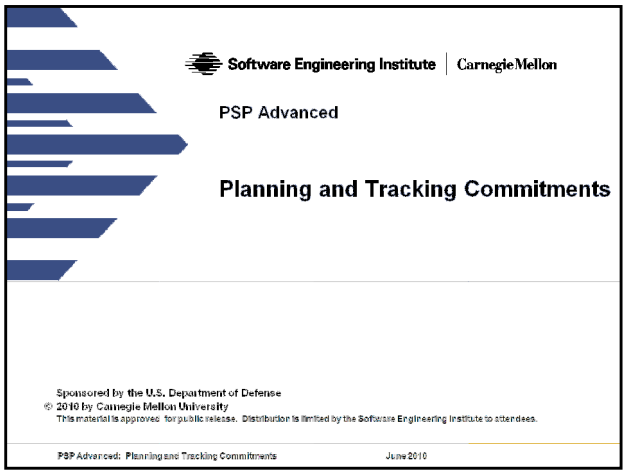
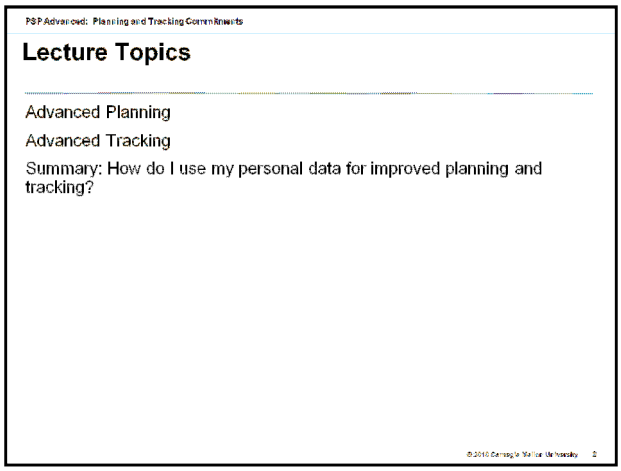


In this lecture we will look at ways on how to improve process performance through advanced planning and tracking

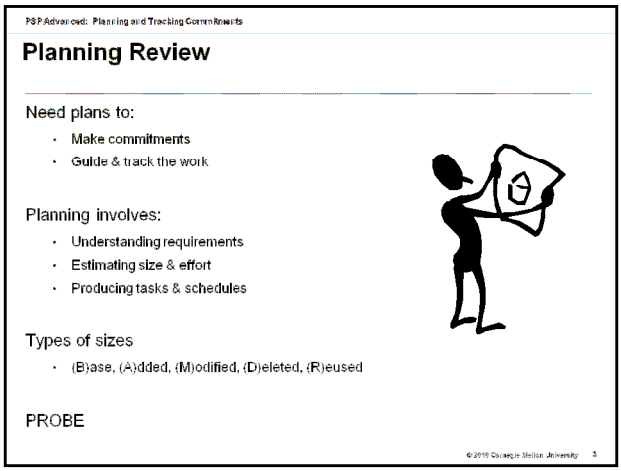


We will spend a decent amount of time getting the rationale behind the statistical concepts, Will give examples on correlation and significance to ensure a good level of understanding

Go over what regression parameters are, and what they mean for size and time, Cover in good detail what “combining estimates” means, go over multiple regression

Explain prediction intervals and how we use them, Using the student tool,

Go over other sound estimating practices as they form the foundation for the PROBE methods used within PSP



A review of the “Fundamental Planning Concepts” lecture from the PSP Fundamentals course

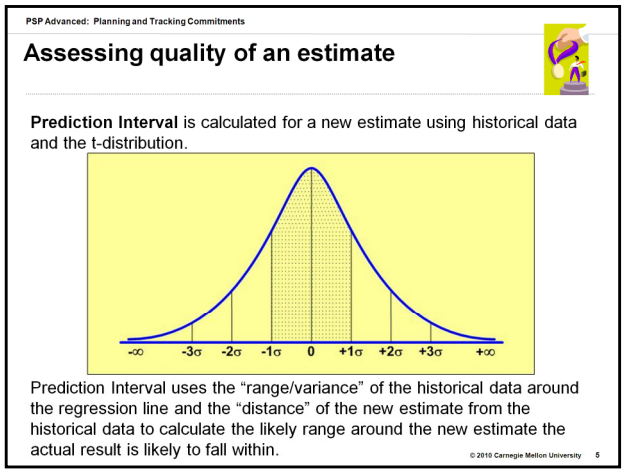
Advanced Planning

The TIME it takes to build a product is directly related to its SIZE!

