

Process: Risk, Estimation, Planning, and Metrics



15-313:
Foundations of Software Engineering

Jonathan Aldrich

Outline



- ☐ **Risk Management**
- ☐ Estimation
- ☐ Planning
- ☐ Metrics

An Example of Risk

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[source: Gil Taran]



Risk Defined



[source: Gil Taran]

- The possibility of suffering loss
 - Webster's dictionary, 1981

- All definitions share the following characteristics:
 - **Uncertainty** - an event may or may not happen
 - **Loss** - an event has unwanted consequences or losses

Risk Management

www.dilbert.com

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- ☐ Anticipating risks so they are not a surprise
- ☐ Plan response to risk
- ☐ Decreasing the magnitude of a potential loss
- ☐ Decreasing the chance of loss
- ☐ Increase control over the risk

Picture of Success



[source: Gil Taran]

- The minimum set of conditions that must be met for project members to consider the project a success
 - A standard against which to measure risks
 - Not the set of all goals

- Characteristics
 - Set at specific time in future
 - Measurable
 - Agreed to by team
 - Short – e.g. one slide with 4-5 statements

Example Pictures of Success

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- ☐ You in this class?
- ☐ Project in a project course?

Picture Of Success – Course Project



[source: Gil Taran]

- ❑ We deliver the “must have” requirements as agreed by us and the client by the end of the semester with the levels of quality specified by the client.
- ❑ The team shares the workload evenly and collaboratively throughout the project and resolves conflict through timely team communication.
- ❑ We have a designated process that is thoroughly documented and followed throughout the project.
- ❑ We periodically, at a minimum once a month, review our actions and processes so as to identify actions that get implemented in the next phase.
- ❑ We are able to articulate core principles in the areas of people, process, and technology, and reflect on having used them in our project so as to understand our successes and failures and react accordingly.

Defining Risks



[source: Gil Taran]

- Condition
 - Phrase describing some factual condition of the project
 - May be positive or negative
 - Example: *There is water on the floor*

- Consequence
 - Potential negative consequence of the condition
 - Example: *Someone might slip in it and get hurt*

Risk Statements



- ☐ What are risks to your picture of success in this course?

Risk Analysis



- Impact: the severity of the loss
- Probability: the likelihood of the loss
- Exposure: Impact * Probability
 - A measure of priority
- Time frame: how long until risk materializes?
 - Urgency combines priority and time frame
- Mitigation
 - Approach to reduce impact or probability of a risk
- Periodic monitoring
 - Identify new risks
 - Increase or decrease in impact or probability

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- ☐ Risk Management
- ☐ **Estimation**
- ☐ Planning
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Estimation is Difficult



- Average project exceeds cost, schedule estimates by 100% - 1998-2000 Standish Report

- Factors
 - Complex systems are hard to estimate
 - Problems look easy until you see the detail
 - We never build the same thing twice
 - Management pressure affects estimates

Estimation Basics



- Cost = person-months * cost-of-person
 - cost-of-person includes benefits, taxes, equipment, support staff, and building
 - may be 2-3 times salary
 - Which factor is more uncertain?

Estimation Principles



- Ultimately based on experienced judgment
 - Structuring techniques may improve accuracy

- Principles
 - Use historical data
 - Divide and conquer
 - Many points of view
 - Correction over time

Estimation: Historical Data



- Find similar projects with cost data
 - Domain
 - Size
 - Architecture

- Adjust for differences
 - Project size/scope
 - Improved expertise
 - New/unknown problems
 - Reuse of old artifacts
 - Note: reuse is not free! Adaptation is required

Estimation: Divide and Conquer

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- Work Breakdown Structure
 - Divide hierarchically into tasks
- Develop conceptual design
 - Break into parts
 - Only for estimation: should redo entirely in real design phase!
- Estimate tasks/parts separately
 - Combine estimates
 - Recognize costs for integration

Estimation: Wideband Delphi



[source: Mel Rosso-Llopart]

- Planning
 - Define the scope of the problem
 - Break large problems into smaller
- The Kickoff
 - Deliver problem to team
- Individual preparation
 - Everyone does individual estimates on problem parts
 - All assumptions are written down
- Estimation Meeting
- Assembling Tasks
 - Put together the estimates of team members
- Review Results as team

Wideband Delphi: Estimation Meeting

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[source: Mel Rosso-Llopart]

- ❑ A moderator collects the estimates for the task being estimated
 - Present the average or a line with all estimates (anonymous)
- ❑ The estimate is discussed and assumptions presented
- ❑ Moderator calls for a new estimate from everyone
- ❑ Values are again presented to the team as average or line
- ❑ Continue process until:
 - Four rounds are completed
 - The estimates “converged” to an acceptably narrow range
 - The allotted meeting time is complete
 - All participants are unwilling to change their estimates
- ❑ 15-20 minutes per item discussed

Rounds in Delphi



[source: Mel Rosso-Llopart]

