Size-Productivity Paradox: Part 4

Duration, Team Size, and Productivity

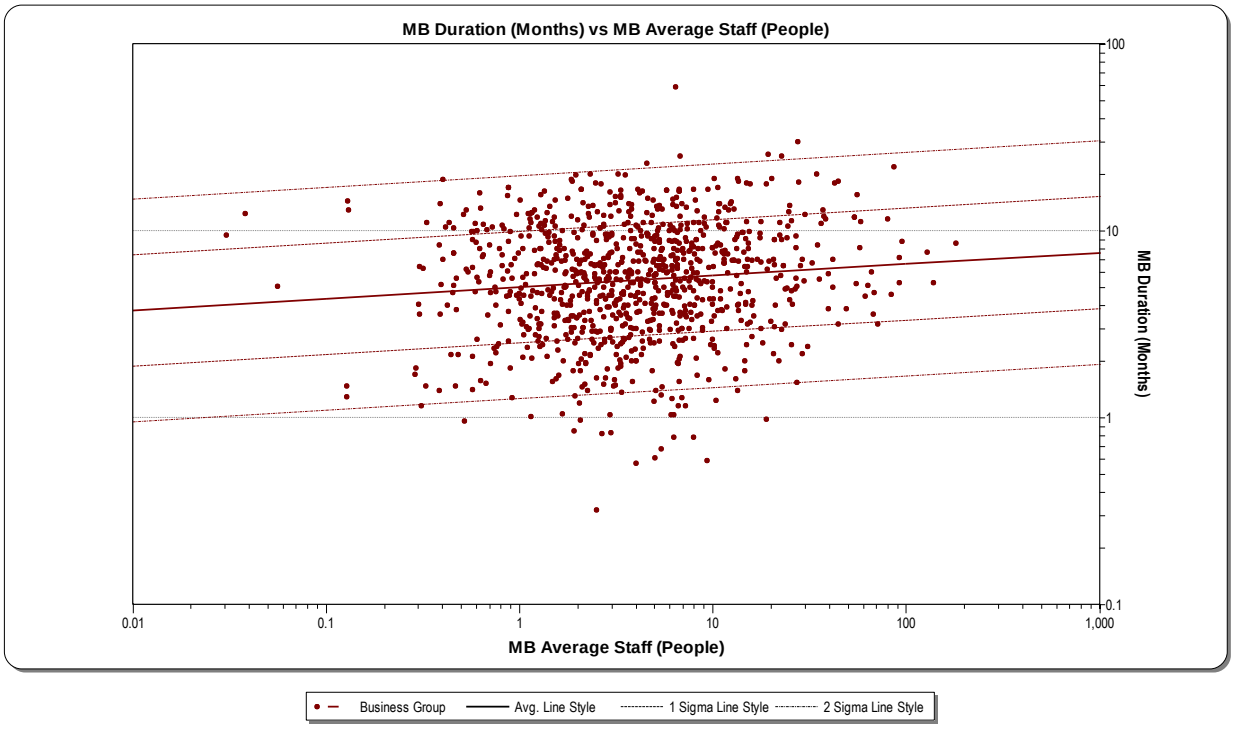
By Paul Below

For many projects, duration is just as important a constraint as cost. In this installment we will tackle the question: How do changes to team size affect project duration and the resulting productivity? Once again we will use our database of business applications completed since January, 2000.

The following graph shows the relationship between average staff (team size) and duration. What does it tell us? In general, duration increases as team size grows. But how can this be? After all, we add staff to shorten project duration, not lengthen it.

One thing that's important to note is that our staff vs. duration chart ignores project size. It stands to reason that larger projects, because they must design, construct, test and deliver more code, would require more people and take longer than small projects. Because another factor – size – is not considered, it should not surprise us that the correlation between duration and team size is relatively weak.