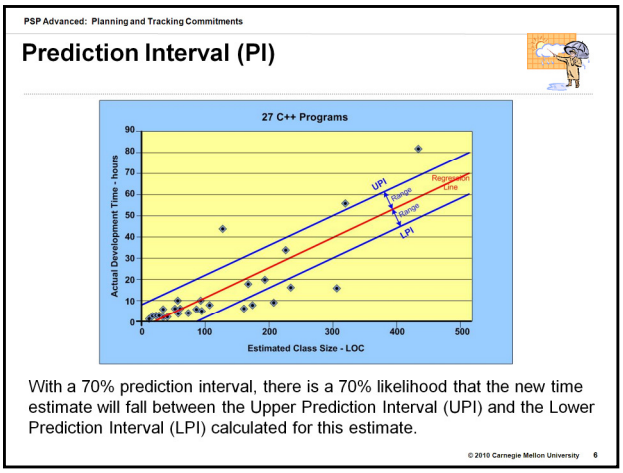
Higher accuracy in size estimating translates into more accurate time estimates.

Mandatory ingredient: DISCIPLINE!

- Record data as you do the work (real time recording!)
- Record ***all*** the prescribed data
- Stick with the process
- Evaluate what works and what does not!
- Use your historical data to guide planning



This is a bit tricky. The prediction interval is calculated for each new estimate. The range of the prediction interval is a function of both the historical data AND the unadjusted new estimate value (the estimated proxy size), i.e. the prediction range is different for different values of the estimated proxy size.



There are two problems with this chart. First, you can only calculate the prediction interval around a new estimated proxy size. There is no estimated proxy size show here for this range. However, you are mainly using this chart to show the concept of a range around the regression line. The second problem here is that the range arrows should be vertical, not perpendicular to the regression line.

Reducing Estimating Errors: Example

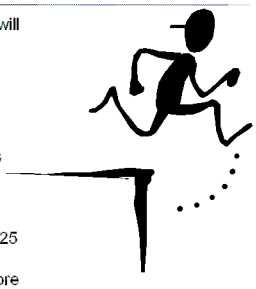
When estimating in parts, the total error will be less than the sum of the part errors.

- Errors tend to balance out.
- This assumes no common bias.

For a 1000-hour job with estimating accuracy of ± 50%, the estimate range is from 500 to 1500 hours.

If the estimate is independently made in 25 parts, each with 50% error, the

- total would be 1000 hours, as before
- estimate range would be from 900 to 1100 hours



Combining Individual Errors

To combine independently-made estimates

- Add the estimated values.
- Combine the variances (squares) of the errors.

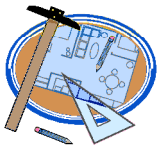
With 25 estimates for a 1000-hour job

- Each estimate averages 40 hours.
- The standard deviation is 50%, or 20 hours.
- The variance for each estimate is 400 hours^2.
- The variances add up to 10,000 hours^2.
- The combined standard deviation is the square root of the sum of the variances, or 100 hours.
- The estimate range is 900 to 1100 hours.

Class Exercise - 1

Start with three estimates.

- A = 45 hours, + or - 10
- B = 18 hours, + or - 5
- C = 85 hours, + or - 25



What is the combined estimate?

Class Exercise - 2

Start with three estimates.

- A = 45 hours, + or - 10
- B = 18 hours, + or - 5
- C = 85 hours, + or - 25

What is the combined estimate?

- total = 45 + 18 + 85 = 148 hours

What is the combined estimate range?

Class Exercise - 3

Start with three estimates.

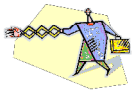
- A = 45 hours, + or - 10
- B = 18 hours, + or - 5
- C = 85 hours, + or - 25

What is the combined estimate?

- total = 45 + 18 + 85 = 148 hours

What is the combined estimate range?

- variance = 100 + 25 + 625 = 750
- range = square root of variance = 27.4 hours



What is the combined UPI and LPI?

