**Group 8 Project**

Project Description

The new software-controlled conveyor belt is an exciting project that moves and positions items on a conveyor belt with a high degree of accuracy (< 1 millimeter of error). The proposed project will produce a new system capable of automating the movement of a wide variety of warehouse materials commonly used in order fulfillment. The following information has been developed for you to use in completing the exercises.

Assumptions and Notes

A seven-day workweek is used for the whole year. No holidays.

An 8-hour workday or 56-hour workweek is used. Overtime is not allowed.

The project should start on January 1 of the next year.

No splitting of activities is allowed.

No partial assignments are allowed (i.e. 50%). All resources must be assigned 100%.

Resources of a particular type have identical capabilities and may be substituted for each other. Hence, when working with resource type having multiple people, please create a single project resource listing (e.g. “Design”) and assign the resource a percentage value corresponding to the number of people (e.g. 200% for two people). Similarly, when working with resource types having a single person, create a single project resource listing and assign it a value of 100% to indicate a single person.

Activity durations are fixed meaning adding resources to an activity does not decrease the duration of the activity.

Table 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Activity** | **Description** | **Resource Type** | **Duration (days)** | **Preceding Activity** |
| 1 | System architecture | Design | 40 | - |
| 2 | Hardware specifications | Development, design | 50 | 1 |
| 3 | Kernel specifications | Design | 20 | 1 |
| 4 | Utilities Specification | Development, design | 25 | 1 |
| 5 | Hardware Design | Design, development | 70 | 2 |
| 6 | Disk drivers | Assembly, development | 90 | 3 |
| 7 | Memory management | Development | 75 | 3 |
| 8 | Operating system documentation | Design, documentation | 15 | 3 |
| 9 | Routine utilities | Development | 60 | 4 |
| 10 | Complex utilities | Development | 90 | 4 |
| 11 | Utilities documentation | Documentation, design | 10 | 4 |
| 12 | Hardware documentation | Documentation, design | 10 | 5 |
| 13 | Integration first phase | Assembly, development | 35 | 6,7,8,9,10,11,12 |
| 14 | Prototypes | Assembly, development | 65 | 13 |
| 15 | Serial I/O drivers | Development | 80 | 13 |
| 16 | System hard/software test | Assembly | 20 | 14, 15 |
| 17 | Order printed circuit boards | Purchasing | 5 | 16 |
| 18 | Network interface | Development | 25 | 16 |
| 19 | Shell | Development | 25 | 16 |
| 20 | Project documentation | Documentation, development | 25 | 16 |
| 21 | Assemble preproduction | Assembly, development | 15 | 17, lag 5 days\* |
| 22 | Integrated acceptance test | Assembly, development | 20 | 18, 19, 20, 21 |

\* Task 21 cannot begin until 5 days after task 17 has been completed

Table 2

|  |  |  |
| --- | --- | --- |
| **Resource Type** | **Number Available to Work on Project** | **Cost ($/hr)** |
| Design | 2 | $175 |
| Development | 2 | $110 |
| Documentation | 1 | $75 |
| Assembly/Test | 1 | $65 |
| Purchasing | 1 | $50 |

Part 1c Question 1 (30 points)

**Do not include resource assignments in your answer to Question 1. Only include activities, activity durations and dependencies.** When entering task information in Question 1, please make sure the schedule mode is set to “Manually Scheduled” instead of “Auto Scheduled” as in Figure 1. Schedule mode may be set using the “Task Information” dialog or via the “Manually Schedule” button on the “Task” ribbon. Also, please make sure the “Level Manually Scheduled Tasks” check box in the “Resource Leveling” dialog box is deselected as in Figure 2. Leveling options may be viewed using the “Leveling Options” button in the “Resource” ribbon. Both are the default settings in MS Project 2019; however, if you’ve used project for other purposes, the default settings may have been adjusted.