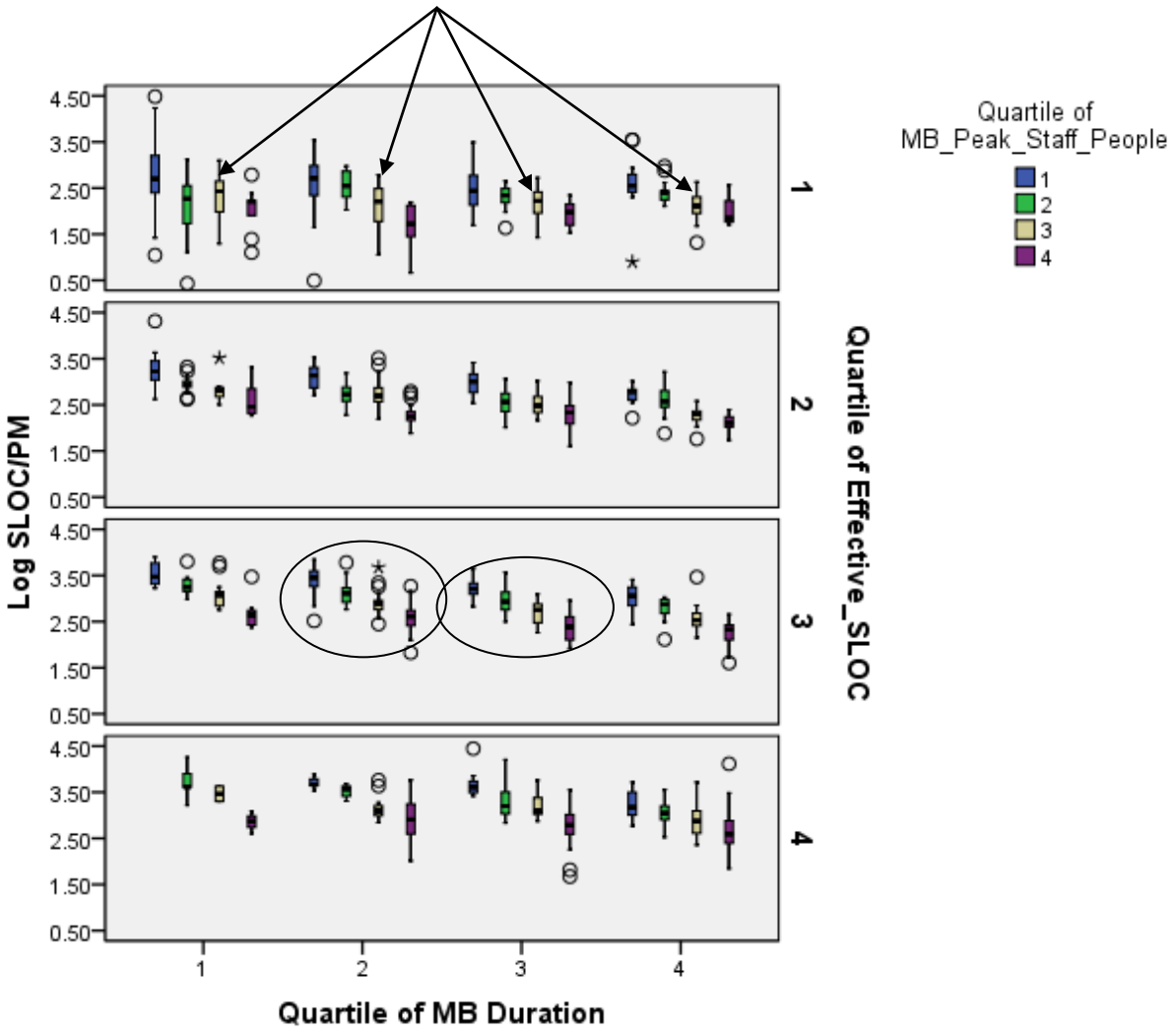
The correlation coefficient is +.313 and it is significant at the 1 in 1000 level.



What we need, once again, is a way to examine multiple metrics at once. We can use box plots to examine four variables at once by stacking them up. Our database is again divided into four size bins or quartiles. Within each size quartile (the four rectangular boxes numbered 1-4 below) productivity tends to decrease as staff size increases. Seen this way, duration has less of an effect on productivity than either staff or size.

The four arrows point to the yellow boxes representing the third quartile of peak staff, within the 1st quartile of size. This lets us look at difference in productivity and duration while controlling for staff and size. As you can see, there is little change in the productivity, which means that duration by itself has little impact on simple productivity.

