REQUIREMENTS ENGINEERING - ESTIMATION

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OUTLINE OF THIS TALK

- Software Estimation
  - Definition
  - Good Estimates vs. Bad Estimates
  - How to make an estimate
  - Other methods of estimation

WHAT IS AN ESTIMATE?

A tentative evaluation or rough calculation

A preliminary calculation of the cost of a project

A judgement based on one's impressions; opinion

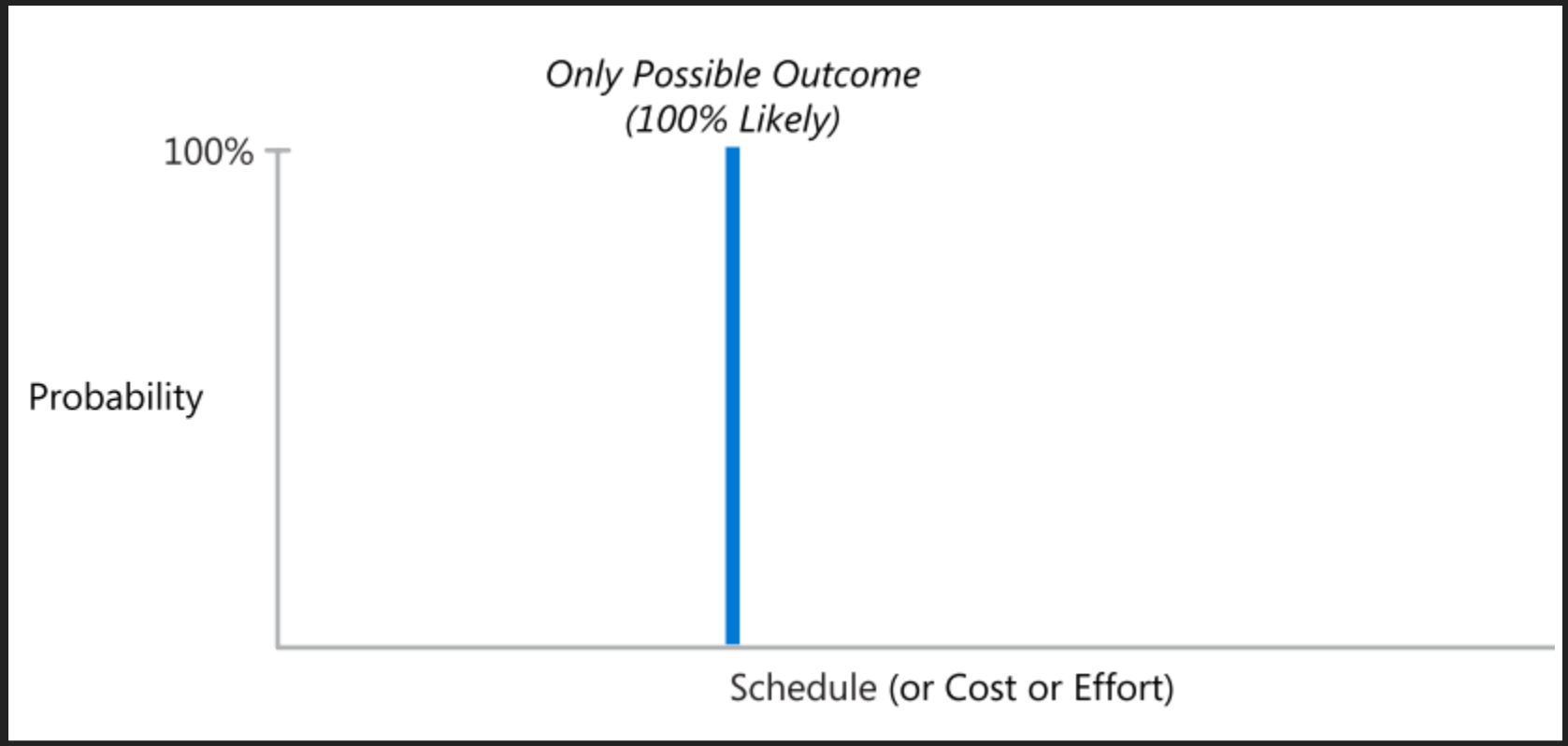
DIFFERENT FROM TARGETS AND COMMITMENTS?