Class Exercise - 4

Start with three estimates.

- A = 45 hours, + or - 10
- B = 18 hours, + or - 5
- C = 85 hours, + or - 25

What is the combined estimate?

- total = 45 + 18 + 85 = 148 hours

What is the combined estimate range?

- variance = 100 + 25 + 625 = 750
- range = square root of variance = 27.4 hours

What is the combined UPI and LPI?

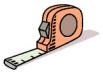
- UPI = 148 + 27.4 = 175.4 hours
- LPI = 148 – 27.4 = 120.6 hours

Size Estimating for Parts other than LOC - 1

Introduce a new unit of measurement when the current one does not correlate well for the task at hand:

Introduce:

- A new unit of measurement,



- A new size proxy

Size Estimating for Parts other than LOC - 2

The new unit of measurement should be:

- Useful for planning - size and time should correlate well
- Precise - there should be a precise size measurement definition
- Automatically countable
- Adaptable to the types of work we are likely to do in the future
- Provide the means to judge the accuracy of our estimates

The proxy should be :

- Easy to visualize at the beginning of the project
- Customizable to the special needs of using organizations
- Sensitive to any implementation variations that impact development cost and effort.

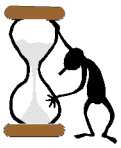
Size Estimating for Parts other than LOC - 3

Possible proxies:

- Objects
- Screens
- Files
- Scripts
- Document Chapters

Possible unit of measurements:

- Lines of Text within a document
- Number of controls on a screen



While size measure depends on the job, the effort measure is always ***Time***.

Selecting a Size Measure - 1

Start with historical data from some past projects

- Development effort
- Product characteristics (candidate size measures)
- Special conditions

Rank the products by development effort.

See what characteristics distinguish those products that took the greatest effort from those that took least.

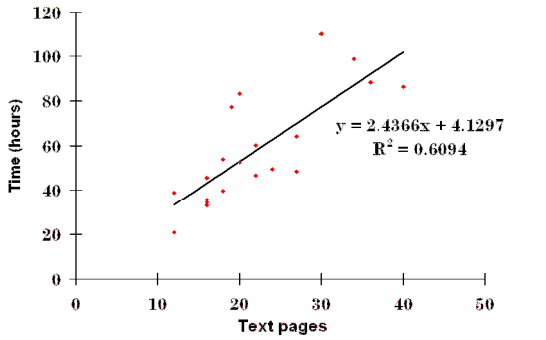
Selecting a Size Measure - 2

Determine if the candidate size measure is related to effort

- Create a graph with the candidate size measure on the horizontal axis and effort on the vertical axis
- Plot each pair of historical data (candidate size measure, effort) as a point on the graph
- If the points define a line, then the candidate size measure is related to effort and can be used for planning.

There may be no single best size measure. A combination of size measures could be needed.

Example: Text Pages versus Writing Time



Using Multiple Proxies

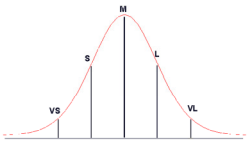
With size/hour data for several proxies:

- estimate each as before
- combine the total estimates and prediction intervals as just described

Use multiple regression if:

- there is a correlation between development time and each proxy
- the proxies do not have separate size/hour data

Intuitive Size Ranges



In judging size, our intuition is generally based on a normal distribution.

That is, we think of something as of average size if most such items are about that same size.

We consider something to be very large if it is larger than almost all items in its category.

When items are distributed equally around the mean, it is called a normal distribution.

With normally distributed data, the ranges should remain reasonably stable with the addition of new data points.

The Distribution of Size Data - 1

With a large volume of data, you could calculate the mean and standard deviation of that data.

For the size ranges

- Medium would be the mean value.
- Large would be mean plus one standard deviation.
- Small would be mean minus one standard deviation.
- Very large would be mean plus two standard deviations.
- Very small would be mean minus two standard deviations.

This method would provide suitably intuitive size ranges if the data were normally distributed.

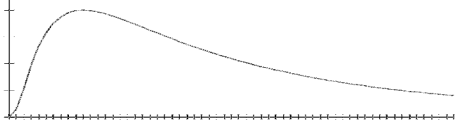
The Distribution of Size Data - 2

Program size data are not normally distributed.

