The Remaining Work Index and the Staffing-to-Schedule Index (StSI)

How to Use the Oak Associates / New Leaf's Indexes to Adjust Staffing and Make your Schedule

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Introduction

Frequently, part way through a project, a team will discover that things have not been going exactly according to plan. The deliverables were not all completed on schedule, a major milestone has slipped, the people working on the project are not the ones envisioned in the plan, and extra work has already been performed to keep the project from falling further behind.

While the solutions can be as varied as the project's problems, a common response is to exert more effort and try to complete the full project by the originally scheduled date. The team will put in longer hours and, often, additional staff will be hired. Because the original plan usually varies its level of staffing to conform to fluctuations in the amount of work, additional workers should be added in a way that preserves the shape of the original staffing plan.

In the small sample project that follows, the shape of the staffing profile might not appear to be important. In most departments, however, the project staffers are in high demand and are simultaneously scheduled on multiple projects. It is essential to adjust staffing for each project to cause the least disruption to the other projects. Preserving the shape of the staffing profile increases the likelihood that extra staff will arrive at the right time, will be used in the best manner, and will interrupt other projects as little as possible.

So the question arises, "How do you add sufficient staff to recover the original schedule while preserving the shape of the original staffing plan?"

A Simple Example

To tackle this common question, we will apply our Remaining Work Index (RWI) and our Staffing-to-Schedule Index (StSI), two handy ratios that simplify some tedious calculations. In order to understand what the RWI and the StSI are and how we can use them, let's look at our example.

Here's a project plan for a seven-month project that will involve 18 staff-months of effort:

Month	Staff
1	1.0
2	2.0
3	3.0
4	4.0
5	4.0
6	2.0
7	2.0

7 Total months, the schedule in months
18 Total staff-months, the budget

While the actual plan probably details the work in staff-hour units, the effort in the table has been summarized in staff-month units to keep the example easy to understand. Notice how the work grows from 1 staff-month the first month to 4 staff-months for the fourth and fifth months, and finally tapers off to 2 staff-months for the sixth and seventh months. The staffing profile is 1-2-3-4-4-2-2.

At the end of the fourth month, the details on the project looked like this:

To Date:

4 **Project is now at end of this month**

10.0 **Planed Value to Date**
11.0 **Actual Cost to Date**
9.0 **Earned Value to Date**

0.82 **Cost Perf. Index (CPI)**
0.90 **Schedule Perf. Index (SPI)**

22.0 **Est. Cost at Complete (Original Budget / CPI)**
7.8 **Est. Schedule at Complete (Original Schedule / SPI)**

After four months, it is clear that the project is not going according to plan. The amount of work that should have been completed at this point was 10 staff-months of work. The actual amount is 11 staff-months, but the earned value of the work completed is only 9 staff months. [1]

We can predict that, if the remaining work is similar to the completed work, the project will cost 22 staff-months (not the planned 18) and be finished in 7.8 months (not the planned 7). Now we ask, "What are the adjusted staffing requirements?"

We will start with a few simplifying assumptions. (After we arrive at an answer we will revisit the assumptions and reconsider our answer in the light of the assumptions.) Our assumptions are:

1. The CPI is stable at this point in the project
2. All activities that have been begun have been completed — there are no partially completed activities
3. Every activity can be shortened by adding additional labor
4. Every staffer is capable of doing every activity on the project
5. People schedule their time in hours, so that fractional staff-months occur
6. Increased numbers of people will work together as efficiently as the originally planned team

Again, the question is, "How much staff should you add to meet the original schedule while preserving the *shape* of the original staffing plan?"

Three Possible Solutions
Here is one possible solution:

Total Method (Forgetting CPI)
9.0 **Remaining work (Budget - Earned Value to Date)**
3.0 **/ Remaining months**
3.0 **= Staff needed next month (Assumes a level staffing to the end of the project)**

Our first solution started with 9 staff-months of remaining work, divided it by the remaining 3 months, and settled on 3 staffers each month for the next three months. However, this solution did not include any consideration of the CPI's fall from 1.0 to .82. Our lower CPI reminds us that we are not as efficient as we originally planned to be.

A second possible solution:

Total Method
9.0 **Remaining work**
3.0 **/ Remaining months**
0.82 **/ CPI**
3.7 **= Staff needed next month (Assumes a level staffing to the end of the project)**

Our second solution began with 9 staff-months of remaining work, divided by the remaining 3 months, then divided again by the .82 CPI to get a staffing level of a 3.7. However, this second solution assumes that we will level-staff the project for the next three months. It disregards the 4-2-2 the shape of the last three months of the original staffing plan.

Our third solution will introduce a couple of new concepts, the Remaining Work Index (RWI) and the Staffing-to-Schedule Index (StSI):

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Staffing-to-Schedule Method (Preserves the original shape of the staffing)
    8.0  Remaining work planned (Budget - Planned Value to Date)
    9.0  / Remaining work (Budget - Earned Value to Date)
   0.89  = Remaining Work Index (RWI)
   0.82  x CPI
   0.73  = Staffing to Schedule Index (StSI)

    4.0  Next month's originally planned staff
   0.73  / Staffing to Schedule Index (StSI)
    5.5  = Staff needed next month
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The third solution begins by creating the Remaining Work Index (RWI) by dividing the remaining work by the planned remaining work. Because the RWI has fallen from 1.0 to .89 we know we are behind in our tasks and that we have extra work to complete by our deadline.

In addition to accounting for the extra work, we must account for having been less productive than planned (our CPI has fallen from 1.0 to .82). We multiply the RWI times the CPI to get .73, the Staffing-to-Schedule Index (StSI). The StSI is the measure of how much we should increase the pattern of our staffing if we wish to meet our original schedule and *preserve the shape of the original staffing plan.* We divide the originally planned staff for the next month, 4.0, by the .73 Staffing-to-Schedule Index and discover that next month's staffing level should be 5.5.

