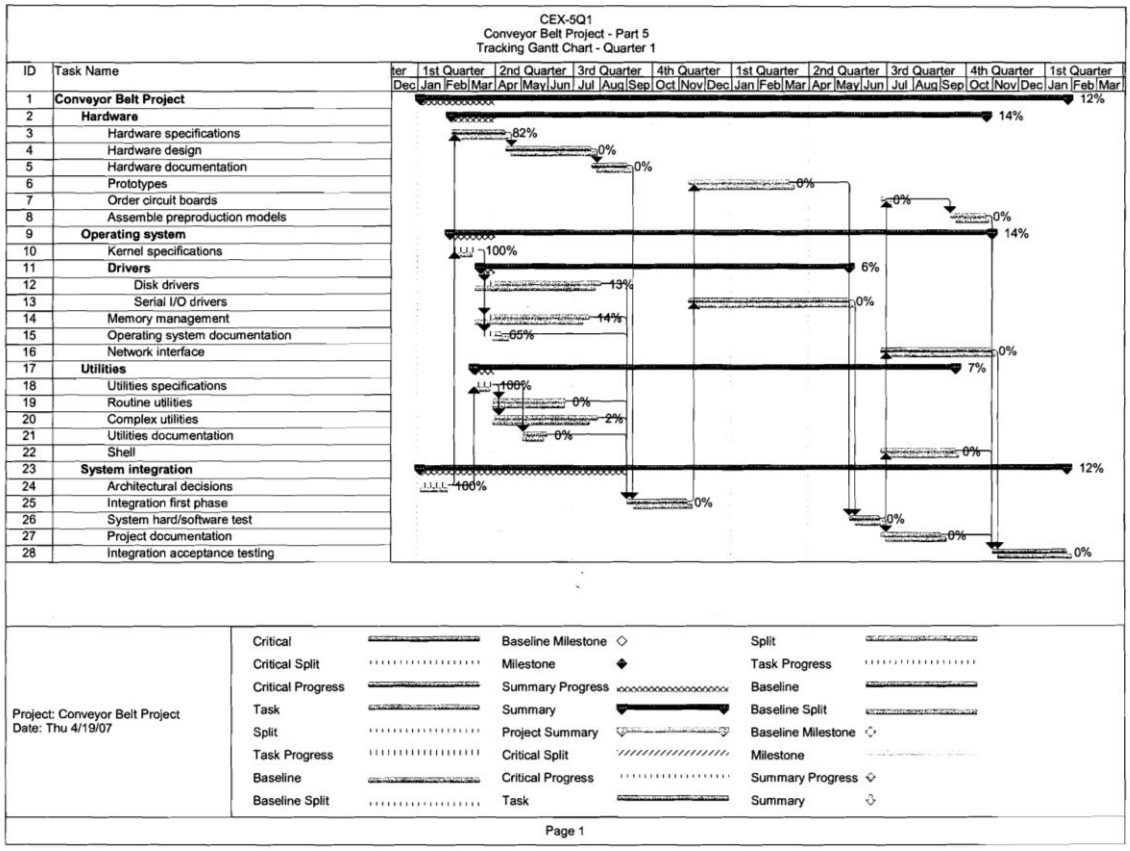
How many days ahead or behind the project can be obtained from the Variance Table.

Hint: Students should be told to enter the tracking information from the tables presented in the text from left to right. For completed activities, first enter the start date, then the finish date. For incomplete activities, first enter the start date, then the actual duration and lastly the remaining number of days.

A problem that sometimes occurs is that when a file is saved the current date and status report date is not saved and has to be re-entered! Note: We have observed this problem when using our **CBP_P5_Q2** file.

First Quarter, April 1, 2010 (File: CBP_P5_Q1)

While there are a variety of options for reporting status information, we recommend that students submit a report containing the "Tracking Gantt Chart" and an Earned Value Table. For this quarter only we have included an example of the Tracking Gantt chart (Figure CEX-5Q1). Note: Students will have to extract information from the latter and put it in a table form using the new acronyms.



1st Quarter	PV	EV	AC	SV	CV
4/1/10	$152,560	$155,981	$151,680	$3,421	$4,301

CPI	BAC	EAC_f	VAC_f
$1.03	$1,051,200	$1,022,215	$28,985

To date the project has accomplished $3,421 worth of work than planned and is currently 4 days ahead of schedule. The project is also slightly under budget (CV $4,301). We are currently getting $1.03 worth of work done for each dollar spent.

Despite starting one day late Hardware specifications was completed 4 days early at a savings of $5,591.

Kernel specifications is currently $4,000 over budget and is projected to be completed 5 days late. Operating system documentation is currently $4,160 under budget and is projected to take 5 days less than planned. Neither of these activities is on the critical path.