- many small values
- a few large values
- no negative values

With size data, the mean minus one or two standard deviations often gives negative size values.

The common strategy for dealing with such distributions is to treat it as a log-normal distribution.



The Log-Normal Distribution

To normalize size data, do the following:

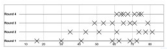
1. Take the natural logarithm of the data.
2. Determine the mean and standard deviation of the log data.
3. Calculate the average, large, very large, small, and very small values for the log data.
4. Take the inverse log of the ranges to obtain the range size values.

This procedure will generally produce useful size ranges.

Other Estimating Methods

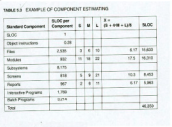
The following methods are important not only because they have each been found useful but also because their concepts form the foundation for the PROBE method used with the PSP.

- Wideband-Delphi



- Fuzzy Logic

- Standard-Component



- Agile Story Points

- Function Points

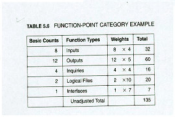


TABLE 5.6 FUNCTION-POINT CATEGORY EXAMPLE

Basic Counts	Function Types	Weights	Total
8	Inputs	8 × 4	32
12	Outputs	12 × 5	60
4	Inquiries	4 × 4	16
2	Logical Files	2 × 10	20
1	Interfaces	1 × 7	7
	Unadjusted Total		135

Estimating Considerations in Planning

Estimating Bias

Incomplete-knowledge bias

Over-compensation

Selecting proper level of abstraction

Large jobs

Unprecedented products

Improving estimating accuracy by sub-dividing estimates into parts

Selecting a size measure that ***correlates*** with development time

Summary: Advanced Planning

Have discipline, record real time, stick to process.

Choose a unit of measure that correlates well with development time.

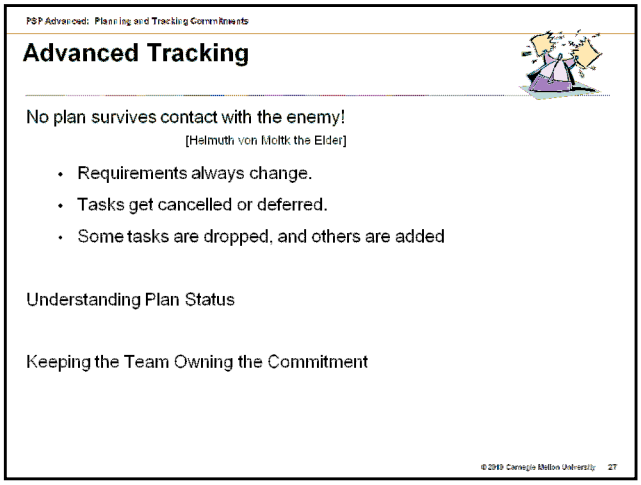
Choose intuitive proxies that are easy to visualize.

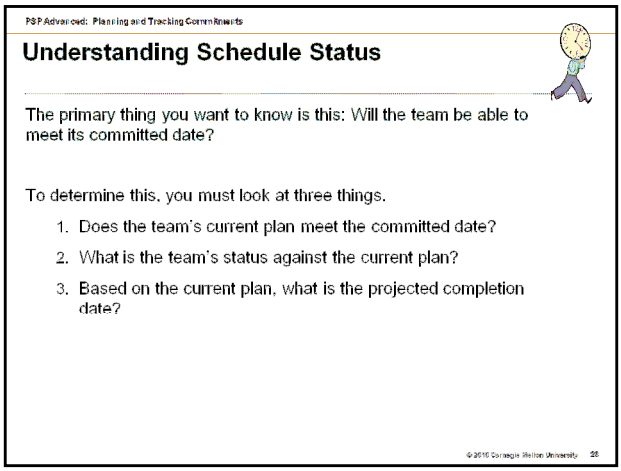
Continuously check your estimates against prediction intervals.

Improve estimating accuracy by subdividing estimates into parts.

Introduce a new unit of measurement when the current one does not correlate well.

Combine other estimating methods as found suitable.


