



The Project Control Company

"experts in project status & performance measurement"

"White Paper Series"

Progress & Performance Measurement



THE ONLY MEASURE OF PROJECT CONTROL

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Progress and Performance Measurement

Progress measurement is a crucial component of effective project control, after all if we don't measure how we are doing against the project plan then the plan becomes obsolete. All projects deviate from the plan, and all schedules change. Unless we are aware of what is going on then the project team will be in a continual reactive mode. Effective progress measurement helps to identify the variances to the plan early enough to either mitigate the impact, or cease the opportunity. Ineffective progress measurement is costly, provides no useful data, and can serve to cloud the real issues. For this reason CMS needs to address its position on progress measurement. This paper will serve as a guide to identify those methods we have determined to be effective, and those that we have deemed ineffective.

In order to measure the progress of a project several things must occur first. An estimate, a plan, execution schedules, and progress reporting formats must be in place in order to aid in the measurement of progress. The **Estimate** holds your hours from which the resource-loaded schedules can be built and gives you the basis for which measurement becomes possible. The **Plan** allows you your baseline for which to measure progress against and will tell you if you are meeting your planned objectives. **Execution Schedules** are loaded with the man-hours from the estimate and these schedules are used as a monitoring tool from which curves are developed. The **Reporting Formats** must be clear and concise and set up to make navigation through simple with simple charts and progress curves. Measuring progress is very important for forecasting. Contractors have contractual obligations to meet cost and schedule therefore measuring progress correctly is vital to keep the project on track or identify what remedial actions are necessary.

The most reliable and most accurate method of progress measurement is based on the number of actual man-hours it took to complete the task at hand. Measuring man-hours is an easier way to track commodities because of the ability to convert man-hours back into the estimate. However, some estimating professionals base their estimates on

pricing commodities, rather than man-hours. Therefore, using man-hours to track commodities, may not be the method of progress measurement of choice for some; it still remains the common denominator in measuring performance.

There are several problems that occur with progress measurement.

- Firstly, no one wants to hear or report unfavorable news.
- Secondly, the people doing the measuring are usually measuring their own status. This leaves room for bias. It's just a natural instinct to make one look better than one actually is, especially if there is a benefit involved.
- Thirdly, overstating progress will improve cash flow so why not do it? Contracts can also be paid out based on percent complete. For example a contractor could be paid 25 percent of the contract dollars when he has finished 25 percent of the work. This would definitely have bearing in the reporting of progress by the contractor.
- Fourthly, "earned value" techniques are not correctly understood or practiced.

EARNED VALUE

Earned value is defined as a method for measuring project performance. It compares the amount of work that was planned with what was actually accomplished to determine if cost and schedule performance is as planned. CMS Inc. uses an "earned value" measurement methodology. Simply put, all work completed is measured against the Current Control Estimate (appropriation plus approved changes). This ensures that the work is measured and not the time, cost, or resources spent. Measurement is therefore based on quantities. This value earned towards the project forms the basis for communication and control. Earned value methods allow for gathering of objective information. By basing all analysis on what has been earned will increase the accuracy in forecasting end dates by allowing current performance trends to be considered. Project fires can be seen ahead of time and corrective actions can be taken to put them

out. Realistic goals can be set, and the Owner has the information right in front of him so that the facts are clear and concise.

Combined with an effort driven schedule, the performance data derived from an earned value measurement system can quickly quantify the efforts necessary to mitigate schedule impacts. Poor performance in one area can impact another. By being able to translate performance trends to effort, cost and schedule impacts can be quickly assessed. Only when we have a complete assessment can a remediation plan be developed.

Earned value can be based on a variety of commodities. Lending itself ideal to gathering data in a variety of methods, and converting it back to the plan. Earned value can be reported in terms of money, work hours, volume, weight, area, and length.

Example

The piping portion of a project requires that 1000 feet of pipe be installed. Piping accounts for 3,000 man-hours in the budget. Total budget is 10,000 man-hours. 350 feet of pipe has been installed. What is the % complete of the pipe portion, and what is the overall % completion??

$$\% \text{ Complete piping} = 350 / 1,000 = 35\%$$

$$\text{Piping has earned } 35\% \times 3,000 \text{ hrs.} = 1,050 \text{ hrs.}$$

$$\text{Project has earned } 1,050 \text{ hrs. } \% \text{ complete project: } 1,050 / 10,000 = 10.5\%$$

It is also important to realize that progress is **NOT**:

- Percent money spent,
- Percent work hours spent,
- Percent time spent.

