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A Throughput Measurement Procedure using SLIM

This paper outlines a procedure for calculating the throughput benefits of different staffing strategies and process improvement programs using the SLIM estimating tool.

Assumptions.

Size. Average size of systems in the inventory: 50,000 ESLOC [calculate this from actual history]

Language. C++

Gearing Factor. 40 C++ ESLOC/Function Point

Efficiency of Development Organization. PI of 16 in 1990; PI of 18 in 1994. Rate of improvement 0.5 PI/year. [Determine from actual data]

No. of people in development organization. 250. [use actual data; stay consistent]

First Example.

Time period. 1990. Assume the throughput is 50 systems/year. This would be about 2,500,000 ESLOC/year. 2,500,000 ESLOC/year/40 ESLOC/FP = 62,500 FP/year.

Normalized by 250 people we get 62,500 FP/year/250 people MY/year = 250 FP/year/person, (or 250 FP/MY since we have 250 people applied over one year).

New time period. 1994. Assume the throughput has now gone up to 60 systems/year because of improvements in process efficiency. This would be about 3,000,000 ESLOC/year. 3,000,000 ESLOC/year/40 ESLOC/FP = 75,000 FP/year.

Normalized by 250 people we get, 75,000 FP/year/250 people MY/year = 300 FP/year/person, (or 300 FP/MY since we have 250 people applied over one year).

Results.

This represents an improvement of 20%, or 5% per year.

Example 2.

Concept. Use smaller teams to exploit the tradeoff law by doing more systems in parallel each taking slightly longer than with bigger teams. This will increase the annual throughput substantially without having to make process improvement. We use SLIM to generate an example. Size: 50,000 ESLOC (1250 FP), C++, 40 ESLOC/FP.

1st Situation. MBI 4.1, peak staff 12 people. Phases: Functional design, main build, maintenance. Level load in each case. See SLIM solution below.