PSP Advanced: Planning and Tracking Commitments
Advanced Tracking
No plan survives contact with the enemy!
[Helmuth von Moltk the Elder]
• Requirements always change.
• Tasks get cancelled or deferred.
• Some tasks are dropped, and others are added
Understanding Plan Status
Keeping the Team Owning the Commitment
© 2010 Carnegie Mellon University 27


PSP Advanced: Planning and Tracking Commitments
Understanding Schedule Status
The primary thing you want to know is this: Will the team be able to meet its committed date?
To determine this, you must look at three things.
1. Does the team's current plan meet the committed date?
2. What is the team's status against the current plan?
3. Based on the current plan, what is the projected completion date?
© 2010 Carnegie Mellon University 28

PSP Advanced: Planning and Tracking Commitments

Possible Problems

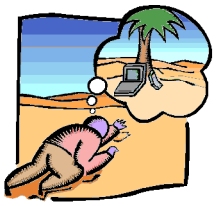
A large number of task hours for unfinished tasks could indicate a problem. Normally, this should be less than 20 per team member. Possible problems include the following.

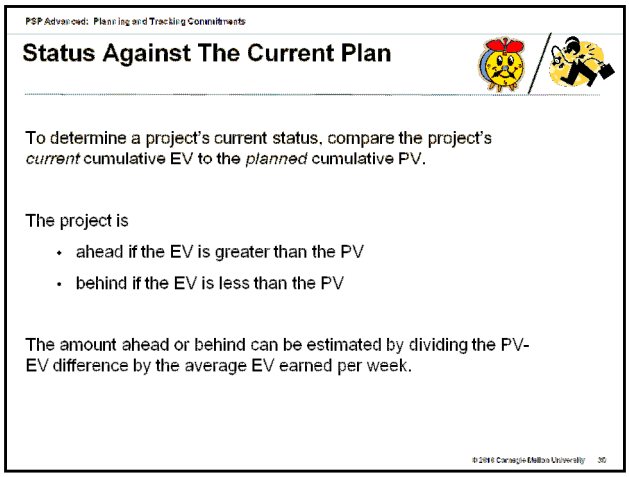
The plan is "bad" because:

- tasks are too large
- task breakdown is wrong

The team is "blocked" because it is:

- waiting on a dependency
- encountering a problem



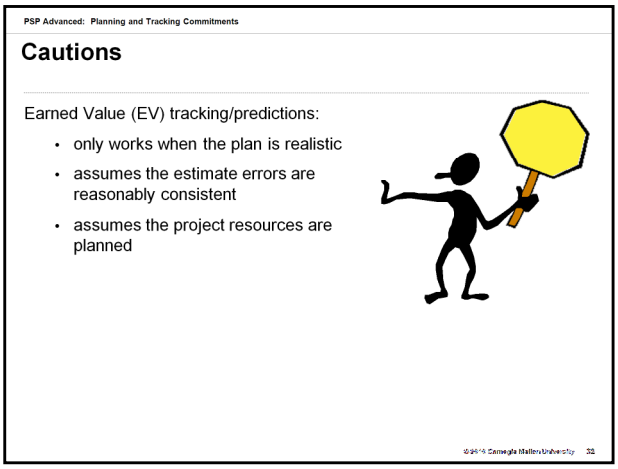

PSP Advanced: Planning and Tracking Commitments
Status Against The Current Plan
To determine a project's current status, compare the project's *current* cumulative EV to the *planned* cumulative PV.
The project is
• ahead if the EV is greater than the PV
• behind if the EV is less than the PV
The amount ahead or behind can be estimated by dividing the PV-EV difference by the average EV earned per week.
© 2010 Carnegie Mellon University 30

PSP Advanced: Planning and Tracking Commitments

Estimating Project Completion

To estimate the project completion date with EV

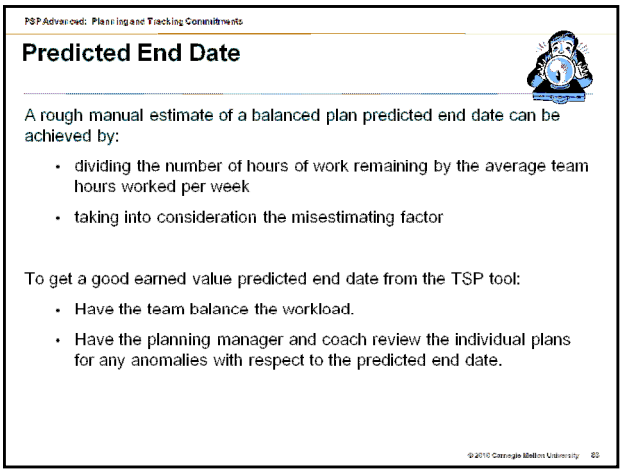
- Determine the EV needed to finish.
- Determine the rate at which the team is earning EV.
- Determine how long it will take the team to earn the remaining EV.

