Software Engineering
Lecture 03

Earned-Value
Planning and Tracking

Referenced documents may be accessed via the URLs located on the course Angel page. Off-campus access will require authentication.

Outline

- Motivation
- CMM and Project Planning/Tracking
- Earned Value Management
- Earned Value Example
- Issues
- Suggestions

Motivation

- ***Why Do Projects Fail?***
  - ***Unrealistic Schedules***
    - Encourages a mad rush to get a product built, regardless of the product's quality or how well the product meets the customers needs

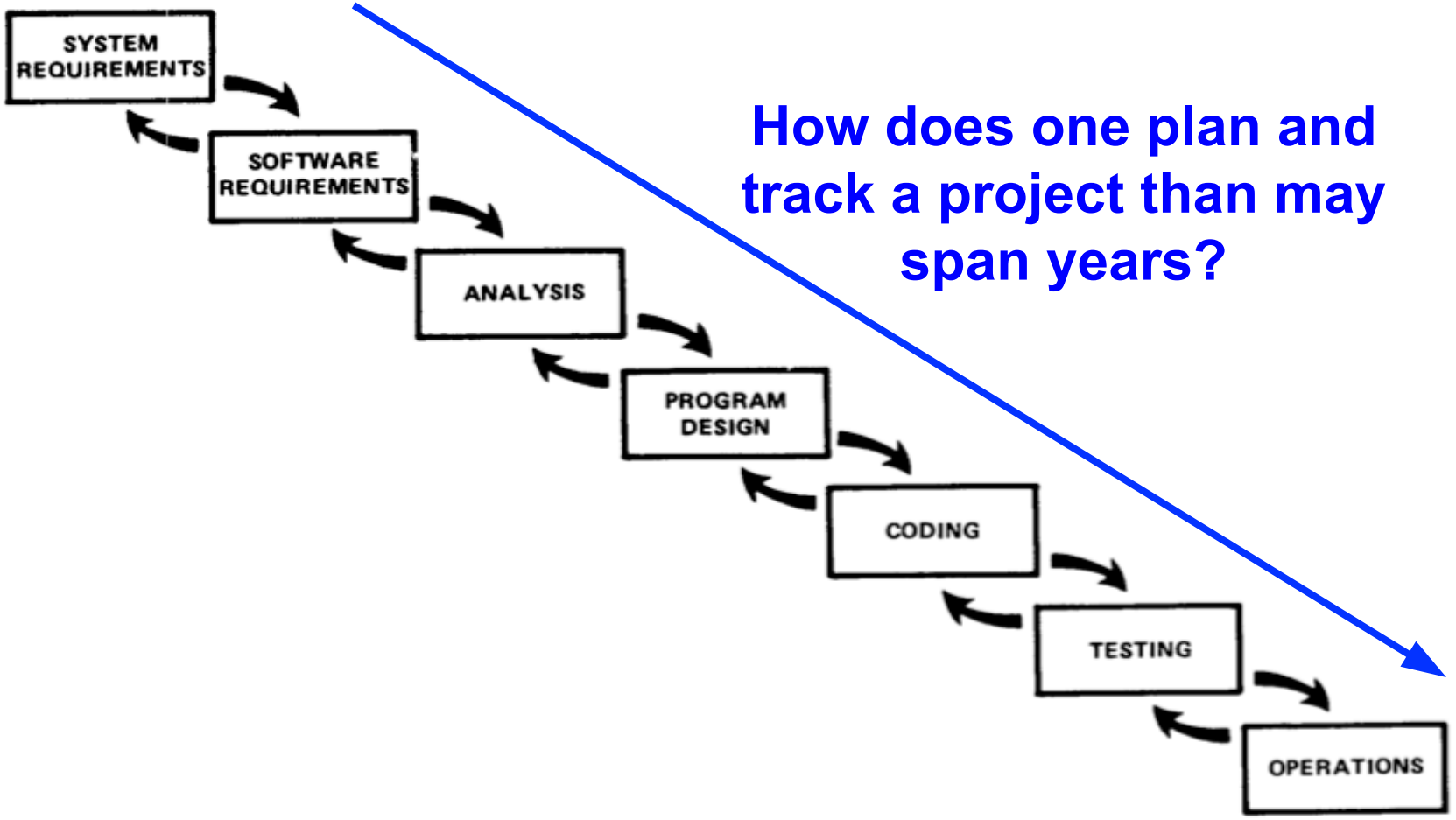
Winning with Software: An Executive Strategy
Watts S. Humphrey, 2002