- *Target*: Description of a desirable business objective
- *Commitment*: A promise to deliver defined functionality at a specific level of quality, by a specific date
- Which one is more ambitious?

HOW IS IT DIFFERENT FROM A PLAN?

- A plan is a biased, goal-seeking process
- A plan usually has a target
- An estimate should ideally be *un-biased*

TYPICAL ESTIMATE

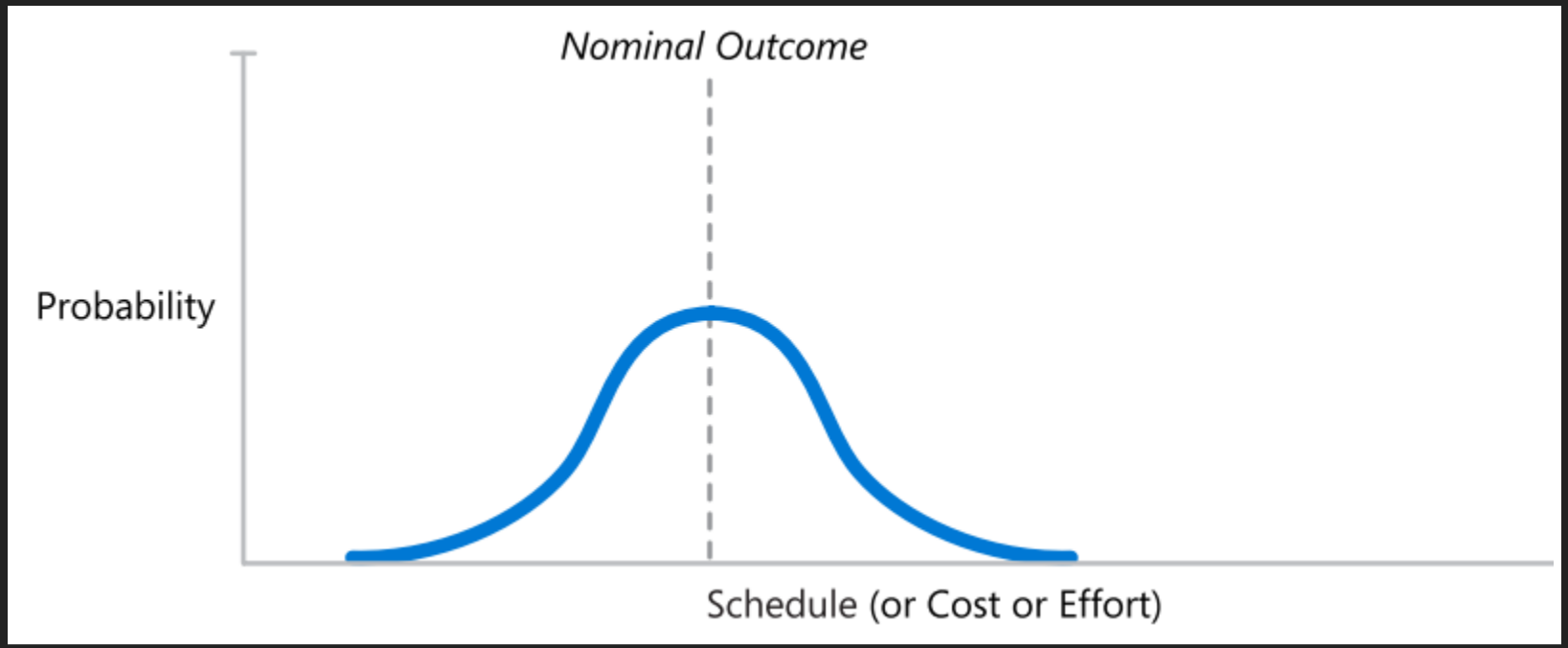


Simplistic single-point estimates assume that nothing will go wrong. Unrealistic.