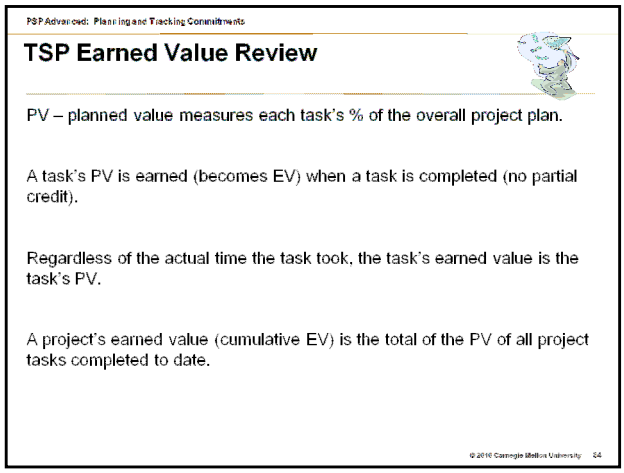


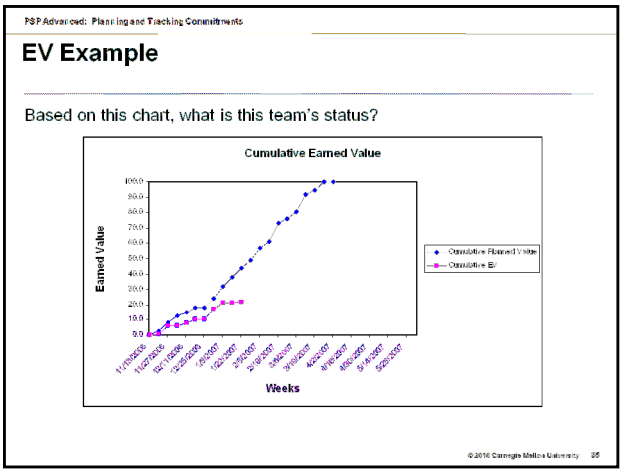
Bullet 1 - EV predictions are not good when the plan is not based on reality. For instance, it the plan for testing is 10% of the development effort and it really takes 40% of the development effort, the EV prediction of when testing will be complete will be way off.

Bullet 2 – Since the EV is predicting based on comparing estimates to actuals for the work completed and projecting that relationship into the future, it assumes that relationship holds for the future work. For instance, if your estimates have been 10% under on the work completed so far, the EV predictions assume that your estimates on the remaining work are also 10% under.

Bullet 3 – To make an EV prediction of when the work will be finished, you need to know the planned resources that will be available through the predicted finish date.


PSP Advanced: Planning and Tracking Commitments
Predicted End Date
A rough manual estimate of a balanced plan predicted end date can be achieved by:
• dividing the number of hours of work remaining by the average team hours worked per week
• taking into consideration the misestimating factor
To get a good earned value predicted end date from the TSP tool:
• Have the team balance the workload.
• Have the planning manager and coach review the individual plans for any anomalies with respect to the predicted end date.
© 2010 Carnegie Mellon University 83


PSP Advanced: Planning and Tracking Commitments
TSP Earned Value Review
PV – planned value measures each task's % of the overall project plan.
A task's PV is earned (becomes EV) when a task is completed (no partial credit).
Regardless of the actual time the task took, the task's earned value is the task's PV.
A project's earned value (cumulative EV) is the total of the PV of all project tasks completed to date.
© 2010 Carnegie Mellon University 34