Two New Indexes
The definitions of our two new indexes are:

- **Remaining Work Index (RWI)** = the (Remaining Planned Work) / (Remaining Actual Work), or the (Budget – Planned Value to Date) / (Budget – Earned Value to Date)
- **The Staffing-to-Schedule Index (StSI)** = the Cost Performance Index (CPI) x the Remaining Work Index (RWI) [2]

Both of these new indexes follow in the familiar approach of the traditional earned-value indexes of CPI and SPI. For both the RWI and the StSI a value of:

- *Exactly 1.0* means things are *on* plan
- *Less than 1.0* means things are *behind* plan
- *Greater than 1.0* means things are *ahead of* plan

Final Check
In order to be sure that the StSI calculation really works, let's compare our second and third solutions to adjust our staffing for the remaining months of the project:

Original planned work	
Month	**Staff**
1	1.0
2	2.0
3	3.0
4	4.0

Current measures	
10.0	**Planed Value to Date**
11.0	**Actual Cost to Date**
9.0	**Earned Value to Date**

Forecasted staffing	---------	**Staff**	---------
	Orig.	**Total**	**Staffing-to-Schedule**
Month	**Plan**	**Method**	**Method**
5	4.0	3.67	5.50
6	2.0	3.67	2.75
7	2.0	3.67	2.75
Total work remaining	8.0	11.0	11.0

We see that while two methods correctly calculate the 11 staff-months of total work remaining, the "Total Method" failed to preserve the 4-2-2 staffing shape of the last three months, while the Staffing-to-Schedule Index Method *proportionately adjusts the staffing* and preserves the shape of the original staffing plan: the staffing profile 4-2-2 becomes 5.50-2.75-2.75.

Assumptions Revisited
Our assumptions were:

1. The CPI is stable at this point in the project
2. All activities that have been begun have been completed — there are no partially completed activities
3. Every activity can be shortened by adding additional labor
4. Every staffer is capable of doing every activity on the project
5. People schedule their time in hours, so that fractional staff-months occur
6. Increased numbers of people will work together as efficiently as the originally planned team

The first assumption – that the CPI is stable – is usually true after the project has progressed past the first 20% of the schedule (in our example, past the second month). [3] So we won't need to adjust our results.

The second assumption – that there were no partially completed activities – allowed us to be sure that our calculations were precise. Small amounts of incomplete work do not

adversely affect earned-value calculations in real projects. If a large amount of incomplete work exists, assigning "partial credit" can usually correct the problem. [4]

The third assumption – that every activity can be shortened – is probably not true. Nine people cannot have a baby in one month. Some activities cannot be compressed. If we are late starting a critical-path activity that cannot be shortened, our schedule will slip no matter how many extra staffers we add.

The fourth assumption – that every staffer can do every task – allowed us to focus only on the calculations. In most projects, we will have to spend some additional time matching the right talent to each task. So we should probably add a little "matching" effort to our 11-staff-month forecast.

The fifth assumption – that people schedule their time in hours – is true of most white-collar projects and does not require any adjustments to our calculations.

The sixth assumption – that increased numbers of people will work together as efficiently as the originally planned team – is seldom true. To the extent that new staffers are:

- Hard to find right away
- Need time to adjust to the work [5]
- Not as individually productive as the original team members
- Not as coordinated on the expanded team [6]

the estimate of 11 staff-months should be increased. The actual staffing for each month might be "rounded up" to the next whole person. So when our assumptions are modified to conform to reality, our calculated staffing of 5.50-2.75-2.75 (total of 11) may become real staffing of 6-3-3 (total of 12).

Conclusion
We have seen how to combine the CPI from traditional earned-value analysis with the Remaining Work Index (RWI) to create the Staffing-to-Schedule Index (StSI). As with the familiar CPI and SPI, for both the RWI and the StSI a value of 1.0 means things are on plan, while *less than 1.0* means things are behind plan, and *greater than 1.0* means things are ahead of plan.

The StSI allows us to preserve the shape of the original plan's staffing profile by *proportionately adjusting it*. This proportional adjustment increases the likelihood that precious staff-hours will be efficiently used on the adjusted project and decreases unnecessary disturbances to the other critical projects that the staff is working on.

These calculations, when modified by a realistic assessment of our initial assumptions, allow us to make a feasible effort to add staff and recover our original schedule.

Notes

1. This discussion assumes the reader is thoroughly familiar with the concepts and calculations of earned value project management. For a good brief tutorial, see Durrenberger (June, 2003). For a good introductory book, see Flemming and Koppleman.
2. These two indexes (in a slightly different form) have been a part of Oak/New Leaf's introduction to project management, (now called *Five Sigma*® *Project Management*) for since 1996. See *Five Sigma*® notebook for additional details.
3. The CPI settles down rather quickly on most projects. See Christiansen for the evidence and Flemming and Koppleman for additional details.
4. While *not* taking partial credit is strongly advocated as a "best practice," an example of taking partial credit is also illustrated in Durrenberger (June, 2003). Flemming and Koppleman discuss other concerns about taking credit for work performed.
5. The concept of up-to-speed time is thoroughly explored in Nevison (Spring, 1994) and Nevison (June, 1994).
6. The idea of expanded teams becoming inefficient led to the title of Fred Brook's *The Mythical Man Month*. This book is both highly entertaining and a source of genuine wisdom about software engineering projects. Some of the "combinatorial" inefficiency that Brooks discusses is probably really "learning curve" effects that Nevison (June, 1994) explores.

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About the Author

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