It is the actual percent of work that has physically been completed, based on original quantities. In other words one must be able to physically see what work has actually been completed.

PERFORMANCE

To report performance, the simplest method is through schedule and tracking curves. Tracking a curve gauges performance by comparing what has actually been accomplished against what was supposed to be accomplished or planned. This is an effective method of communicating the current status. Tracking curves can be developed for a number of reporting activities like progress, cost, changes, and productivity. Each curve can be based on either actual (what has been spent), or on earned value (what has been performed against the plan). In many applications actual, earned, and scheduled will be identified on the same curve. With the aid of a resource-loaded schedule, which quickly spreads the hours to be earned, and progress curves, one can easily view progress status. (See attached curve #1)

Performance measured against a schedule is a comparison of what was planned to what was done. We call this Earned / Burned. This is the earned hours divided by the actual hours spent. If the budgeted work hours were less than the earned work hours, this would mean that more work was done than planned. The Schedule Performance Index (SPI) formula is:

$$\text{SPI} = (\text{earned work hrs. or \$ to date}) / (\text{budgeted work hrs. or \$ to date})$$

The SPI can also be actual days/schedule days. A duration-based schedule will give you the SPI.

Performance measured against budget is a comparison of what was done to what was paid for. This is done by earned work hours compared to actual work hours. The Cost Performance Index (CPI) formula is:

$$\text{CPI} = (\text{earned work hrs. or \$ to date}) / (\text{actual work hrs. or \$ to date})$$

Project managers should always be interested in knowing how well actual productivity (work hrs. / unit) compares with the figures used in planning and budgeting the work. A Performance Factor (PF) may be calculated for a single work package or a combination of work packages (or the total project) using this formula:

$$\text{PF} = (\text{sum of earned man hrs.}) / (\text{sum of actual work hrs.})$$

Here is an example of Performance Factors

	Project Totals	Feb 2/02	Feb 9/02	Feb 16/02	Feb 23/02	Mar 2/02	Mar 9/02	Mar 16/02	Mar 23/02	Mar 30/02	April 6/02
Planned Earned Hours	5,580	72	456	440	516	546	684	741	779	604	742
Earned Hours	4916	67	444	350	375	400	590	690	700	600	700
Actual Hours	4915	70	435	345	500	375	600	700	690	550	650
Performance Factor	1.00	0.96	1.02	1.01	0.75	1.07	0.98	0.99	1.01	1.09	1.08

To get the Performance Factor, divide the Earned Hours by the Actual.

Although numbers greater than one, or less than one can represent measures of good productivity, CMS Inc. will formulate data so that performance exceeding the base is greater than one. Although there may be some arithmetic advantage in a number less than one we believe everyone understands the concept of giving 110% and this allows the data to be clearly understood.

Productivity is a relative measure of labour efficiency, either positive or negative, when compared to an established base or norm as determined from an area of great experience. Positive productivity will include less money spent, less time spent, less

man-hours spent, and a more bang for the buck. There are many factors that effect productivity and several of them are individual worker skills, material and equipment availability, interruptions, engineer change control, safety/loss control, change management, and planning. The simplistic overall understanding for productivity would be the Quantity Units / Work Hours.

DATA COLLECTION

Progress can be gathered in many different ways. Whichever way is chosen, one should consider what the end objective of collecting data is and to use it effectively. If the information being collected is not being used then there really is no value in collecting that information. Data must be reported because it's meaningful and not because it's available.

To collect the actual manpower data, we rely on force reports, time sheets, or an actual physical head count done on site. Force reports and time sheets will contain the actual number of men on site and will also contain the length of time they worked. We will also conduct a physical walk around site and count the number of people working.