CAN WE ADD SOPHISTICATION?

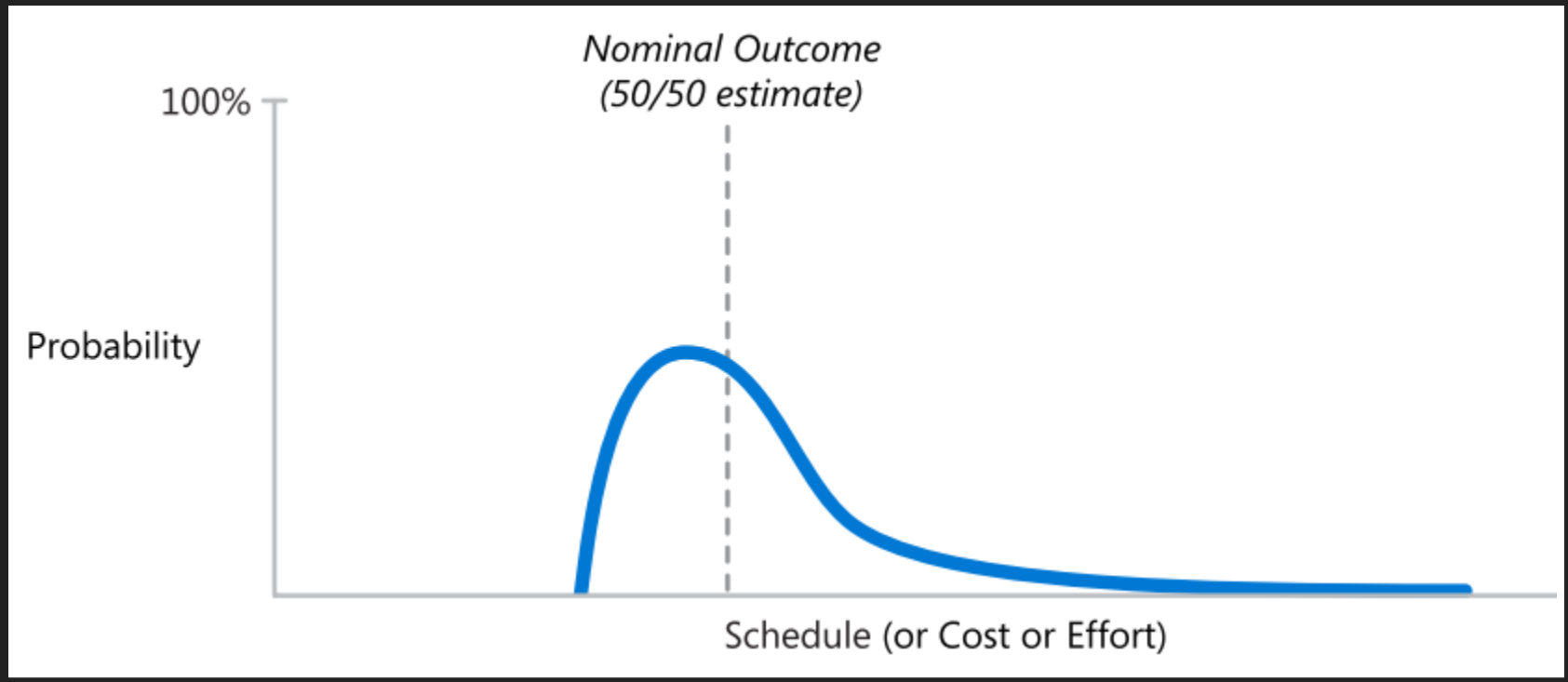
- Real-life software projects have many sources of uncertainty
- Uncertainty means probability of things not going to plan is non-zero
- More likely that software outcomes have a probability distribution

SO, WE PRODUCE A PROBABILITY DISTRIBUTION. EASY!