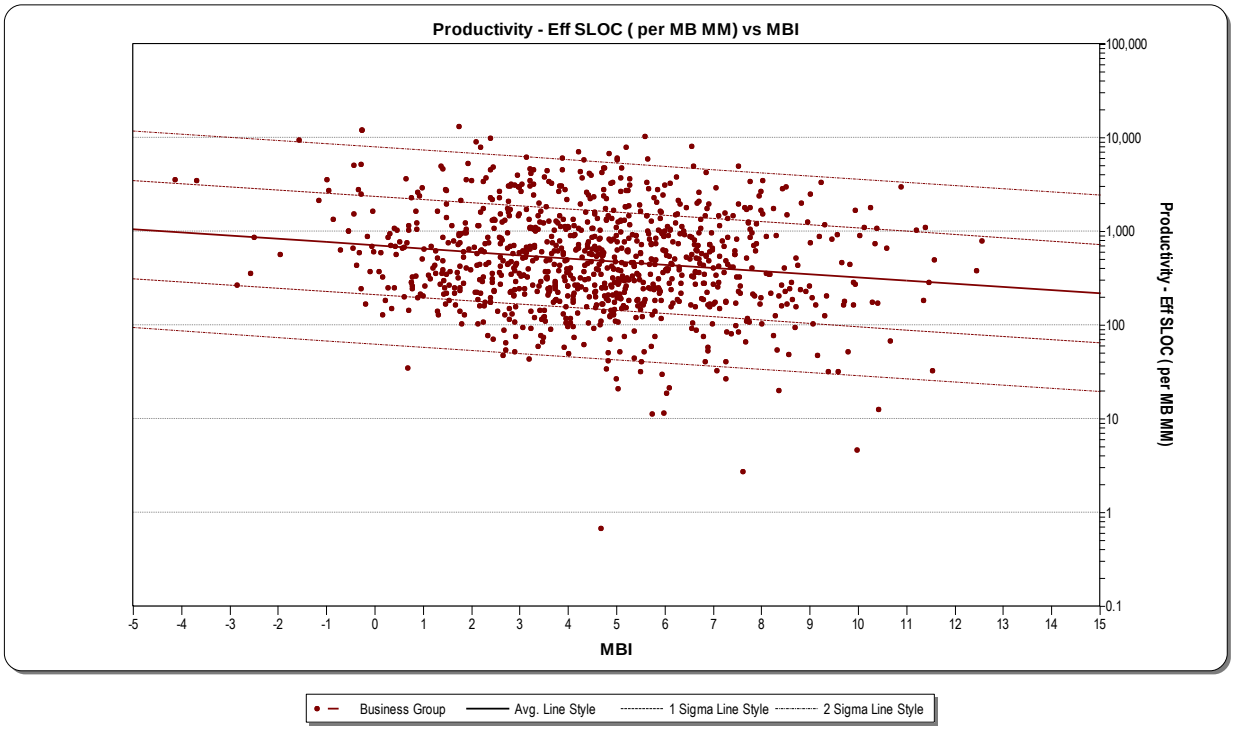
Another way to examine it is to look across the boxes within a quartile of size. When controlling for size in this way, the pattern of productivity due to staff size is repeated, but the trend for duration is flat. For example, compare the boxes with the ovals in the 3rd quartile of size. This is another way to visually see that duration has little impact on simple productivity.



