The Problem with Dangling Activities

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Lee J. Hobb has raised an important issue in project scheduling in his Executive Article, "There's More than Carrots Dangling Here," (Cost Engineering, May 2004, produced by AACE International, pp. 7-8). He cites an article by Alan Hurst where the claim is made that "…failure to tie any activity by its start and finish terminuses is 'per se' improper CPM technique." Following on, Mr. Hobb explains what is meant is that it is a "*per se* flawed network because there is no way for the untied start or finish of that activity (and the duration) to be related to the overall network.

Mr. Hurst is taking into account the possibility, even the probability, that we do not know the activities' durations with certainty. Mr. Hurst is explaining that, without ties to activities' start and finish points, a change in duration of an activity is not transmitted correctly to any other successor without manual intervention. He is pointing out that the schedule must reliably compute the correct dates and critical paths when durations change, as they will, not only when durations are fixed.

We all know that on day 1 of the project some duration changes. That is what status meetings are all about. We also know that the critical path may change as the project proceeds. A result of these status meetings is the change, from the baseline schedule, in durations with their impact on the rest of the project.

Correctly reflecting the impact of changed durations without making manual changes to the schedule is much better than having to go in and fix the schedule by hand. Of course, uncertainty in activity durations in real projects is precisely the point of schedule risk analysis where the possibility of different durations in real projects is explicitly considered.

Simply put, if the schedule does not calculate the right completion dates and critical path when durations change, it is "*per se* improper scheduling technique." Mr. Hobb does not focus on this point since he assumes deterministic or static activity durations that are known with certainty. More realistically, however, if you believe that the durations of future activities cannot be known with certainty, Mr. Hurst's principles become obvious and compelling.

Take Mr. Hobb's Case No. 1, where the activities are linked with start-to-start logic. Both the predecessor, "Design" in the figure below, and the activity, "Draft," are dangling activities because they are linked only by start-to-start logical relationships. Let us see what happens when either the predecessor or the activity itself are delayed, perhaps because of external risk factors, lower productivity than planned, poor understanding of the difficulty of the task, lack of proper resources or other common

factors that threaten the duration. To clarify this exercise, let us assume we are making widgets, and we need to design them, draft the designs and build them. There can be some overlap but there are some imperatives that are ignored in the schedule of Figure A.