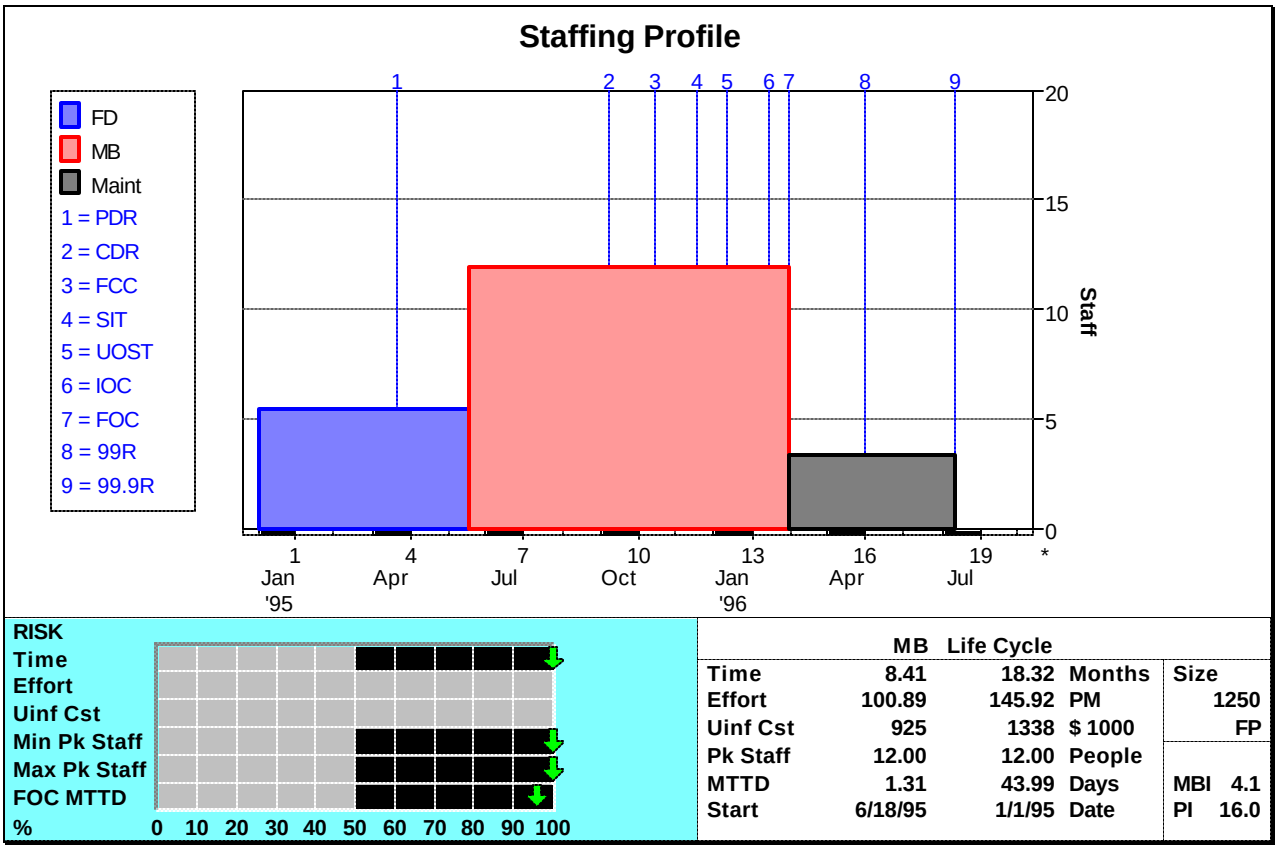

Figure 1. SLIM solution for PI 16, peak staff of 12 people, 50,000 ESLOC, 1250 FP.

The key parameters are:

Life cycle time: 18.32 months
Life cycle effort: 145.92 PM
Average manpower: 145.92/18.32 = 7.97 = 8 people

Average throughput = 250 people/8 people * (12 mos./yr./18.32 mos./system) = 20.47 systems/year. In FP this is 20.47(50,000 ESLOC/system/40 ESLOC/FP) = 25,586.79 FP/year.

Normalized this is: 25,587 FP/year /250 people = 102 FP/person/year.

2d situation. MBI 2.7, peak staff 6 people. Phases: Functional design, main build, maintenance. Level load in each case. See SLIM solution below.