A screenshot of a computer

Description automatically generated A screenshot of a software project

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**Figure 1 – Initial Task Information Dialog Figure 2 – Initial Resource Leveling Dialog**

a. Create the project described in table 1 in Microsoft Project and paste a screenshot of the bar (Gantt) chart of the project highlighting the critical path below. Please make sure all tasks are clearly labeled with their corresponding task name. Your Gantt chart should also include a summary task. DO NOT INCLUDE THE RESOURCE ASSIGNMENTS LISTED IN THE THIRD COLUMN OF TABLE 1.

**Critical Path in Gantt Chart:**

A screen shot of a computer

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b. Include a screenshot out of early start, late start, early finish, late finish, total slack and free slack in table form. The screenshot provided should also include a summary task for the project.

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c. How many days will the project take to complete?

The project will take **350 days** to complete.

d. What is the scheduled finish date?

The scheduled finish date is **Tue 16-12-25.**

e. What percent of project activities are on the critical path?

Total activities = 22

Activities on critical path = 13

Percent of total activities: 13/22 \* 100 = **59.09%**

f. What activity has the most total slack? What activity has the most free slack? Explain the difference between free slack and total slack.

**Activity having the most total slack:** Task 8 (Operating System Documentation)

**Activity having most slack:** Task 8 (Operating System Documentation)

**Free Slack:**

Free slack refers to the amount of time an activity can be delayed without delaying the start of any subsequent activities. In other words, it is the time buffer that won’t affect dependent tasks. Delaying an activity by its free slack will not impact any other task in the project schedule.

**Total Slack:**

Total slack is the amount of time an activity can be delayed without delaying the project’s overall completion date. It represents the total flexibility available before the delay affects the project's finish.

g. What is the total slack for the project as a whole? Use the summary task to help answer this question.

Summary task shows 0 total slack for the project as a whole, indicating there is no room for delay in this project.

h. Is it better to have a higher percentage of activities on the critical path or a lower percentage of activities on the critical path? Explain your answer.

The critical path is the sequence of activities that determines the minimum project duration. Activities on the critical path have zero total slack.

It is generally better to have a **lower percentage** of activities on the critical path in a project.

A lower percentage of of activities on the critical path means more tasks have slack, giving the team more flexibility to avoid delays.

Fewer critical path activities reduce the overal risk to project completion.

With fewer critical path activities, the project manager can focus resources and attention on key tasks that truly impact the project timeline.

Part 1c - Question 2 (30 points)

Using the project you created in question 1, assign resources to perform each activity. The project is limited to the resources listed in Table 2. All scheduled activities must include a list of resource commitments.

a. After assigning resources, what is the cost of the project?

Cost of the project: **$1,161,400.00**

b. Which, if any, of the resources are over-allocated? List the resources that are over-allocated.

Overallocated Resources:

Design

Development

Documentation

c. Assume overallocations are calculated on a week by week basis. For each over-allocated resource, by how many hours is the resource type overallocated? Your answer should be a single number for each overallocated resource type. For example, if Purchasing is overallocated, you need to determine by how many hours it is over-allocated and provide the answer (e.g. Purchasing is over-allocated by 50 hours over the life of the project).

Design: 264 hours over the life of the project

Development: 2096 hours over the life of the project

Documentation: 72 hours over the life of the project

d. Assume overallocations are calculated on a week by week basis. How many weeks of the project have overallocated resources? This part of the answer should be a single number. For example, if 10 weeks of the project have overallocated resources, you should answer 10. List each week of the project with overallocated resources.

|  |  |
| --- | --- |
| 1 | W7 |
| 2 | W8 |
| 3 | W9 |
| 4 | W10 |
| 5 | W11 |
| 6 | W12 |
| 7 | W13 |
| 8 | W14 |
| 9 | W15 |
| 10 | W16 |
| 11 | W17 |
| 12 | W18 |
| 13 | W19 |
| 14 | W20 |
| 15 | W21 |
| 16 | W22 |
| 17 | W23 |
| 18 | W24 |
| 19 | W47 |
| 20 | W48 |

e. Try to resolve the over-allocation problems without extending the duration of the project using the resource leveling feature of MS Project. To level resources without extending the duration of the project, make sure the check boxes for “Level only within available slack” and “Level manually scheduled tasks” are both selected. Also, assume “Leveling can adjust individual assignments on task”, “Leveling can create splits in remaining work”, and “Level resources with the proposed booking type” are deselected. See Figure 3 for the correct leveling settings? Which, if any, of the over-allocated resources are no longer over-allocated? Which, if any, of the resources are still over-allocated?