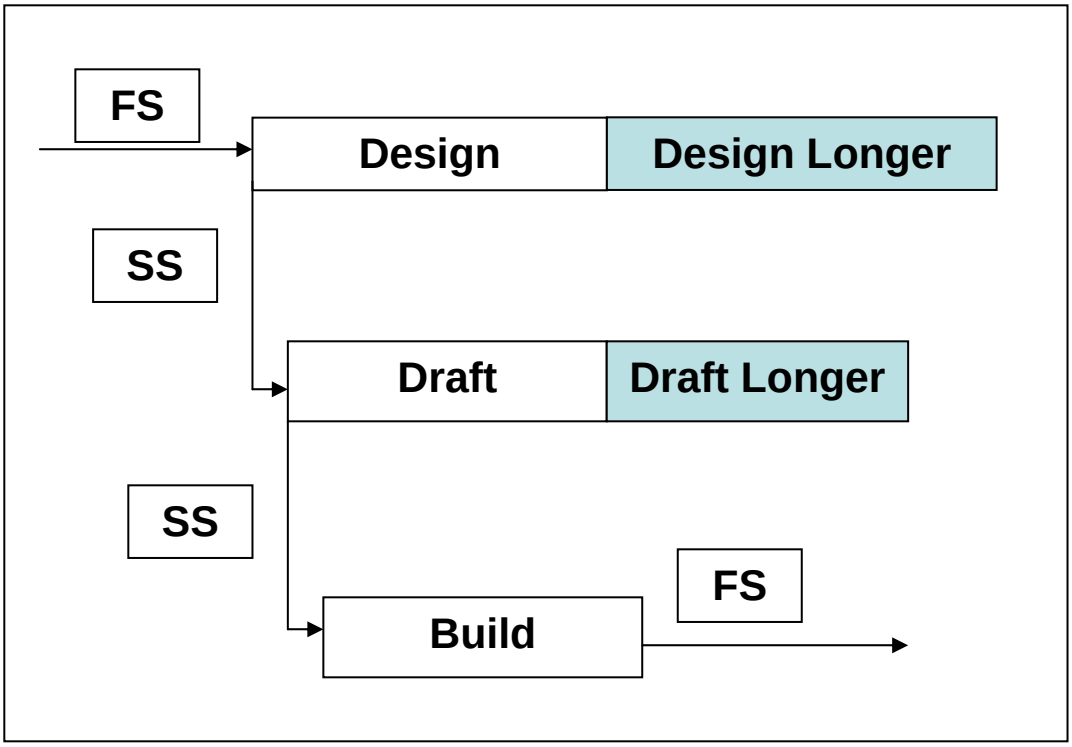

Figure A – Lengthening of S-S Danglers

From the example above, the extra duration on Design widgets or Draft widgets is not transmitted to any other activity, unless they extend beyond the finish date of the entire project. The software does not know that "Build" cannot finish before "Draft," which cannot complete before "Design." These are just words to the software. In this schedule, however, we have the illogical situation that building the widgets completes before drafting the widget designs, which, itself, completes before the widget design is completed. This will not happen in the real project, but it will happen with dangling activities in this schedule.

Take Mr. Hobb's Case No. 2, with the activity and successor dangling because they have finish-to-finish logic relationships. Here again, lengthening the duration of the Draft activity and the Build successor has the potential of being ignored by the schedule (but not by the project where real damage can be caused) because of lacking links to their starts. Again the culprit is changes in durations, although this may not be as bad as in Case No. 1 if, say, the activities have actual starts.

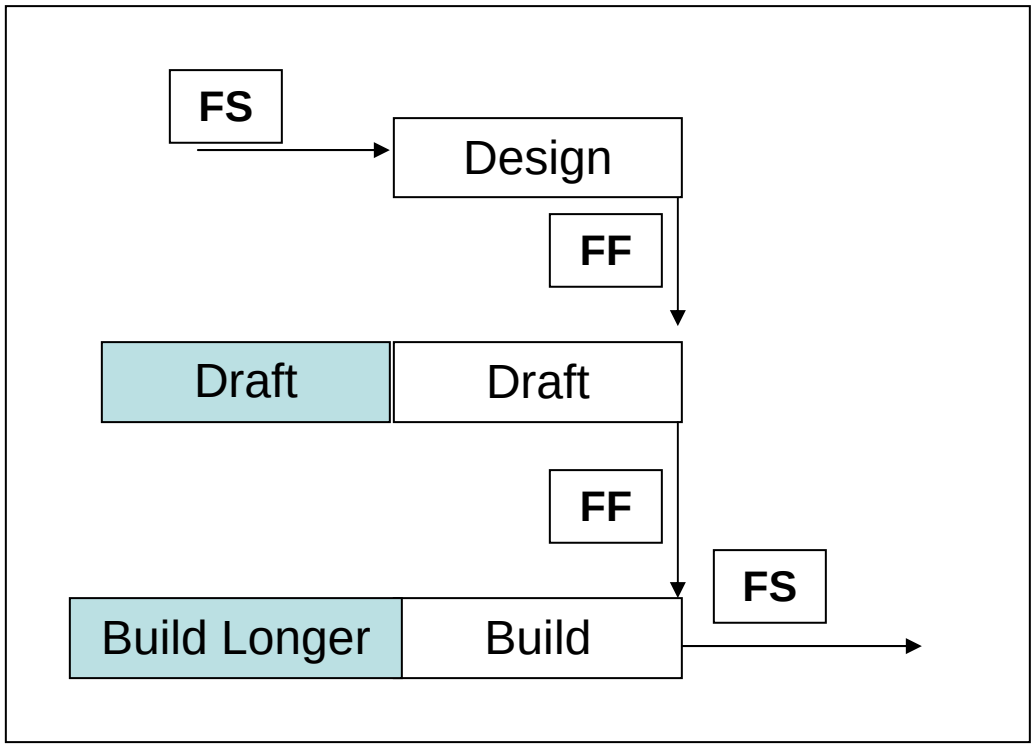

Figure B – Lengthening F-F Danglers

The scheduling software knows what to do with extra duration on an activity that cannot finish later than a certain date (F-F) – it just starts it earlier. The software, no matter what it costs, does not know that "Build" cannot start before "Draft" which itself cannot start before "Design." The extra duration in Draft and Build are not transmitted to any activity, unless they extend their starting date beyond the start of the project.

So, what to do? One obvious fix is to use finish-to-start logic everywhere. This is not always possible since it may require more detail than we need or want.