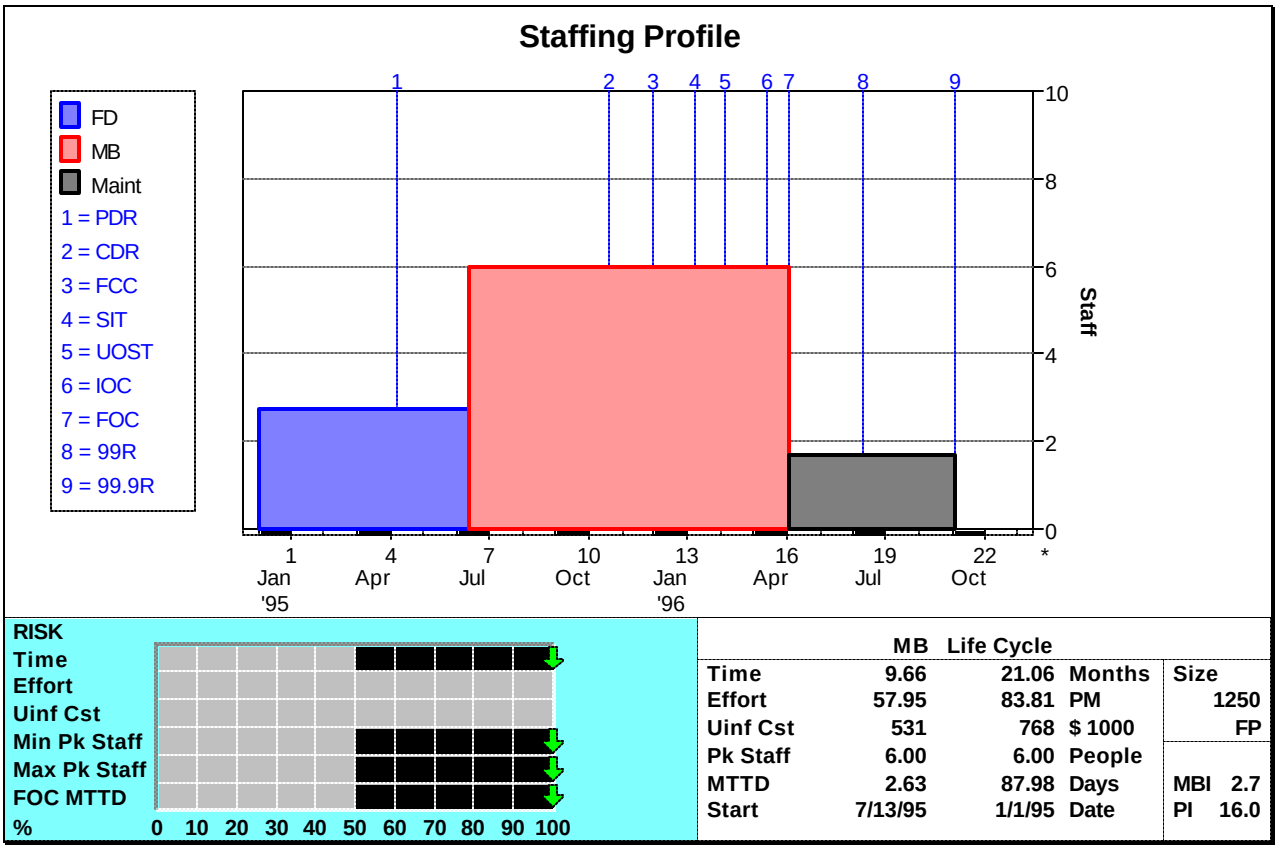

Figure 2. SLIM solution for PI 16, peak staff of 6 people, 50,000 ESLOC, 1250 FP.

Key parameters are:

Life cycle time: 21.06 months
Life cycle effort: 83.81 PM
Average manpower: 83.81 PM/ 21.06 mos. = 3.98 = 4 people.

Average throughput = 250 people/4 people * (12 mos./yr./18.32 mos./system) = 35.61 systems/year. In FP this is 35.61(50,000 ESLOC/system/40 ESLOC/FP) = 44,515.67 FP/year.

Normalized this is: 44,516 FP/year /250 people = 178 FP/person/year.

Results over 4 years (it might take this long to get the procedure fully into play).

Increase in throughput ratio. (178 FP/person/year) / (102 FP/person/year) = 1.75, or 75% better.

This is 75/4 = 18.75%/ year improvement in throughput.

Observations.

The developer spends the same money each year. It is a fixed budget of 250 people*average labor rate.

This is a one time operation. Once the size of the teams is down to the minimum practical level, one can't do it anymore.

The sacrifice is that each system on average takes 2.75 months (15%) longer. This is probably within the normal tolerance of management. If deliberately planned and managed with some critical exceptions it should be a viable strategy. (that is, not everything in the inventory is priority 1 in business terms).

Third Example.

Concept. Process efficiency improvements are implemented. The PI increases from 16 to 18 in a 4 year period. This permits the same size system to be built with a smaller team, or more function can be produced by the same size team in a given time period. See SLIM outputs below.

First Situation. 1990. PI 16. Peak staff = 12 people (MBI 4.1) The SLIM solution is show below.