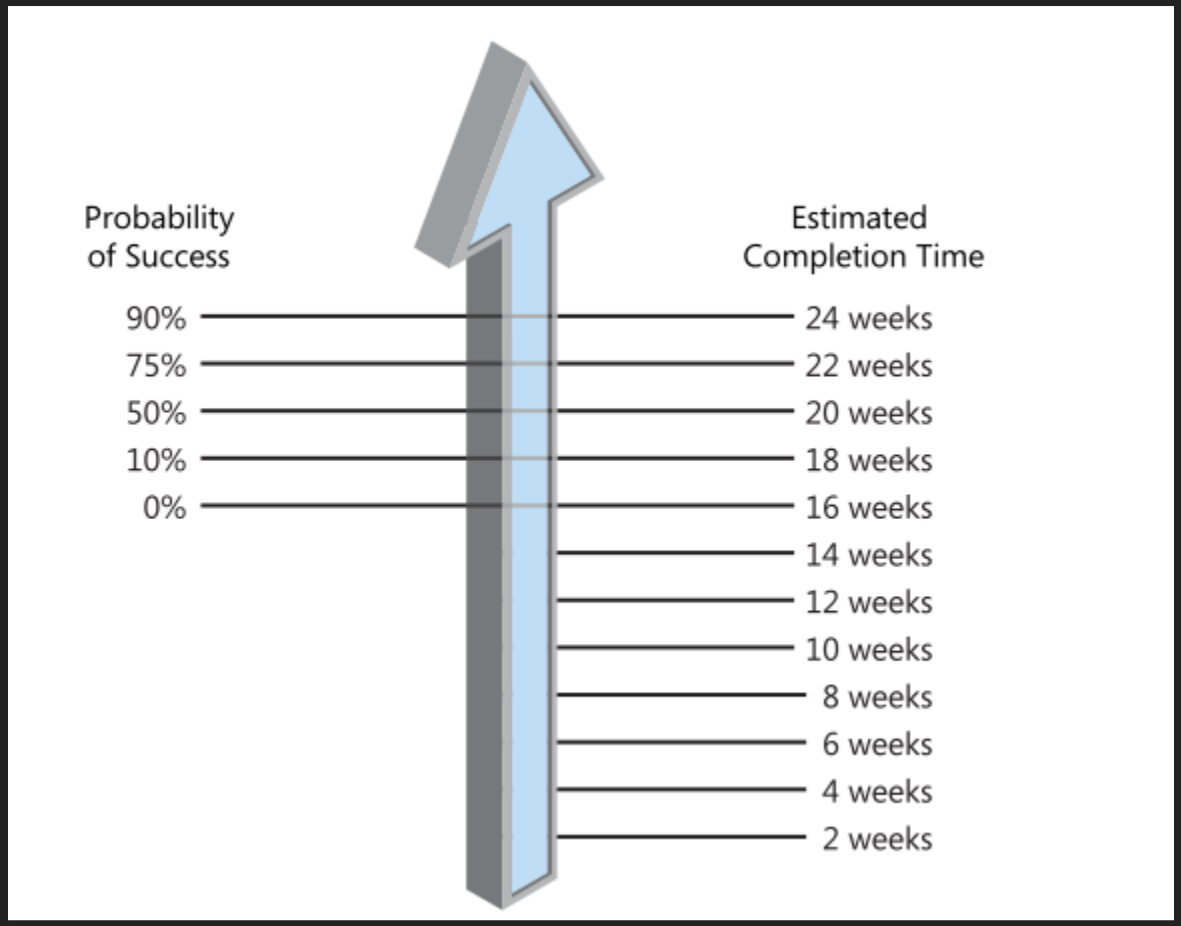


What is wrong with this figure?

A SLIGHTLY MORE REALISTIC ESTIMATE



WHAT CAN WE SHOW THE PROJECT MANAGER?