Capability Maturity Model (CMM)

CMM Level	Key Process Areas (KPAs)
5 - Optimizing	Process change management Technology change management Defect prevention
4 - Managed	Software quality management Quantitative process management
3 - Defined	Peer reviews Intergroup coordination Software product engineering Integrated software management Training program Software process definition Software process focus
2 - Repeatable	Software configuration management Software quality assurance Software subcontract management **Software project tracking** and oversight **Software project planning** Requirements management
1 - Initial	

See Paulk et al., *The Capability Maturity Model: Guidelines for Improving the Software Process*

Waterfall Process



How does one plan and track a project than may span years?

Winston Royce, "Managing the Development of Large Software Systems",
Technical Papers of Western Electric Show and Convention (WesCon), August 25-28, 1970.

Earned Value Management

- Provide a framework for constructing a realistic schedule
- Provide an objective measure of progress

Watts S. Humphrey, ***PSP: A Self-Improvement Process for Software Engineers, 2005***

Task Hours - 1

- A ***task hour*** is defined as time spent directly working on project artifacts included in the project plan
  - Not every hour during work week is considered a task hour
  - For a nominal 40-hour work week, many developers struggle to achieve 12-15 task hours per week
  - Task hours produce deliverables!

Watts S. Humphrey, ***PSP: A Self-Improvement Process for Software Engineers, 2005***

Task Hours - 2

- Task hours may vary greatly
  - Week-to-week
    - Sick days, holidays, etc.
  - Developer-to-developer
    - One developer may be full-time on a project while another is half-time

Task Hours - 3

- **What happens when a plan contains an unrealistic task hours per week assumption?**
  - **Planning to fail**
    - Projects whose schedules are based upon unrealistic task hour assumptions start out “challenged” at best
    - Heroic last-minute efforts may succeed but may also lead to employee burn out

Earned versus Planned Value

- Technique for objectively monitoring cost and schedule performance used in a variety of industries

- **Planned Value of Task X**
  - Estimated percent of labor required to complete Task X relative to entire project

- **Earned Value of Task X**
  - Planned value that is earned only upon completion of Task X

Earned Value Performance

- **Schedule Performance Index (SPI)**

  SPI = EV / PV

  SPI < 1 ==> Behind Schedule

  SPI = 1 ==> On Schedule

  SPI > 1 ==> Ahead of Schedule

Constructing an Earned Value Plan

- Start with a list of tasks
- Prioritize task list
- Estimate the hours required per task
- Compute planned values
- Estimate available task hours per week
- Schedule tasks
- Track progress
  - Gain **earned value** only when task is complete

Prioritized Task List (EV Example #1)

Workflow	Task	Estimated Hours	Cumulative Planned Hours
Requirements	Requirements Workshop	4	4
Requirements	Use Cases	8	12
Requirements	Domain Class Diagram	4	16
Test	Requirements Inspection	2	18
Design	Refine Class Diagram	10	28
Design	Detailed Design	12	40
Test	Design Review	2	42
	Total	42	

Prioritized Task List with Planned Values (EV Example #1)

Workflow	Task	Estimated Hours	Cumulative Planned Hours	Planned Value	Cumulative Planned Value
Requirements	Requirements Workshop	4	4	9.5	9.5
Requirements	Use Cases	8	12	19.0	28.6
Requirements	Domain Class Diagram	4	16	9.5	38.1
Test	Requirements Inspection	2	18	4.8	42.9
Design	Refine Class Diagram	10	28	23.8	66.7
Design	Detailed Design	12	40	28.6	95.2
Test	Design Review	2	42	4.8	100.0
	Total	42		100	