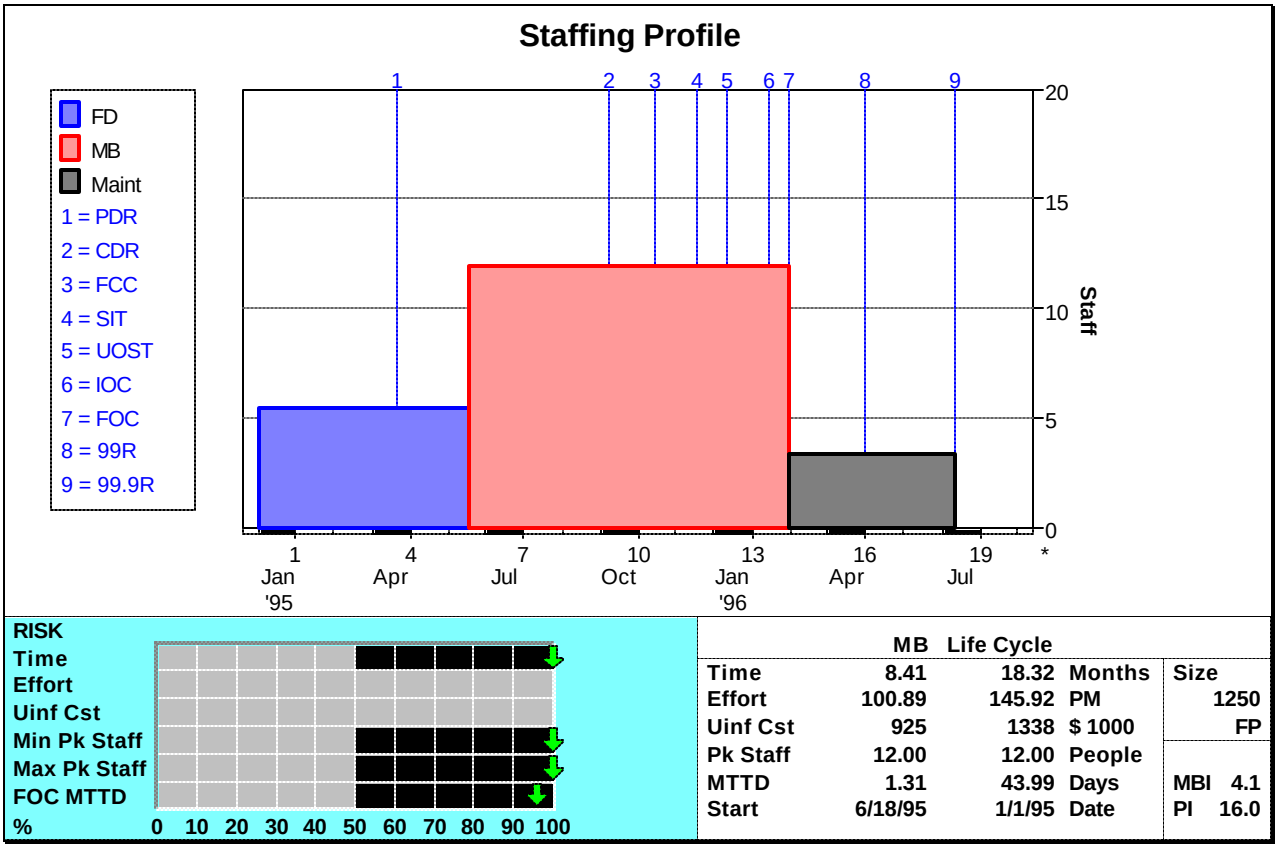

Figure 3. SLIM solution for PI 16, peak staff of 12 people, 50,000 ESLOC, 1250 FP.

Life cycle time: 18.32 mos.
Life cycle effort: 145.92 person-months
Average staff: 145.92/18.32 = 7.97 = 8 people

Average throughput = 250 people/8 people * (12 mos./yr./18.32 mos./system) = 20.47 systems/year. In FP this is 20.47(50,000 ESLOC/system/40 ESLOC/FP) = 25,586.79 FP/year.

Normalized this is: 25,587 FP/year /250 people = 102 FP/person/year

Second Situation. 1994. PI 18. Peak staff = 8 people (MBI 4.1) See SLIM solution below.