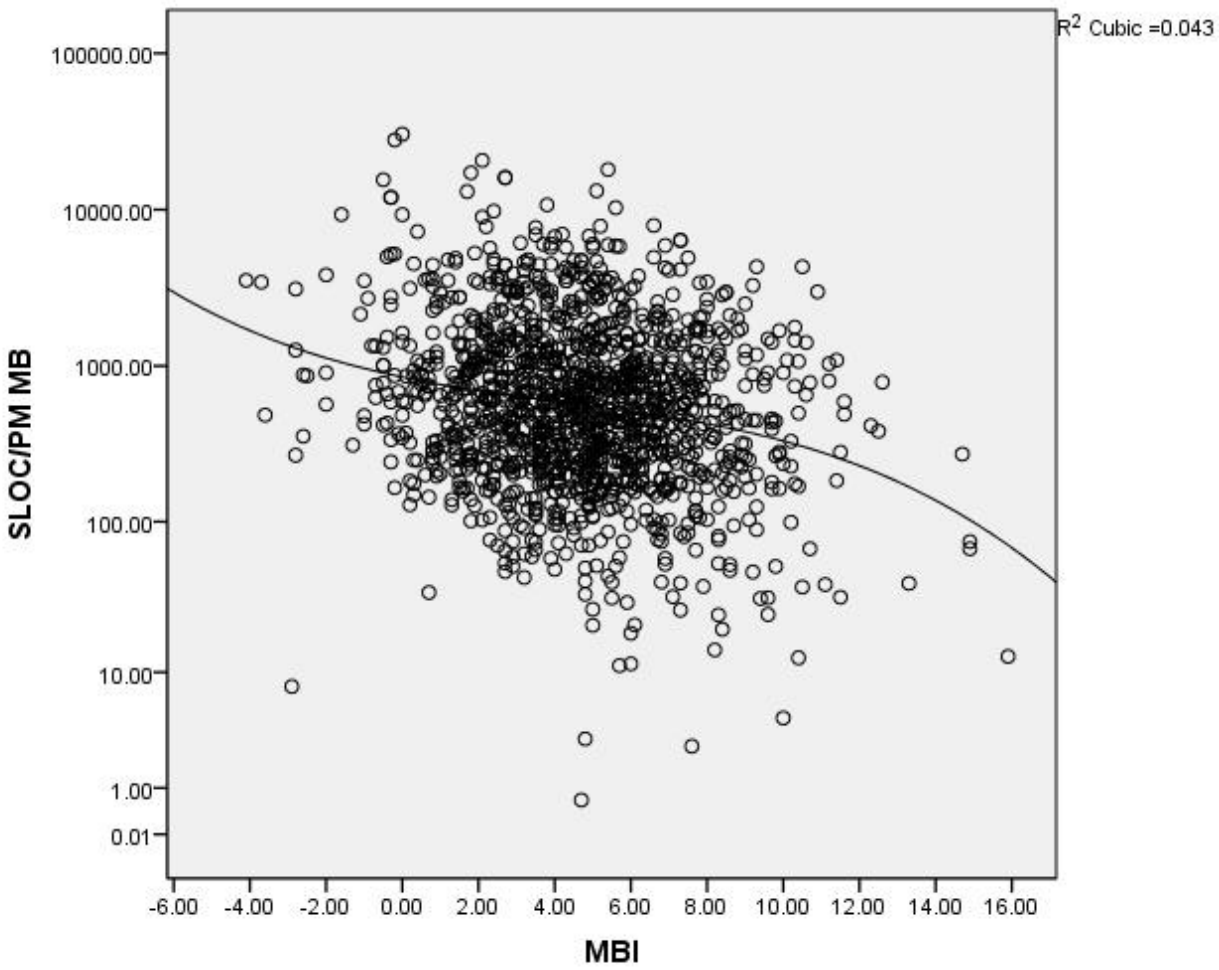
The lack of a steep slope within each size block suggests that team size has far less impact on duration than we might expect. This observation was immortalized by Fred Brooks in *The Mythical ManMonth* and has been confirmed repeatedly by Larry Putnam, Sr. and others over the past 3 decades. And, indeed, it is one component built into the SLIM Estimate tool.

If team size doesn't have much of an effect on time to delivery, what about the rate at which people are added to a project (in other words the staffing curve)? QSM uses the Manpower Buildup Index (MBI) to measure the rate at which people are applied to a project. The MBI is an indexed value ranging from -3 to 20. Higher MBIs means a steeper staffing curve (people are added more rapidly to the project).

The next graph shows a slight relationship between MBI and productivity: productivity decreases slightly as MBI increases. The relationship appears stronger when the lowest and highest MBIs are compared. In the middle range (MBIs of 2 to 6 or so), the relationship seems to be fairly flat.



This flat section in the middle can be seen more clearly if we fit a cubic line to the data, as in the next graph. Take away from this is that adding people to a project extremely quickly is a bad thing for productivity. This makes intuitive sense, people newly added to a project require guidance from those who were already on the project.



Summary

Adding staff to a project does not guarantee that the duration will be shorter. Once again, a key project management concept is confirmed.

I hope you have enjoyed reading the four entries in this series of blog posts, and I hope you have gained some insights into the relationships that underlie the "productivity paradox".