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Task Prioritization Rules For Project Execution

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ABSTRACT

This paper provides a substantially better way to prioritize the tasks within a multi-project environment than the one currently advocated by Critical Chain Project Management and used by its practitioners. This new method differs from the currently accepted method on two grounds. Firstly, it results in significantly high probability of achieving a faster project completion, and secondly, it makes the task priority signals far more objective and easy to derive. The author uses a computer simulation to check 970987 possible cases of a resource conflict occurring within a project and compares the resulting lead-time from the generally accepted task prioritization method of CCPM and the proposed new rule of task prioritization within a project.

Keywords: Multi-project environment, task prioritization, Critical Chain Project Management(CCPM), feeding buffer, buffer based priorities, resource conflicts.

1.INTRODUCTION

Resource conflicts are extremely common occurrence within any multi project environment. Even after completely eliminating all possible resource conflicts using resource leveling during the project-planning phase, reasonable common cause variation (uncertainty, or statistical fluctuations) can result in resource conflicts from time to time during execution phase. Project managers normally lack any objective decision making criteria in such situations and generally rely on their experience or other subjective criteria to make decision in such cases. CCPM provides an objective decision making rule in such situations. Fundamentally it advocates that a task on critical chain always gets higher priority than all other tasks of the project. For two or more tasks occurring on feeding chains, it advocates looking at the ratio of feeding buffer consumption percentage to chain completion percentage of the contesting feeding chains (assuming conflicting tasks are on feeding chains) and giving higher priority to the task with higher ratio.

2. PRIORTISING TASKS IN A SINGLE PROJECT ENVIRONMENT USING CCPM

In most of the literature on CCPM, e.g., Critical Chain (1997), Newbold (1998), Simpson and Lynch (1999), Homer (1998), and Leach (1999) have advocated dividing the various possible combinations of feeding buffer consumption percentage and chain completion percentage into three zones of Red, Yellow and Green. If the conflicting tasks occur on chains, which are in different color zones, the task in the red chain gets higher priority over the task in the yellow chain, which in turn gets higher priority over the task in the green chain. If the two tasks occur on the chains, which are in the same color zone, CCPM, at best, says that doing any task first is equally acceptable.

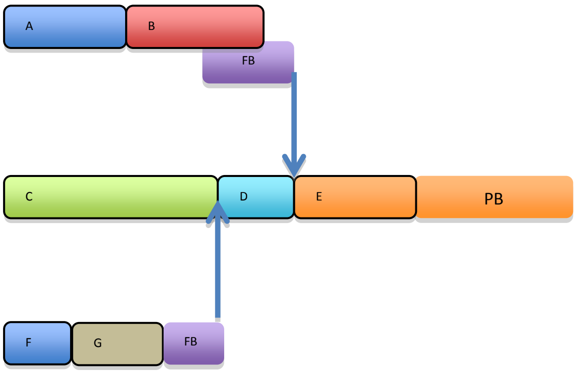

Figure 1: Sample Project network

For example, if a project network as shown in figure 1, has Task A and Task F which are to be done by the same resource, CCPM recommends following procedure.

a. Calculate the expected remaining duration of each of the chains on which the two tasks lie.
b. Calculate the buffer duration available for each chain based on the remaining duration calculated in step 1.
c. Compute the ratio '% Buffer Consumption=(Planned buffer duration – Buffer duration available)/Planned buffer duration.
d. Also compute the ratio '% Completion=(Planned chain duration – Remaining chain duration)/Planned chain duration.
e. Plot the value of the two ratios on the fever chart shown below.
f. Divide the fever chart into 3 zones of Red, Yellow and Green as shown in figure2.
g. All the tasks of the respective chains get the color of the band where the point corresponding to the % Buffer Consumption and % Completion lies on the fever chart.
h. The task priority of task to be followed is red, yellow and green in that order.