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**Figure 3 – Resource Leveling Dialog for question 2d**

Overallocated resources which are no longer overallocated:

Documentation

Overallocated Resources:

Design

Development

f. Include a Gantt chart and schedule table after leveling only within available slack. Please include a summary task and make sure all tasks are clearly labeled with their corresponding task name.

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g. What is the impact of leveling within slack on the percent of project activities on the critical path?

Percent of project activities on the critical path before levelling = (13/22)\*100 = 59.09%

Percent of project activities on the critical path after levelling = (18/22)\*100 = 81.82%

Difference of percentage = 22.73%

Since the percentage has increased, leveling within slack has pushed more tasks on the critical path, reducing flexibility.

h. Assume you cannot add additional resources and the project is resource constrained. How many days will the project take after resolving all overallocation problems? What is the scheduled finish date?

See Figure 4 for the correct leveling settings. After leveling your project, change the scheduling mode for all tasks to “Auto Schedule” and review all tasks in the project to ensure no problems exist.

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**Figure 4 – Resource Leveling Dialog for Question 2g**

**After resolving all allocation problems, project takes 503 days.**

**Scheduled finish date: Mon 18-05-26**

i. How does the schedule in 2g compare to the schedule in Question 1? Why did the number of days to complete the project in 2f increase?

Question 1 schedule = 350 days

Question 2 schedule = 503 days

The project duration increased by 153 days.

Reasons:

1. Resource constraints: In question 1, schedule was created disregarding resource availability.
2. Resource leveling: Leveling adjusted the schedule to ensure no resources were overallocated, which involves delaying tasks that are sharing same resources.

j. What is the total cost of the project after resolving all over-allocation problems in step 2f? How does this cost compare with the cost in 2a?

**Cost before =** **$1,161,400.00**

**Cost after = $1,161,400.00**

Total cost remains the same after resolving over-allocation problems. Total hours for each resource is constant, just spread over longer periods.

k. Fill in the details in the table below with the number of hours worked by each resource type over the life of the project and the total cost for each resource type over the life of the project. Which resource type has the greatest cost? What is the formula for calculating the total cost of a resource type?

|  |  |  |
| --- | --- | --- |
| **Resource Type** | **Total Hours Worked Over the Life of the Project** | **Total Cost** |
| Design | 1920 | $336,000.00 |
| Development | 6000 | $660,000.00 |
| Documentation | 480 | $36,000.00 |
| Assembly/Test | 1960 | $127,400.00 |
| Purchasing | 40 | $2,000.00 |

Group Presentation to Class (7.5 points)

The day the assignment is due, be prepared to present any one of the answers above to the class. You do ***not*** need to prepare a PowerPoint and should instead be prepared to use your Microsoft Word solution file and/or your Microsoft Project file to help answer the question. I will ask questions to each group that presents and you will be graded using Peer Exchange on both the answer to the homework question and your answers to my questions.

Individual Feedback on Presentations (7.5 points)

The day the assignment is due, be prepared to provide feedback on every group that presents. You will be graded on the helpfulness of your feedback.

Part 1c – Team Member Contributions (0 to -100)

List and briefly describe the contribution of each team member on this assignment. The description should be one or two sentences at most.

Eshan: Q1 parts a-d

Jess: Q1 parts e-h

Jay: Q2 parts a-c

Kamen: Q2 parts d-f

Harsh: Q2 parts g-k