4 / 42 = 9.5%

Estimate Available Task Hours (EV Example #1)

Week #	Planned Hours	Cumulative Planned Hours
1	4	4
2	4	8
3	6	14
4	6	20
5	0	20
6	6	26
7	6	32
8	4	36
9	4	40
10	6	46
11	6	52
12	6	58

Schedule Tasks (EV Example #1)

Workflow	Task	Estimated Hours	Cumulative Planned Hours	Planned Value	Cumulative Planned Value
Requirements	Requirements Workshop	4	4	9.5	9.5
Requirements	Use Cases	8	12	19.0	28.6
Requirements	Domain Class Diagram	4	16	9.5	38.1
Test	Requirements Inspection	2	18	4.8	42.9
Design	Refine Class Diagram	10	28	23.8	66.7
Design	Detailed Design	12	40	28.6	95.2
Test	Design Review	2	42	4.8	100.0
	Total	42		100	

Week #	Planned Hours	Cumulative Planned Hours	Actual Hours	Cumulative Actual Hours	Planned Value	Cumulative Planned Value	Earned Value	Cumulative Earned Value
1	4	4			9.5	9.5		
2	4	8			0.0	9.5		
3	6	14			19.0	28.5		
4	6	20			14.3	42.8		
5	0	20			0.0	42.8		
6	6	26			0.0	42.8		
7	6	32			23.8	66.6		
8	4	36			0.0	66.6		
9	4	40			28.6	95.2		
10	6	46			4.8	100.0		
11	6	52						
12	6	58						

Estimated Week of Completion = Week #10

Track Progress (EV Example #1)

Workflow	Task	Estimated Hours	Cumulative Planned Hours	Planned Value	Cumulative Planned Value
Requirements	Requirements Workshop	4	4	9.5	9.5
Requirements	Use Cases	8	12	19.0	28.6
Requirements	Domain Class Diagram	4	16	9.5	38.1
Test	Requirements Inspection	2	18	4.8	42.9
Design	Refine Class Diagram	10	28	23.8	66.7
Design	Detailed Design	12	40	28.6	95.2
Test	Design Review	2	42	4.8	100.0
	Total	42		100	

Week #	Planned Hours	Cumulative Planned Hours	Actual Hours	Cumulative Actual Hours	Planned Value	Cumulative Planned Value	Earned Value	Cumulative Earned Value
1	4	4	4	4	9.5	9.5	9.5	9.5
2	4	8	5	9	0.0	9.5	0.0	9.5
3	6	14	7	16	19.0	28.5	19.0	28.5
4	6	20	5	21	14.3	42.8	0.0	28.5
5	0	20	0	21	0.0	42.8	0.0	28.5
6	6	26	4	25	0.0	42.8	9.5	38.0
7	6	32	8	33	23.8	66.6	4.8	42.8
8	4	36	5	38	0.0	66.6	0	42.8
9	4	40	5	43	28.6	95.2	23.8	66.6
10	6	46	6	49	4.8	100.0	0	66.6
11	6	52	6	55			28.6	95.2
12	6	58	6	61			4.8	100.0

Schedule Slip Begins

Actual Week of Completion = Week #12

Issues with EV Management

- Many managers don't understand why a developer cannot achieve 30-40 task hours per week

- Requirements change

Earned Value Planning Suggestions - 1

- **Keep your estimated weekly task hours in mind when constructing your task list**
  - Want to be able to show progress each week
  - Break larger tasks into smaller tasks so progress may be visible
  - Example:
    - For a person working full time on the project, keep task size at or below 10 hours per task
    - Each week one or more small tasks will be completed assuming that you get in at least 10 task hours each week

Earned Value Planning Suggestions - 2

- **Set an aggressive but achievable schedule**
- **Increasing the number of weekly task hours**
  - **Managers may designate "quiet" time every day**
    - Designate some period of time every day in which no meetings can occur
  - **Everyone should plan your daily tasks and work your plan**