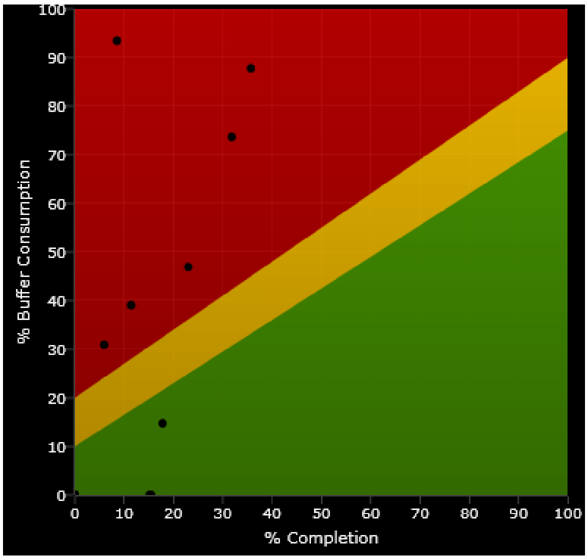

Figure 2: A fever chart

There are several critiques to the above methodology. Tzvi Raz, Dov Dvir and Robert Barnes (2003) say that buffer penetration, is defined as the amount of time running from the original start date of the buffer on the critical chain or one of the feeding chains, as appropriate, to the projected end date of the last task on the corresponding chain. The projected dates are based on estimates of the 'duration left' for the tasks. The estimation of how much work remains to be done is also subjected to inflation by safety margins – the very same problem CCPM attempted to solve by using buffers. Moreover, the estimate of 'duration left' is highly subjective, and varies significantly for different people involved with the same project. This gives rise to lot skepticism and lack of confidence for the task priorities derived by this algorithm in the members of the project team.

3.1 RULE BASED ON INTEGRATION POINT POSITION FOR SINGLE PROJECTS

The rule that was found to give much better results than the above mentioned CCPM task prioritization rule is as follows.

If the two conflicting tasks occur on two feeding chains, which integrate with the critical chain at two different points, then the task on the feeding chain, which integrates earlier with the critical chain, gets higher priority over the task in the chain that integrates later with the critical chain. If the two conflicting tasks occur on two feeding chains, which integrate at the same point with the critical chain, then doing any task first is equally acceptable.

3.2 THE SIMULATION INVOLVING A SINGLE PROJECT

In order to check the difference in the resulting project lead-time by following the above two rules, the following assumptions are made.

a. There will be no other resource conflict in the project other than the one under consideration. This assumption is valid because CCPM methodology demands removal of almost all the resource conflicts during the project-planning phase.
b. The conflicting tasks occur on two different feeding chains integrating at two different points on the critical chain.

With these two assumptions, a project network, whose results can be impacted by the two different decision-making rules, can be made as follows:

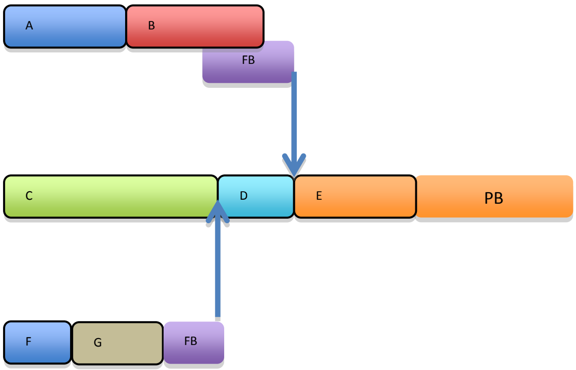

Figure 3: Project network used in the simulation

Figure 3 illustrates the project network used for simulating the lead times achieved by following the two different task priority rules. Task A and Task F are to be done by the same resource and there is a conflict of priority. By checking the different possible durations of each of the task and chain in the project network, the impact of the two different decision-making rules, in all the possible situations can be studied. In other words, this is the most generalized project network to study the impact of the decision-making rules under consideration.

The following sets of conditions are studied.

a. When task A and task F are in same color band
b. When task A is in Red and task F is in Yellow or Green & when task A is in Yellow and task F is in Green

For all the above cases, the buffer consumption based priority rule can give opposite priority to the integration point position based priority rule.

Since the critical chain completion percentages for both the chains are 0%, it is assumed that 0% to 10% buffer consumption is Green band, 10% to 20% buffer consumption is Yellow band and 20% and higher is Red band (CCPM suggests to keep the color bands biased towards red zone for smaller chain completion percentages).