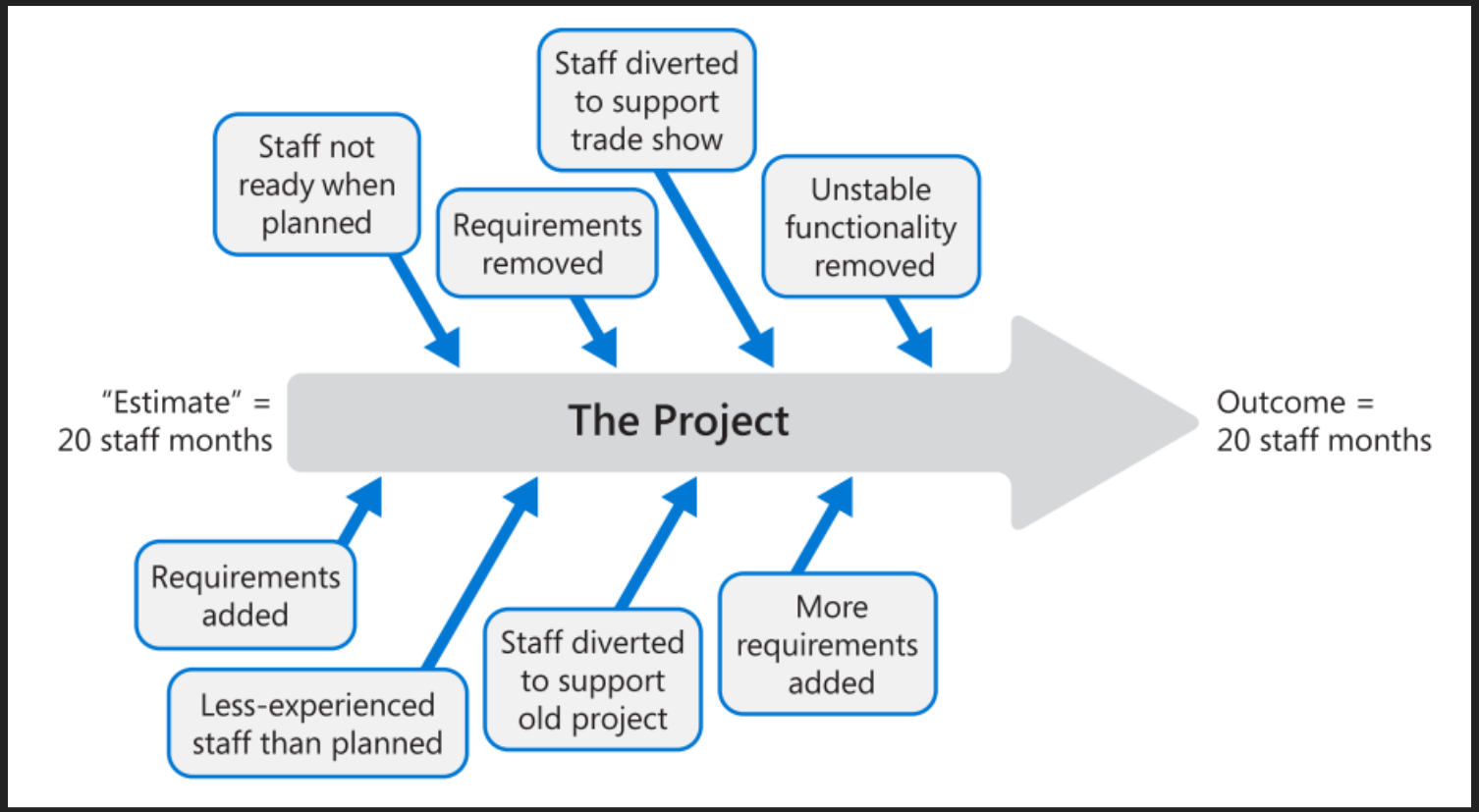
- Best-case; worst-case
- Range of duration, instead of single-point

WHAT IS A GOOD ESTIMATE?

A good estimation approach should provide estimates that are within 25% of actual results, 75% of the time.