Another approach, at least with the activities shown, is to "close off" the danglers with S-S and F-F relationships. Figure C shows how closing off the dangling activities works. It shows how to handle the possibility of longer durations of either the predecessor or successor by following Mr. Hurst's prescription of linking both start and end points. In this way the extra time the activity takes is correctly transmitted to the proper successor.

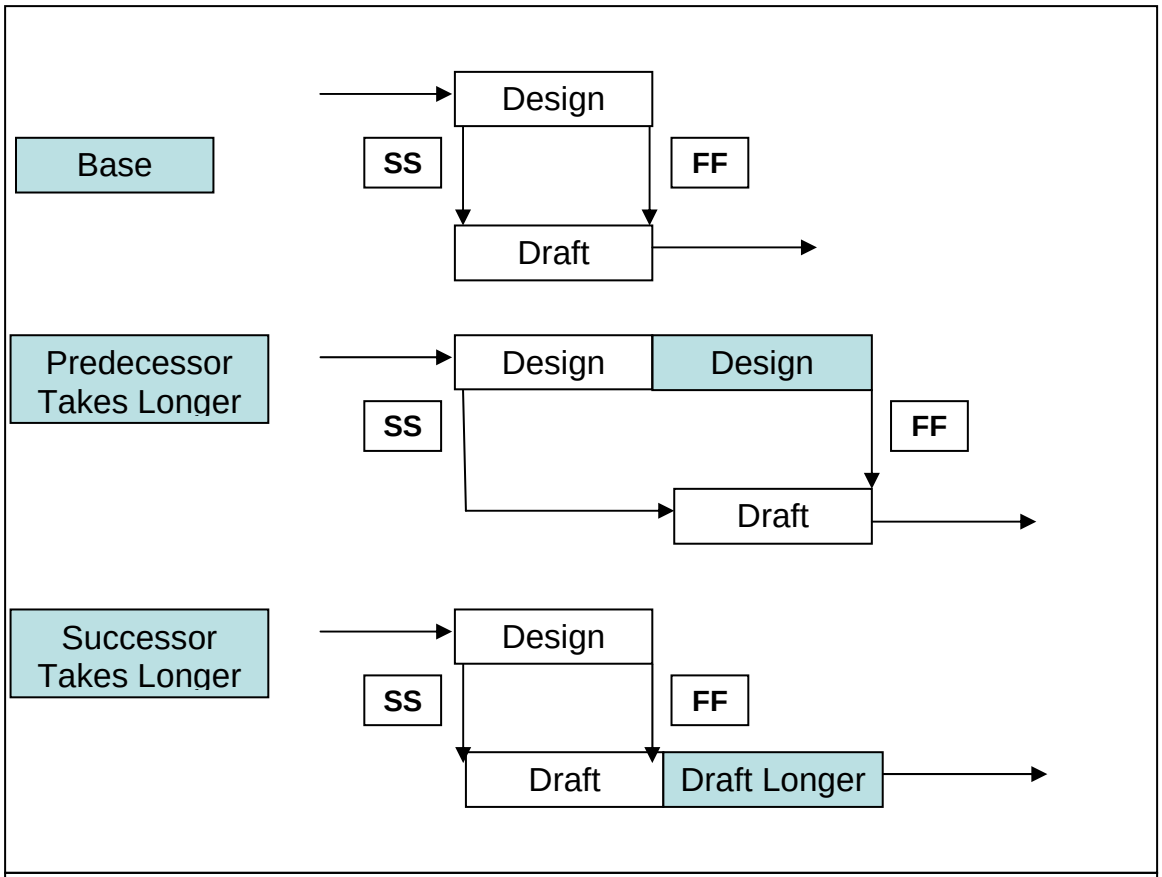

Figure C – Closing Off Danglers, Activities Longer, Right Answers

In summary, the meaning of Mr. Hurst's condemnation of "dangling activities" as *per se* improper CPM scheduling technique is clear and convincing when we consider the reality that the duration of activities cannot be estimated with certainty. When activity durations change, the effect of those changes must be transmitted to the rest of the project correctly. The schedule logic must represent what would happen in the real project if durations change. You cannot see these problems if you look at static, deterministic schedules or bar charts without logic. The meaning becomes clear, however, the minute you look at uncertainty in the durations.

Linking activities logically so the schedule "works" if durations are uncertain is an important principle in CPM scheduling, but it is mandatory for schedule risk analysis. In schedule risk analysis, the schedule is iterated many times in a Monte Carlo simulation. In this analysis, there simply is no chance to make manual adjustments between iterations. The analyst must be sure that there are no dangling activities in Mr. Hurst's valid meaning of the term.