Topics covered

1. Introduction
2. Approaches to Estimation
4. Level of Uncertainty in an Estimation Process
5. The Productivity Model
6. The Estimation Process
7. Roles & Responsibilities
1.2 Approaches to Estimation
Generic approaches in estimation models

- Judgment & craftsmanship
- Engineering
Craftsmanship


Adapted from https://sites.google.com/site/seourpicz/1/humor/ar/1/chistes-page-50

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Judgment & craftsmanship

• Known as: “expert judgment” estimation approach
• Highly dependent on the expertise of people (craft)
• Varies from project to project
• This estimation process is subjective:
  • Without statistical analysis
  • Little traceability to quantitative historical data
• Improving ‘expert judgment’ is also subjective
Engineering

- Detailed observation of past projects
- Quantitative data collection
- Analysis of the impact of individual variables (one at a time)
- Selection of relevant samples
- Demographics and statistical analyses
- Very careful extrapolation to similar or other contexts
1.3 The estimation process: Overview & current practices
Common view of a estimation process
Estimation inputs

- Product requirements (functional and non-functional)
- Software development process (iterative, agile, etc.)
- Project constraints (deadlines, budget, etc.)
Estimation models

• Expert judgment
  • Implicit models from experts
  • The models are not document

• Mathematical model
  • Regression, case-based reasoning, neural networks, etc.
  • Traceability to quantitative data
The estimate

- Effort
- Cost
- Project duration


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Are current estimation practices mostly craft practices or engineering practices?

Figure 1.1 Common view of an estimation process.
Figure 1.2 Some poor estimation practices observed in industry.
Poor estimation practices: Inputs

Estimation inputs from customers:

• Brief description of the expected software system
• No measurement of functional requirements
• Summary text descriptions of non-functional requirements
• Lack of description → many cost drivers
Figure 1.2 Some poor estimation practices observed in industry.
Figure 1.3 Some of the worst estimation practices.
Poor estimation practices: Models

- Mix of formal or informal models with:
  - Local experience (expert judgment approach)
  - Mathematical models (books or tools)

- Guesstimate of Lines of Code:
  - with little knowledge of requirements
  - Limited knowledge of mix of programming languages, etc.

- Too many variables & cost drivers
Figure 1.3 Some of the worst estimation practices.
Estimation expectations
The dream: an accurate estimate

Estimation Inputs

Product Requirements = a wish list
Subjective assessment of process factors.
Project Constraints

Estimation Model

Expert Judgment
Black box models & Integration of adjustment factors

Estimation Output

The dream = An accurate estimate
Figure 1.2 Some poor estimation practices observed in industry.
Poor estimation practices: Outputs

• A single estimate selected as the project budget
• Limited analysis of variations in the estimates
• Limited documentation on the quality of the estimation process itself and of its estimation outcomes
• Overly optimistic attitude!
Current estimation practices lead to a tally of failures

Project success trends based on Standish Group data (adapted from Miranda 2010)
1.4 Level of Uncertainty in an Estimation Process
Levels of uncertainty

• The cone of uncertainty

• Uncertainty in a productivity model
The cone of uncertainty

Range of expected variations in models across the project life cycle

Adapted from Boehm 2000, figure 1.2, p.10

Margin of error = orders of magnitude!
Uncertainty in a productivity model

- 100% of projects within ±XX%
- 80% of projects within ±20%

Diagram showing a scatter plot with effort on the y-axis and size on the x-axis.
Uncertainty in a productivity model

• The context used to build the model may be different from the current situation
  • data collected

• Estimations are performed early in the project life cycle.
1.5 Productivity models
How productivity models are built?

- Using data from completed projects
- Quantitative information
  - Example: functional size of software
- Nominative information
  - Programming language
  - Categories of case tools
  - Levels of complexity
Mathematical equation models

Known Facts = No Uncertainty

- Product Requirements: Sized with ISO standards
- Successful Development Process
- No remaining risk

Model

Statistical techniques

Output

Equation & variance information

Effort

Size

CH01FG08
Benefits of mathematical equation models

• The variables are described using a documented set of conventions.
• The variables are quantitative & objective
• The performance of the model can be described and analyzed.
• The models can be used by anybody.
Expert judgment approach (a model ?)

- Informal, not documented
- Derived from past experience (subjective recollection of past projects)
- Lack of precise quantitative information of independent variables
  - Product size
  - Cost drivers

Can then precise information of dependent variables be reasonably expected?
- effort & duration?