Conte, Dunsmore, and Shen 1986

A GOOD ESTIMATE MUST GRAPPLE WITH REALITY



A GOOD ESTIMATE

A good estimate is an estimate that provides a clear enough view of the project reality to allow the project leadership to make good decisions about how to control the project to hit its targets

HOW TO PRODUCE A GOOD ESTIMATE

- Count
- Compute
- Judge

COUNT

- Things that are highly correlated with size of software being estimated
  - Usecases
  - Number of user-interfaces, database tables, web-pages, ...
- Things are available as early as possible
  - High-level usecases
    - Refine as soon as you get low-level usecases
- Things you have counted before
  - So you can have meaningful statistics

COMPUTE

Use historical data to convert count into estimate

Quantity to Count	Historical Data Needed to Convert the Count to an Estimate
Features	■ Average effort hours per feature for development and/or testing
Use cases	■ Average total effort hours per use case ■ Average number of use cases that can be delivered in a particular amount of calendar time
Stories	■ Average total effort hours per story ■ Average number of stories that can be delivered in a particular amount of calendar time
Engineering requirements	■ Average number of engineering requirements that can be formally inspected per hour ■ Average effort hours per requirement for development/test/documentation

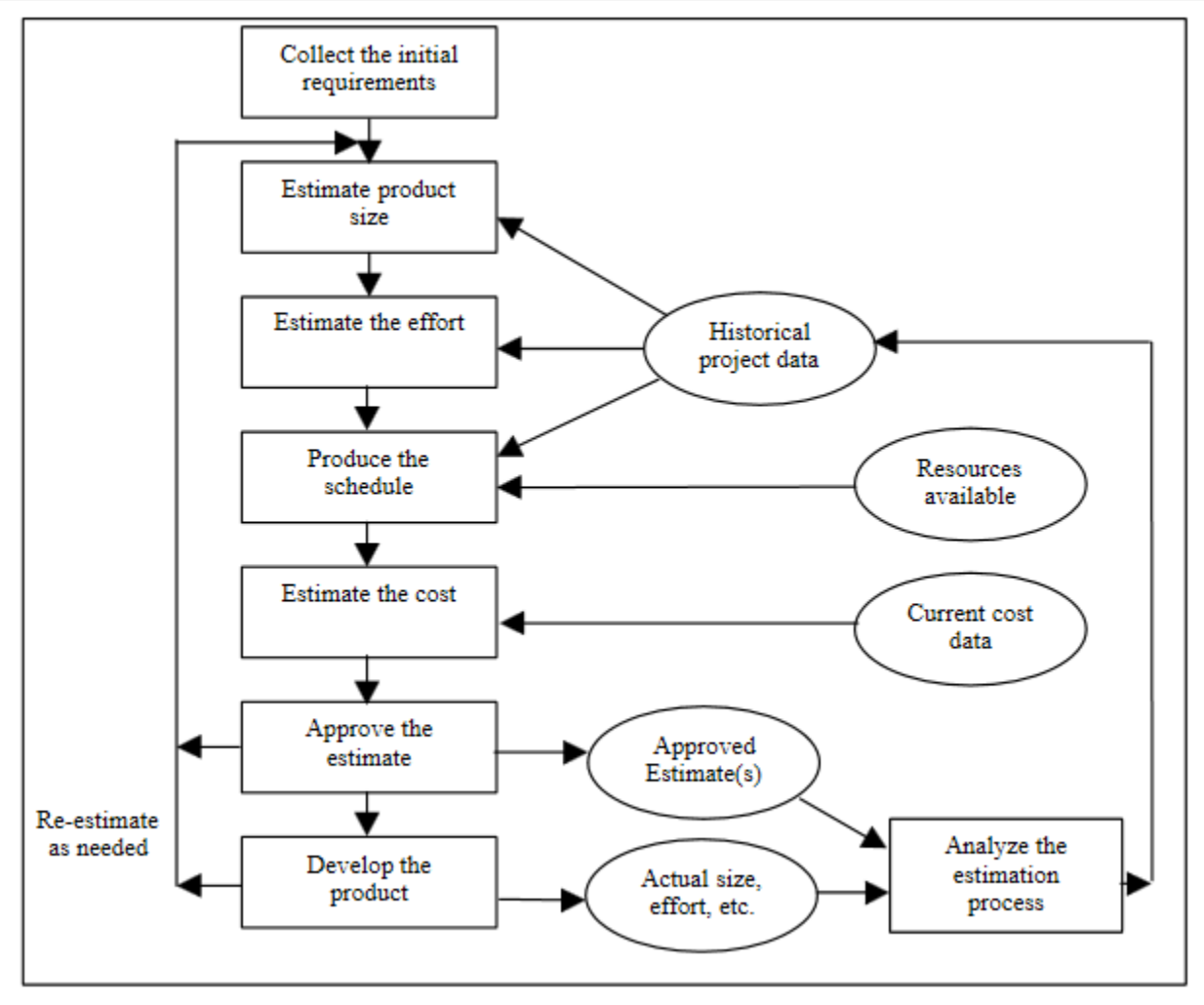
ESTIMATION BY COUNT-COMPUTE

If you know that you have 400 open defects, and you know that the 250 defects you've fixed so far have averaged 2 hours per defect, you know that you have about 400 x 2 equals 800 hours of work to fix the open defects

ESTIMATION BY COUNT-COMPUTE - II

If your data says that so far your project has taken an average of 40 hours to design, code, and test each Web page with dynamic content, and you have 12 Web pages left, you know that you have something like 12 x 40 equals 480 hours of work left on the remaining Web pages

BASIC ESTIMATION PROCESS



JUDGEMENT?

- Only as a last resort
- Least accurate mechanism
- Most subjectivity and bias

TECHNIQUES OF JUDGEMENT

- Decomposition and Recomposition
- Estimation by analogy

DECOMPOSITION AND RECOMPOSITION

- Divide a project into smaller parts
  - Choose form of decomposition (multiplicative or additive)