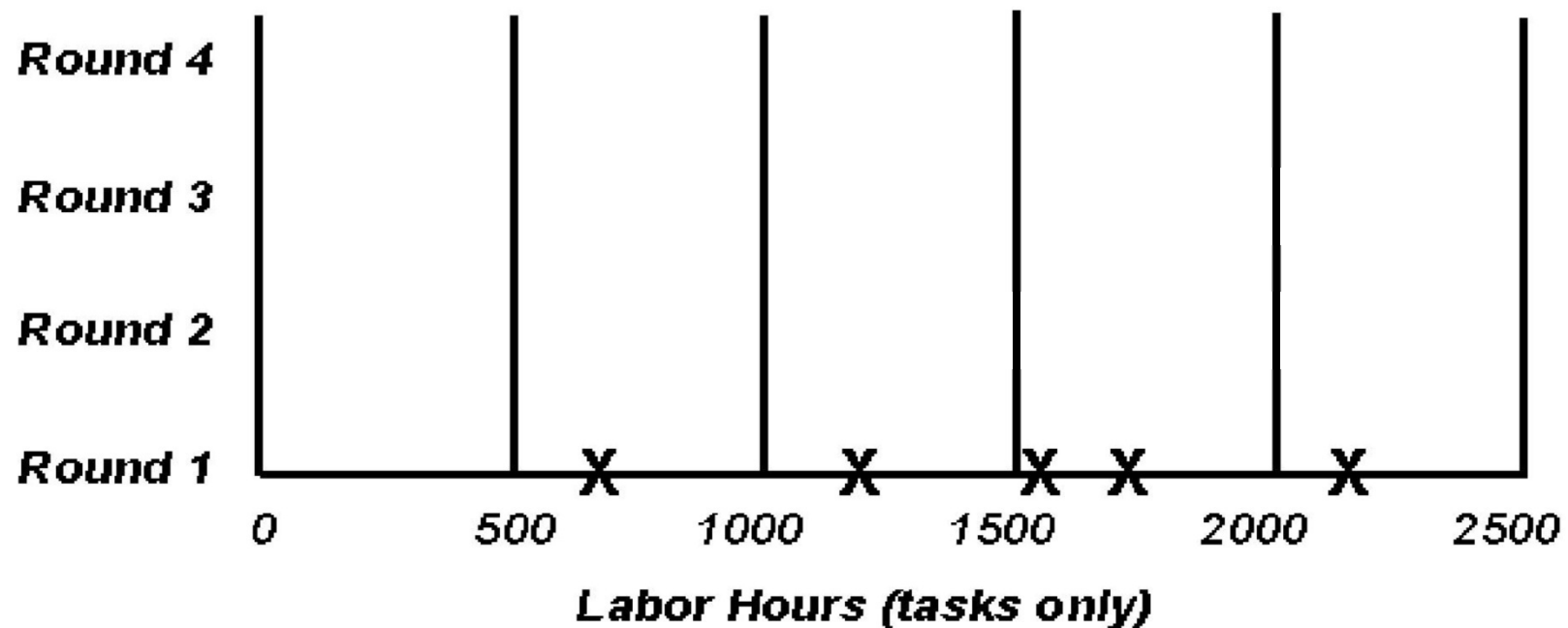


Figure 4. Estimation chart showing three rounds from a Wideband Delphi session.

Wideband Delphi: Best Practices



[source: Mel Rosso-Llopart]

- ☐ Gather a heterogeneous team
- ☐ Write down assumptions
- ☐ Make anonymous estimates
- ☐ Never estimate tasks larger than you are comfortable with

Estimation: Correction over Time

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- Last task estimated cost: 10 hours
- Last task actual cost: 20 hours

- Next task estimated cost: 15 hours
 - How long will it actually take?

- XP: load factor
 - Developers estimate tasks in “ideal time”
 - Time with no meetings, questions from buddies, etc.
 - Multiply all estimates by empirically measured “load factor”
 - $\text{load factor} = \text{actual} / \text{estimate} = 20 / 10 = 2.0$
 - $\text{New task estimate} = \text{ideal} * \text{load factor} = 15 * 2.0 = 30$

Estimation: Function Points



[source: Alvin Alexander, devdaily.com]

- Standard unit of measure for software size
 - In terms of requirements, not code
- Data Functions
 - Internal logical files
 - Database table, file, preferences
 - # FPs depends on record, field structure
 - External interface files
 - Data the app needs but does not maintain
- Transactional Functions:
 - External Inputs
 - User data entry, automatic data feeds
 - External Outputs
 - Output of computed or processed data
 - External Inquiries
 - Output of retrieved data

From FPs to Effort



- Historical data
 - Cost per FP on similar projects
 - May need fudge factors to account for differences

- COCOMO
 - Adjust function points based on project characteristics
 - Product: reliability, complexity, reuse, ...
 - Platform: performance, storage, change
 - Personnel: capability, continuity, experience
 - Project: tools, distributed dev., schedule

 - Convert to person-hours based on historical data

Outline



- ☐ Risk Management
- ☐ Estimation
- ☐ **Planning**
- ☐ Metrics

Planning

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- Choosing in what order to do things
- Inputs
 - Cost determined by engineers
 - Priority determined by customer
- Ordering Principles
 - Deliver a working system early
 - Biggest risk: not delivering anything
 - Deliver customer value early
 - Agile: customer can change his mind!
 - Mitigate risks early
 - Beware: New risks may come up
 - Respect dependencies & critical path

Outline



- ☐ Risk Management
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- ☐ Planning
- ☐ **Metrics**

Metrics: How are we doing?



- Earned Value
 - Sum of *estimated cost* of all *tasks actually completed*
 - Expressed as a percentage of total budgeted cost

- Cost Performance Index
 - Are we over budget?
 - $CPI = BCWP / ACWP$
 - Budgeted / Actual Cost of Work Performed

- Schedule Performance Index
 - Are we on time?
 - $SPI = BCWP / BCWS$
 - Budgeted Cost of Work Performed / Scheduled

Earned Value Exercise

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Task	Budget	Month	Done?	Actual
1	20	1	N	
2	5	1	Y	10
3	10	1	Y	15
4	10	2	Y	5

- ❑ Earned Value = BCWP = value of tasks 2,3,4 = $5+10+10 = 25$
- ❑ $CPI = BCWP / ACWP = 25 / (10+15+5) = 25/30$
- ❑ $SPI = BCWP / BCWS = 25 / (20+5+10) = 25/35$