1.6 The Estimation Process & its Phases
The estimation process
The estimation process

Staff experience

Imprecise requirements

Unknows

COST
EFFORT
RISK
Phases of the estimation process

A
Collection of Estimation Inputs

B
Execution of the productivity model

C
Adjustments

D
Budgeting & Contingencies

E
Re-estimation

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Phase A: Collection of the estimation inputs

Estimates of Inputs

- Product requirements & expected range of sizes
- Expected process
- Project constraints

Confidence in the inputs

Productivity model

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Phases B: Execution of the productivity model

- Estimates of inputs
  - Product
  - Process
  - Constraints

- Confidence in the inputs

- Confidence in the model

- Initial range of estimates

Repository of productivity data
Phase C: The adjustment process

Assumptions, risks & other cost drivers

Adjustment process

INFORMATION
Expected ranges of estimated values
Phase D: The budget decision

- Confidence in the inputs
- Assumptions, risks & other cost drivers
- Confidence in the estimation model
- Initial range of estimates
- Adjustment process
- INFORMATION Expected ranges of estimates values
- Business risks

A unique project budget
Contingency Funds

Repository of productivity data
Phase E: The re-estimation process
Phase F: Estimation process improvements
1.7 Budgeting & Estimating
Project budget

A budget = a single value (selected by a manager)
from a large range of candidate values

(identified by the software estimator)
Project budget: Strategies

- Overly optimistic culture
- Very conservative culture
- Hybrid

http://www.123rf.com/photo_16596571_two-business-teams-fight-each-other-by-pulling-rope-over-a-ground-crack.html
Overly optimistic budget

- Aggressive commercial culture
- Price to win

http://www.improveit360.com/should-you-lower-bids-to-win-the-deal/
Very conservative budget

- Long delays for approval
- Budget with a large number of contingencies
- Non competitive environment
1.7.2 Roles & Responsibilities
Estimation Roles

Estimator

• Build the productivity model
• Carry out phases A to C of the estimation process

Manager

• Select the optimal budget
• Allocate resources for implementing the estimation process
• Assign skilled and trained resources to the estimation process
Estimation Roles

Estimator

- Build the productivity model
- Carry out phases A to C of the estimation process

Manager

- Select the optimal budget
- Allocate resources for implementing the estimation process
- Assign skilled and trained resources to the estimation process
Estimator role:
Provide Information

- Confidence in the inputs
- Product
- Process
- Constraints
- Productivity model
- Initial range of estimates
- Adjustment process
- Estimation process improvements
- Re-estimation
- Project monitoring & control
- Assumptions, risks & other cost drivers
- INFORMATION Expected ranges of estimates values
- Business risks
- A unique project budget
- Contingency funds
- Repository of productivity data
- Repository of estimates
- $$$
Manager role: Pick a number & Manage Risk
1.8 Pricing strategies
Pricing strategies

- Time and materials billing mode
- Fixed price contract

http://www.stratagem-intl.co.uk/projects-pricing-strategy
Summary:
Which one correspond to your estimation process?
Key Lessons Learned

The goal of an estimation process should not be to provide a single hard figure, but rather to provide:

- information about ranges of plausible values,
- feedback about how good this information is,
- limitations of the information used as input to the estimation process,
- limitations of the information provided as output of the estimation process,
- analysis and mitigation of risks by documenting the assumptions made about the inputs, and the use of these inputs, in the estimation process.
Exercises

1. If you do not have quantitative information on your organization’s performance in software project delivery, can you expect to have good estimates for the next project? Explain your answer.

2. What are the two broad approaches to software estimation, and what are their differences?

3. Identify some of the worst practices with regard to inputting to an estimation process.

4. Identify some of the best practices with regard to inputting to an estimation process.

5. Identify some of the poor practices in handling the outputs of an estimation process.
Exercises

7. What do industry surveys tell us about the performance of software projects in meeting their budget and deadlines?
8. What is the difference between a ‘productivity model’ and an ‘estimation process’?
9. If you know the accuracy of a productivity model, what is the expected accuracy of its use in an estimation context?
10. How can you design a productivity model?
11. How do you evaluate the performance of a productivity model?
12. What are the benefits of mathematical productivity models?
13. For estimation, how would you handle cost drivers not included in the productivity model?
14. For estimation, how would you handle risk factors not included in the productivity model?
Exercises

14. How can an organization take into account potential scope changes when using its productivity model in an estimation context?

15. Discuss the key differences between providing an estimate for a project and taking a decision on a project budget. Discuss roles and responsibilities in estimation.

16. What are some of the key characteristics of estimation? Taking into account these key characteristics, what can you deliver when an organization expects accurate estimates from you? Provide your management with a better definition of ‘accuracy’ in this context.

17. When a manager selects a project budget from a range of estimates, what other major decision should he take concurrently?

18. How can an organization take into account actual scope changes in its estimation process?

19. Why should an organization have not only a plain productivity model, but also a re-productivity model?
Term Assignments

1. Document the estimation process in your organization.

2. Compare the performance of your projects with that documented in industry surveys, such as the Standish Group Chaos Report.

3. Compare the estimation process in your organization with the estimation processes illustrated in Figures 1.2 and 1.15. Identify improvement priorities for your organization’s estimation process.
Term Assignments

1. Propose an action plan to address the top 3 priorities for improving an organization’s software estimation process.

2. Compare the estimation process in Figure 1.15 with an estimation model proposed in a book. Comment on the similarities & differences. Identify strengths & weaknesses in the productivity model analyzed.

3. Take an estimation model proposed by a vendor and compare it to the estimation process in Figure 1.15. Comment on the similarities & differences. Identify strengths & weaknesses in the productivity model analyzed.

4. Take an estimation model that is available free on the Web and compare it to the estimation process in Figure 1.15. Comment on the similarities and differences. Identify strengths and weaknesses in the productivity model analyzed.