THE RANGE OF TASK DURATIONS STUDIED IN THE SIMULATION

Task A – 1 to 21 days
Chain B – 10 to 100 days in steps of 3
Chain C – 10 to 100 days in steps of 3
Chain D – 10 to 100 days in steps of 3
Task F – 1 to 21 days
Chain G – 10 to 100 days in steps of 3

For the 647501 cases found where both task A and task F were in the same color band, the following is the frequency distribution of percentage difference in the lead time of project by following the buffer priority rule and the integration point position based priority rule was observed.

Upper Limit	Frequency
-10	4
-8	11
-6	48
-4	92
-2	241
0	571911
2	22587
4	20465
6	13614
8	8309
10	4533
12	2747
14	1416
16	695
18	431
20	248
22	100
24	33
26	16

Figure 4: Frequency distribution of difference in project lead times for cases where both task A and task B are in the same color band.

In figure 4, upper limit of -10 and frequency 4 means that there were 4 cases found where the integration point position based priority rule gave a longer lead time by 10% to 12% of buffer priority rule. Similarly Upper limit of 26 and frequency 16 means that there were 16 cases found where the integration point position based priority rule gave a shorter lead-time by 24% to 26%

For the 323486 cases found where task A and task F were in the different color band and the two rules gave opposite result, the following is the frequency distribution of percentage difference in the lead time of project by following the buffer priority rule and the integration point position based priority rule was observed.

Upper Limit	Frequency
-8	33
-6	62
-4	140
-2	399
0	287352
2	13289
4	9339
6	5843
8	3203
10	1758
12	936
14	537
16	273
18	150
20	108
22	37
24	23
26	3
28	1

Figure 5: Frequency distribution of difference in project lead times for cases where task A and task B are in the different color band.

It looks very clear from the above result that both the probability of achieving a lower lead time & magnitude of the reduction in lead time, is favorable in the case of following an integration point position based priority rule rather than the rule currently advocated by CCPM.

4. PRIORTISING TASKS IN A MULTI-PROJECT ENVIRONMENT USING CCPM

In the case when the conflicting tasks occur on feeding chains of two different projects, *the available literature on Critical Chain Project Management is not very explicit of the rule to be followed*. The author's experience with many CCPM software show that most of them do task prioritization with following methodology.

a. Color the tasks on the critical chain of the project with dark red, dark yellow or dark green based on the zone in which the %Buffer Consumption and % Completion of critical chain lie on the fever chart.

b. Color the tasks on the feeding chains of the project with light red, light yellow and light green based on the zone in which %Buffer Consumption and % Completion of individual feeding chains lie on the fever chart.

c. The tasks are then prioritized in the order of dark red, dark yellow, dark green, light red, light yellow, light green.

Some software, while doing the above steps, keep the position of the feeding buffers fixed all throughout the execution of the project irrespective of the status of the critical chain, while other keep the position of the feeding buffers floating along the timeline depending upon the updated status of the critical chain. Some software completely ignore the status of the feeding buffer in case a feeding chain starts to intrude into the project buffer and color the feeding chains dark red, dark yellow or dark green depending on the incursion of feeding chain into the project buffer, while others always look at feeding buffer status to color the feeding chains.

All the above task prioritization methods inevitably lead to situations when tasks of different projects get mixed up with each other. That means that one resource can have task of project A as the highest priority task and task of project B as lower priority task whereas another resource can have task of project B as the highest priority task and task of project A as lower priority task. Also, a resource can have one task of Project A as highest priority task, then a task of project B and then again another task of project A. These situations are completely counter conducive to achieve synchronization of different resources and inevitably leads to inflation of project lead times.

4.1 RULE BASED ON PROJECT PRIORITY FOR MULTIPLE PROJECTS

The task prioritization rule that was found to give much better results than the above-mentioned CCPM rule is as follows. Priority of tasks of two or more projects should never be mixed up. That means that if one task of a project A has higher priority than another task of project B, then all the tasks of project A must have higher priority than all the tasks of project B for all the resources.

4.11 THE SIMULATION WITH TWO PROJECTS

In order to check the difference in the resulting project lead-time by following the above two rules, the following assumptions are made. There will be no other resource conflict in the project other than the one under consideration. This assumption is valid because CCPM methodology demands removal of almost all the resource conflicts during the project-planning phase.