PCIB = 15% PCIC = 15%

After the first 3 months of the project it is approximately 15% complete.

EAC_f = $1,022,215 VAC_f = $28,985

If we continue to get 3 cents more on the dollar the project will be roughly $29,000 under budget.

TCPI = $.995

We can get 99.5 cents worth of work for each remaining dollar spent and still come in on budget.

Overall, the project appears to be doing quite well. We have managed to create a 4 day completion buffer as we head into the busiest time of the project. Although not as high a priority, cost savings are always appreciated.

Second Quarter, July 1, 2010 (File: CBP_P5_Q2)

2nd Quarter	PV	EV	AC	SV	CV
7/1/10	$489,200	$454,431	$470,720	-$34,769	-$16,289

CPI	BAC	EAC_f	VAC_f
$0.97	$1,051,200	$1,088,879	-$37,679

The project has both a negative cost and schedule variance. Since the schedule variance indicates that $34,000 of scheduled work has not been completed as planned one would conclude that the project is behind schedule. In fact, work along the critical path has gone well and the project is 7 days ahead of schedule! Hardware design started 4 days early and is expected to be completed 3 days earlier than planned. The negative schedule variance is a function of delays in non-critical activities, most notably Disk drivers (SV – $14,560) and Routine utilities (SV -$15,951). The key question is whether any of the delays in non-critical tasks will exceed the slack available and become critical.

When the Late Start is compared with the Actual Start of the non-critical activities, one discovers that while slack has been absorbed none of the late activities have become critical. This is an important lesson to be learned from interpreting Schedule Variance!

When assessing the impact of the delay in the start of Routine utilities (4/26/10), the students should point out if all goes according to plan that this should not delay the project since this activity has a Late Start of 6/15/10.

In terms of cost, Hardware is below budget while Operating system and Utilities are over budget. The biggest cost over-run is with Disk drivers which is roughly $8,000 over budget. We are only getting 97 cents worth of work for each dollar spent.

Students should also point out that Kernel specifications took 5 days longer than planned which delayed the start of Memory management and Disk drivers.

PCIB = 43% PCIC = 43%

After 6 months the project it is approximately 43% complete.

EAC_f = $1,088,879 VAC_f = -$37,679

If we continue to get 3 cents less on the dollar the project will be roughly $38,000 over budget.

TCPI = $1.03

We need to get an extra 3 cents of work for each dollar spent to come in within budget.

Overall, the project appears to be doing well. We have managed to extend the 4-day completion buffer to 7 days which is good given the importance of completing on time. The project went from being under to over budget during the second quarter. Cost containment needs to be monitored.

Third Quarter, October 1, 2010 (File: CBP_P5_Q3)

3rd Quarter	PV	EV	AC	SV	CV
10/1/10	$599,440	$609,520	$631,600	$10,080	-$22,080

CPI	BAC	EAC_f	VAC_f
$0.97	$1,051,200	$1,089,280	-$38,080

The project has a positive schedule variance and is 10 days ahead of schedule. Hardware continued to get work done quicker than planned with Hardware documentation being completed 3 days earlier than planned. At the same time all the non-critical activities preceding Integration first phase were completed prior to its scheduled start though in several cases these activities took longer than planned. Most notably Disk drivers, Memory management, Routine utilities, and Complex utilities took between 5 and 15 days longer than planned.

The cost variance is -$22,080 and we continue to get 97 cents worth of work for each dollar spent. Hardware was under budget while both Operating system and Utilities were over budget. Disk drivers was $11,200 over budget and Complex utilities was $8,400 over budget.

The PCIB is 58%. The PCIC is 58%.

Approximately 58% of the project has been completed by the end of the third quarter.

EAC_f = $1,089,280 VAC_f = -$38,080

The TCPI is $1.05.

The project continues to go well. After nine months with approximately 58% of the work completed, the project is ten days ahead of schedule and has modest cost over-runs. Of particular note is that cost over-runs did not expand during the third quarter.

Fourth Quarter, January 1, 2011 (File: CBP_P5_Q4)

4th Quarter	PV	EV	AC	SV	CV
1/1/11	$685,120	$691,634	$721,200	$6,514	-$29,566

CPI	BAC	EAC_f	VAC_f
$0.96	$1,051,200	$1,096,137	-$44,937

Despite the positive schedule variance the project is now 18 days behind schedule! Even though the critical Serial I/O drivers activity started 5 days early, it is projected to be 18 days late. The positive SV is due to Prototypes which is projected to be completed 2 days earlier than plan.

We continue to have a negative cost variance with a slight decline in CPI from $0.97 to $0.96.