- Estimate each small part
  - Use multiple techniques to arrive at estimates
- Recompose
  - Sum up (or multiply, as per above)

HOW MANY PINTS OF BEER ARE SOLD IN IRELAND EVERY DAY?

- Decompose by county?
- Decompose by population density?
- Decompose by pub density?

ESTIMATION BY ANALOGY

- Select similar projects
  - Application Domain (e.g., web-based applications, smartphone apps, ...)
  - Size of Client
  - Programming Language
  - Middleware / Backend
  - Location of development (client's location or in-house)
- Combine with decomposition and recomposition

RECOMMENDED ESTIMATION PROCESS

- Use multiple types of estimation approaches
- Use experts to converge on a range with probability distribution
- Revise at least twice, as more detail is available

OTHER ESTIMATION PROCEDURES

- COCOMO & COCOMO-II
- Function Points
- Wideband Delphi

COCOMO (I & II)

- Based on lots (and lots and lots) of historical data
- Based on lots of experts
- Well-known
- Good tutorial: http://csse.usc.edu/csse/event/1996/COCOMO/1_Boehm%20%20Tutorial.pdf

FUNCTION POINTS

- Counting 'functions' in a software
- Different types of 'functions' -- UI, computation, transactions, ...
- Not so well-known
- Tutorials:
  - http://alvinalexander.com/FunctionPoints/
  - http://www.ifpug.org/Conference%20Proceedings/IFPUG-2004/IFPUG2004-04-Aguiar-introduction-to-function-point-analysis.pdf

READING LIST

- **Software Estimation: Demystifying a black art**, by *Steve McConnell*
- Software Engineering Economics, by *Barry Boehm*
- Practical Software Measurement: Objective Information for Decision Makers, by *John McGarry et al.*

GITLAB ISSUES :-(

Note we are having a Gitlab issue (developers don't seem to get push access to the master branch!)

You can get around this via the following commands:

```
your-directory> git checkout -b assignments
your-directory> mkdir 1
your-directory> cd 1
your-directory> git add yourfile.java
your-directory> git add EngineersLog.csv
your-directory> git commit -a -m "submission for assignment 1"
your-directory> git push origin assignments
```

Basically, the first command creates a new branch called "assignments" and switches to it. Then you can add or commit as many files as you want. Just remember to push to "assignments" and not "master".

THAT'S ALL, FOLKS!

Questions? Comments?