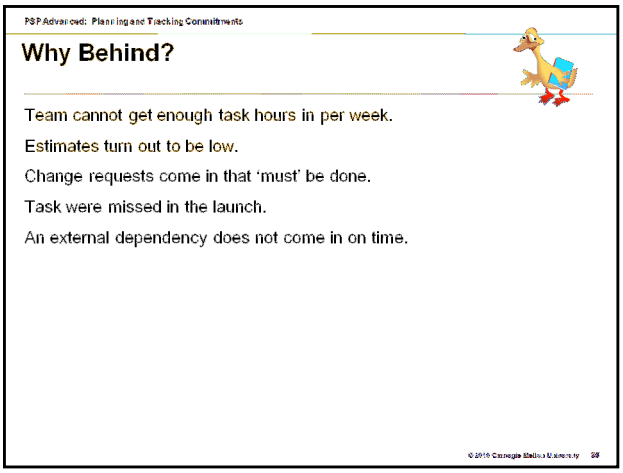


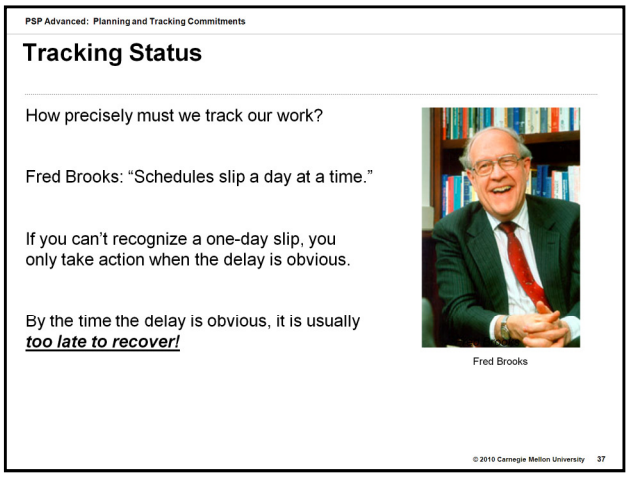
Discuss the team status with the class

•Is the team behind?

•Why is it behind? – kind of a trick answer, there is not enough information to tell.

•What can cause a team to get behind schedule? – record on a flip chart


PSP Advanced: Planning and Tracking Commitments
Why Behind?
Team cannot get enough task hours in per week.
Estimates turn out to be low.
Change requests come in that 'must' be done.
Task were missed in the launch.
An external dependency does not come in on time.
© 2010 Carnegie Mellon University 36



As Fred Brooks said, "Schedules slip a day at a time." To maintain schedules and costs, these one-day slips must be recovered the next day or the delays will soon compound and become completely unmanageable. With current practices, schedule slips are typically undetectable until projects are weeks or months late. The only clear indicators are code complete or test completion. Even then, these are often very fuzzy dates. The code is rarely complete when the developers say it is and testing is typically stopped when all or most of the existing test cases run, not when some quality criteria are met.

Summary: Advanced Tracking

Plans *always* change *all the time*.

Use Planned Value and Earned Value to understand status.

Regularly re-estimate project completion based on current Earned Value rate.

Recognize 1-day slips.

If behind schedule, analyze reasons.

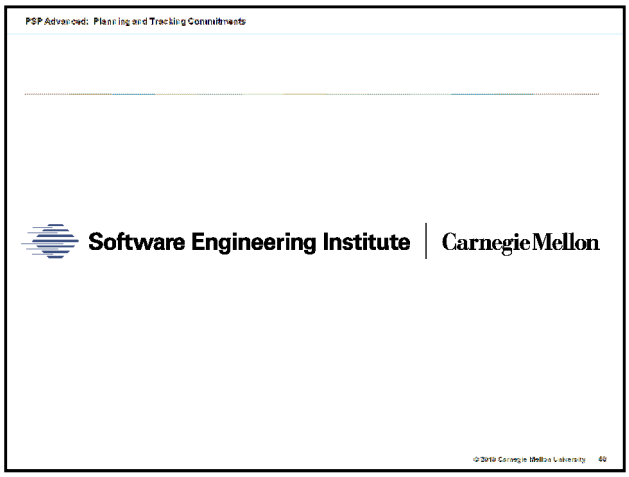
Understand and analyze what the linear regression parameters are telling you.

Re-plan as needed and have the team balance the workload.

Messages to Remember

In order to properly plan and track:

- collect and record the data needed to manage the plan
- manage your personal plan
- know the status of your commitments
- proactively manage and communicate the risks and issues with your commitments
- regularly report your status to your management!


PSP Advanced: Planning and Tracking Commitments
Software Engineering Institute | Carnegie Mellon
© 2010 Carnegie Mellon University 40