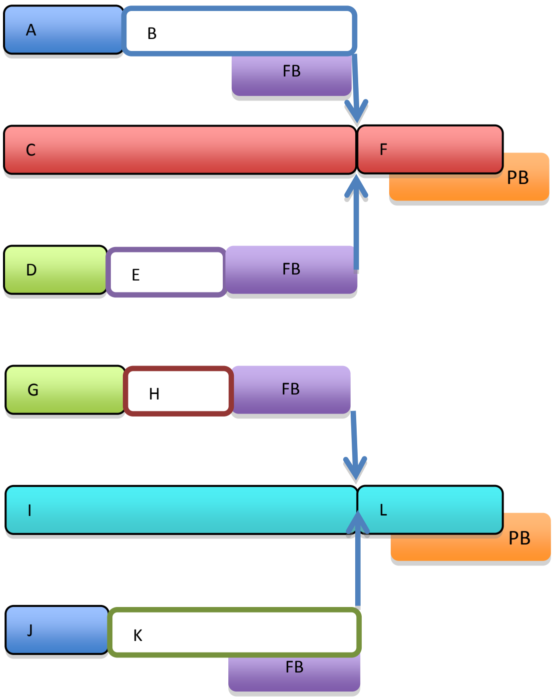

Figure 6: Project network used in simulation

Figure 6 illustrates the two project networks used for simulating the lead times achieved by following the two different task priority rules. Task A and Task J are to be done by the same resource and there is a conflict of priority. Similarly, Task D and Task G are to be done by a different resource and there is a conflict of priority. By checking the different possible durations of each of the task and chain in the project network, the impact of the two different decision-making rules can be studied.

The conditions when task A and task J both are in light red color band is studied. In this situation, either the buffer color priority system will mix the tasks of the two projects (if other tasks are of light yellow or light green) or it will be neutral towards doing any task in preference to any other (if other tasks are also of light red color).

THE RANGE OF TASK DURATIONS STUDIED IN THE SIMULATION

Task A – 3 to 8 days
Chain B – 3 to 8 days
Chain C – 3 to 8 days
Task D – 3 to 8 days

Chain E – 3 to 8 days
Task G – 3 to 8 days
Chain H – 3 to 8 days
Chain I – 3 to 8 days
Task J – 3 to 8 days
Chain K – 3 to 8 days

For the 1498 cases found where both task A and task J were in the red color band, the following is the frequency distribution of percentage difference in the lead time of project by following the buffer priority rule and the integration point position based priority rule was observed.

Upper Limit	**Frequency**
-4	**9**
-2	**0**
0	**61**
2	**0**
4	**0**
6	**285**
8	**0**
10	**477**
12	**30**
14	**357**
16	**145**
18	**97**
20	**34**
22	**3**

Figure 7: Frequency distribution of difference in project lead times for simulation involving the two projects.

In figure 7, upper limit of -4 and frequency 9 means that there were 9 cases found where the integration point position based priority rule gave a longer lead time by 6% to 4% of buffer priority rule. Similarly Upper limit of 22 and frequency 3 means that there were 3 cases found where the integration point position based priority rule gave a shorter lead-time by 20% to 22%.

5.CONCLUSION

The integration point position based priority rule & the rule of never mixing up tasks of different projects while prioritizing, gives a better result than buffer priority rule in far more number of cases. Also, the quanta of benefits are more for the rules compared to the buffer priority rule. Since project environments are known to be highly uncertain and variations in task lead times is quite common, a rule that is more likely (higher probability) to give a better result must be followed even though in a certain particular case, some other rule seems to give a better result. Since the new rules have higher probability of giving a shorter lead-time for a project, these rules should be preferred over the current buffer based task prioritization rule.

6. MANAGERIAL IMPLICATIONS

The new rules of task prioritization, as proposed in this paper, especially the rule for task prioritization within single projects based on the position of integration point, apart from the obvious effect of shortening the project lead time, will drastically improve the acceptability of the change within the project team and save invaluable time which would have otherwise been spent on resolving conflicts occurring due to a flawed rule and the subjectivities involved in its method of calculation. The second rule of task priorities in multiple projects, based on the project priority, simplifies the task priority calculations, makes them more intuitive and easy to follow for everyone involved.

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