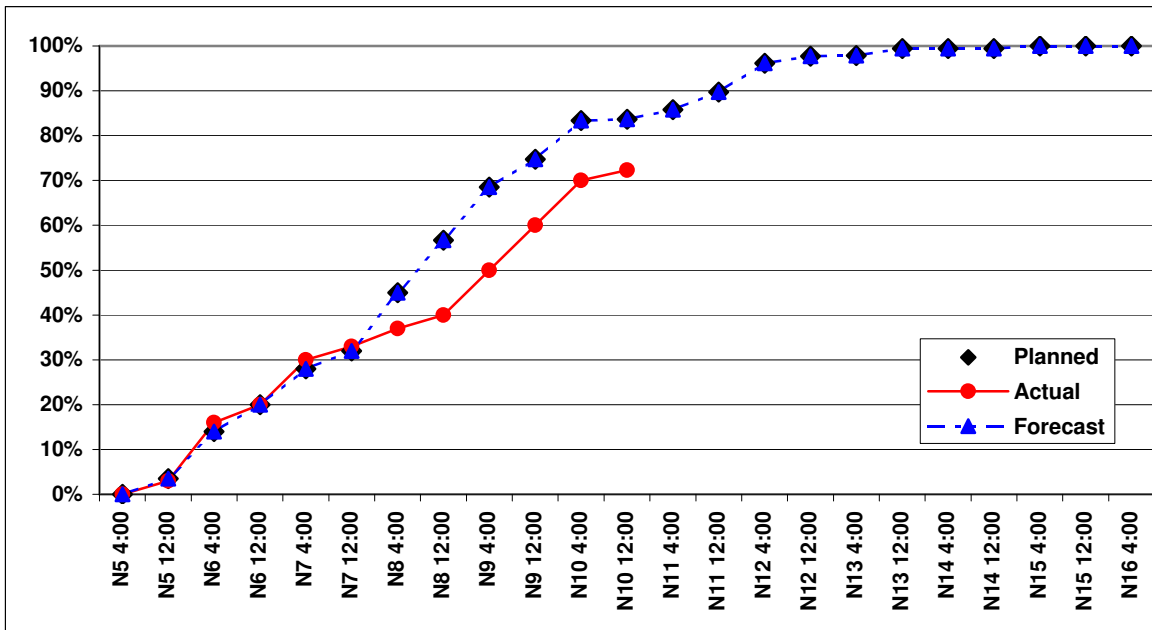
When tracking actual lengths complete we will rely on isometric drawings mark ups. The contractor's foreman marks up these drawings at the end of the day or again, we will take the isometric drawing around site and mark them off ourselves.

When monitoring engineering performance, the simplest way is to use weighted milestone schedule for their deliverables. Each activity has been given an agreed upon weighted amount for each phase during the deliverable activity. Combined with curves and histograms, actual progress of engineering performance can be analyzed.

We feel when reporting progress, a picture is worth a thousand words. We will plot the planned, the actual progress, and actual expended manpower on a chart accompanied by a curve. Instead of a person dealing with pages of numbers, which take time and

effort, many would prefer a visual representation of the jobs current status as well as it's forecasted status.

Curve #1



Status Time	N5 4:00	N5 12:00	N6 4:00	N6 12:00	N7 4:00	N7 12:00	N8 4:00	N8 12:00	N9 4:00	N9 12:00	N10 4:00	N10 12:00
Planned	0.0%	3.5%	14.0%	20.0%	28.0%	32.0%	45.0%	56.7%	68.5%	74.7%	83.3%	83.6%
Actual	0.0%	3.0%	16.0%	20.0%	30.0%	33.0%	37.0%	40.0%	50.0%	60.0%	70.0%	72.3%
Forecast	0.0%	3.5%	14.0%	20.0%	28.0%	32.0%	45.0%	56.7%	68.5%	74.7%	83.3%	83.6%

RESOURCE LOADED Vs. DURATION BASED SCHEDULES

When using a schedule as a measuring tool for progress, we would only use a resource-loaded schedule compared to a duration-based schedule. The resource-loaded schedule would contain all your hours and manpower built into it. This will give us a more accurate picture of what is happening on site and what could happen if a contractor was late. Duration-based schedules are not reliable because an activity displayed could have a month's duration with 75% of the work-taking place in the last week. With a resource-loaded schedule, it would identify that 75% of the work to be done at the end of the job. Where as the duration based schedules show that 75% of

the job is complete, when really only 25% of the work may be complete because 75% of the work is completed in the final week.

Reporting should identify the good as well as the bad, allowing praise for the effective completion of planned goals and at the same time should quickly identify potential future problems in order to plan a successful solution before that variance gets worse.

CONCLUSION

In conclusion, progress measurement is a crucial component of effective project control. Effective progress measurement helps to identify the variances to the plan early enough to either mitigate the impact, or cease the opportunity. There are many ways to measure progress and we feel that the best way to measure this progress is through the common denominator – man hours. Everything really comes back to how many man-hours were spent to the actual man hours planned. By measuring your performance, progress, and productivity you can measure how far ahead or behind a project is going. It is the process of developing a proactive system compared to using a reactive system.

REFERENCES

Materials used in preparation for this position paper follow:

1. **Skills & Knowledge of Cost Engineering.** 3rd edition (1992) Ch. 9; AACE International, pg 9-4.