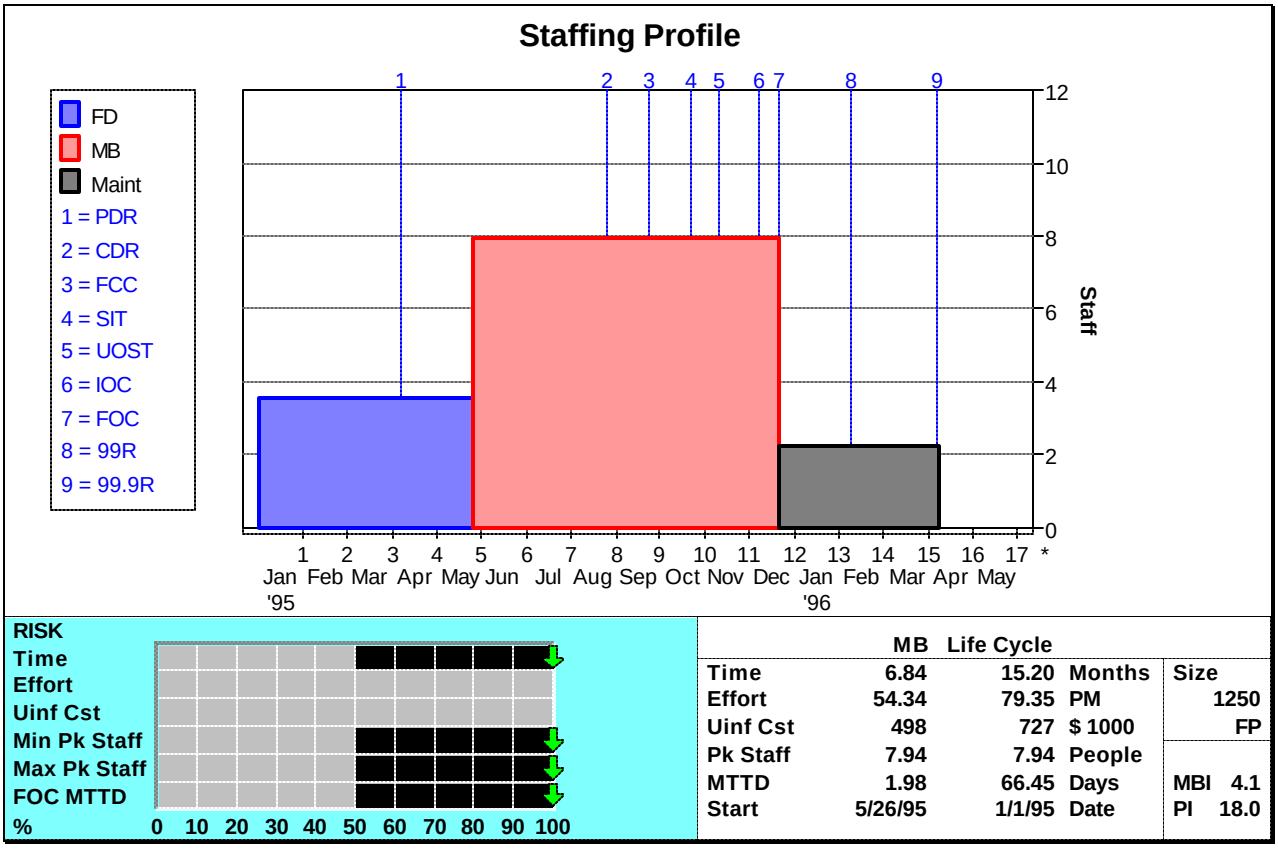

Figure 4. SLIM Solution for PI 18, peak staff of 8 people, 50,000 ESLOC, 1250 FP.

Life cycle time: 15.20 mos.
Life cycle effort: 79.35 person-months
Average staff: 79.35/15.2 = 5.22 people

Average throughput = 250 people/5.22 people/system * (12 mos./yr. /15.2 mos./system) = 37.81 systems/year. In FP this is 37.81(50,000 ESLOC/system/40 ESLOC/FP) = 47,262.55 FP/year.

Normalized this is: 47,262.55 FP/year /250 people = 189 FP/person/year

Results over 4 years (at the rate of process improvement assumed).

Increase in throughput ratio. (189 FP/person/year) / (102 FP/person/year) = 1.85 or 85% better.

This is 85/4 = 21.25% / year improvement in throughput.

Observations.

Must have an effective process improvement program in place and working.

There are no time penalties. Average time is shortened as well as smaller teams with less effort.

This technique may be applied indefinitely except that the team size will eventually get to a minimum level that you will not want to go below. At that point in time the benefits will come from increased throughput per team in less elapsed time. This analysis can be performed using SLIM as well.

Summary.

- Increased throughput can be demonstrated using SLIM.
- Increased throughput can be achieved by using a strategy of using smaller teams and doing more systems in parallel. This exploits tradeoff. It cannot be exercised indefinitely.
- Increased throughput can also be achieved by using a long term strategy of process improvement. This can be continued indefinitely.
- Both of these strategies can be combined initially to get the combined benefit occurring faster and with greater magnitude. Such a combined strategy will require more management planning and skill to execute. Because of this the full potential may be difficult to achieve. Nevertheless it costs little to try.
- Measurement is a must to know whether or not objectives are being achieved on the schedules established.

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QSM, Inc.