EAC_f = $1,096,137 VAC_f = $44,937 over budget

PCIB = 66% PCIC = 66%

After one year, two-thirds of project is completed.

TCPI = $1.09

With less opportunity to make up for cost over-runs, we need to earn $1.09 worth of work for each dollar spent to meet our budget.

For the first time the project appears to be in serious trouble with one-third of the work remaining and a projected 18 days completion delay. We need to investigate opportunities to get back on schedule.

Part 6

The project has been underway for one year and now the students are asked to make projections about the final completion of the project.

The file is **CBP_P6**.

The revised estimates to completion are included in Figure CEX-6 in terms of costs and schedule.

1. *What is the new EAC for the project? How long should the project take given these revised estimates?*

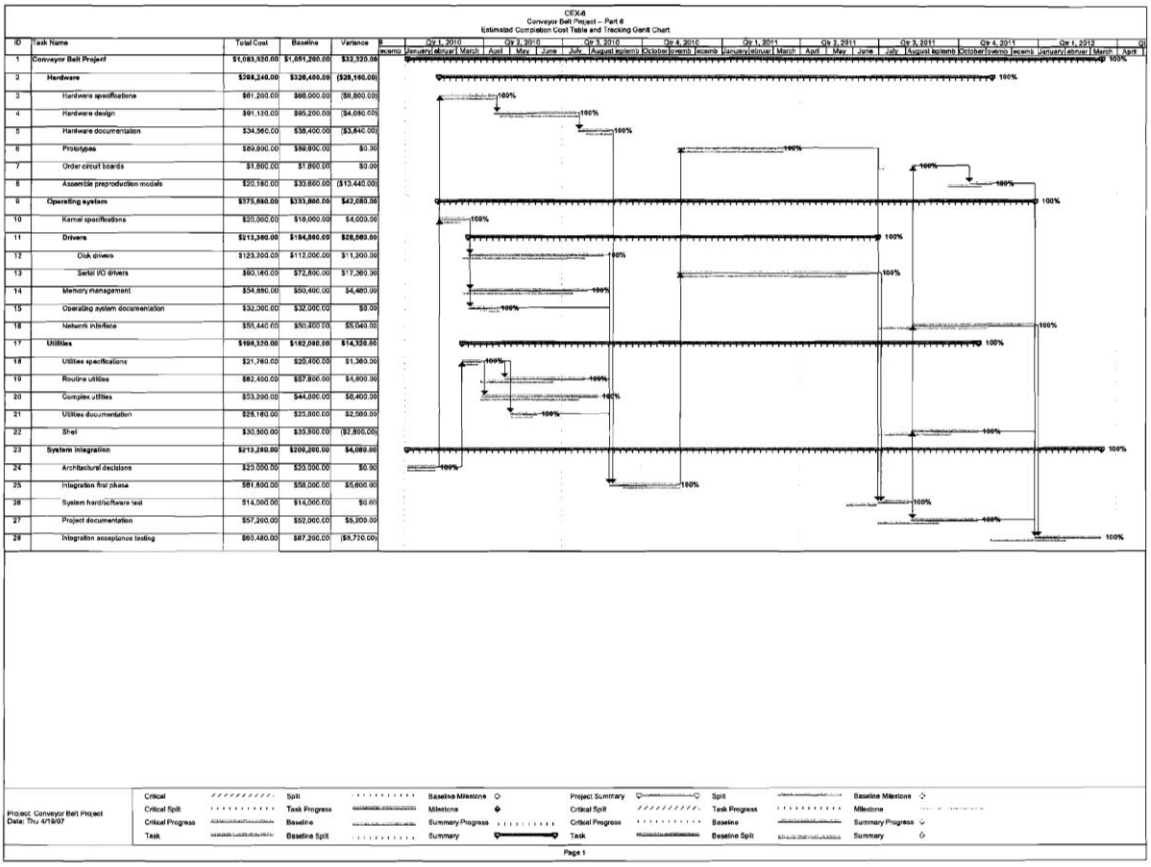
   The project is expected to cost $32,320 more than budgeted and be completed 29 working days late! The estimated completion date is 3/14/12.

2. *How happy will top management be with these forecasts given the priorities of the project?*

   Top Management will not be happy!

3. *What recommendations would you make?*

   Some students will say look for another job! Seriously, the question is directed at the project not the project manager! Students should contact the project sponsor and inform him/her of their estimations. They can look at options for accelerating the remaining activities, but with only one-third of the project remaining this may be difficult and risky to do. We recommend stressing the importance of reshaping the expectations of significant stakeholders. Key people need to be informed of the likely delay so they can take appropriate action.



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