Software Project Management (6 – 20191120)

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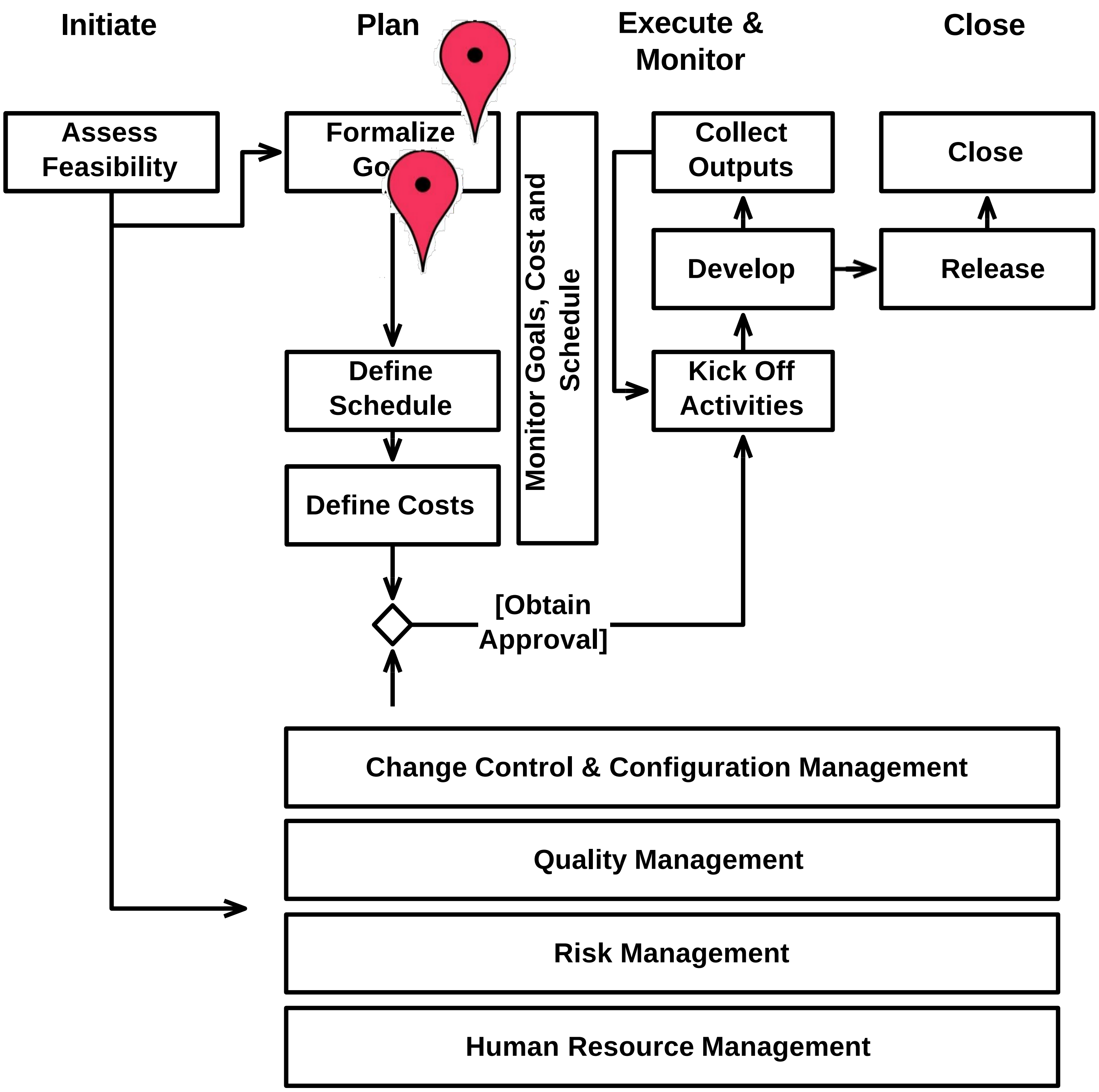
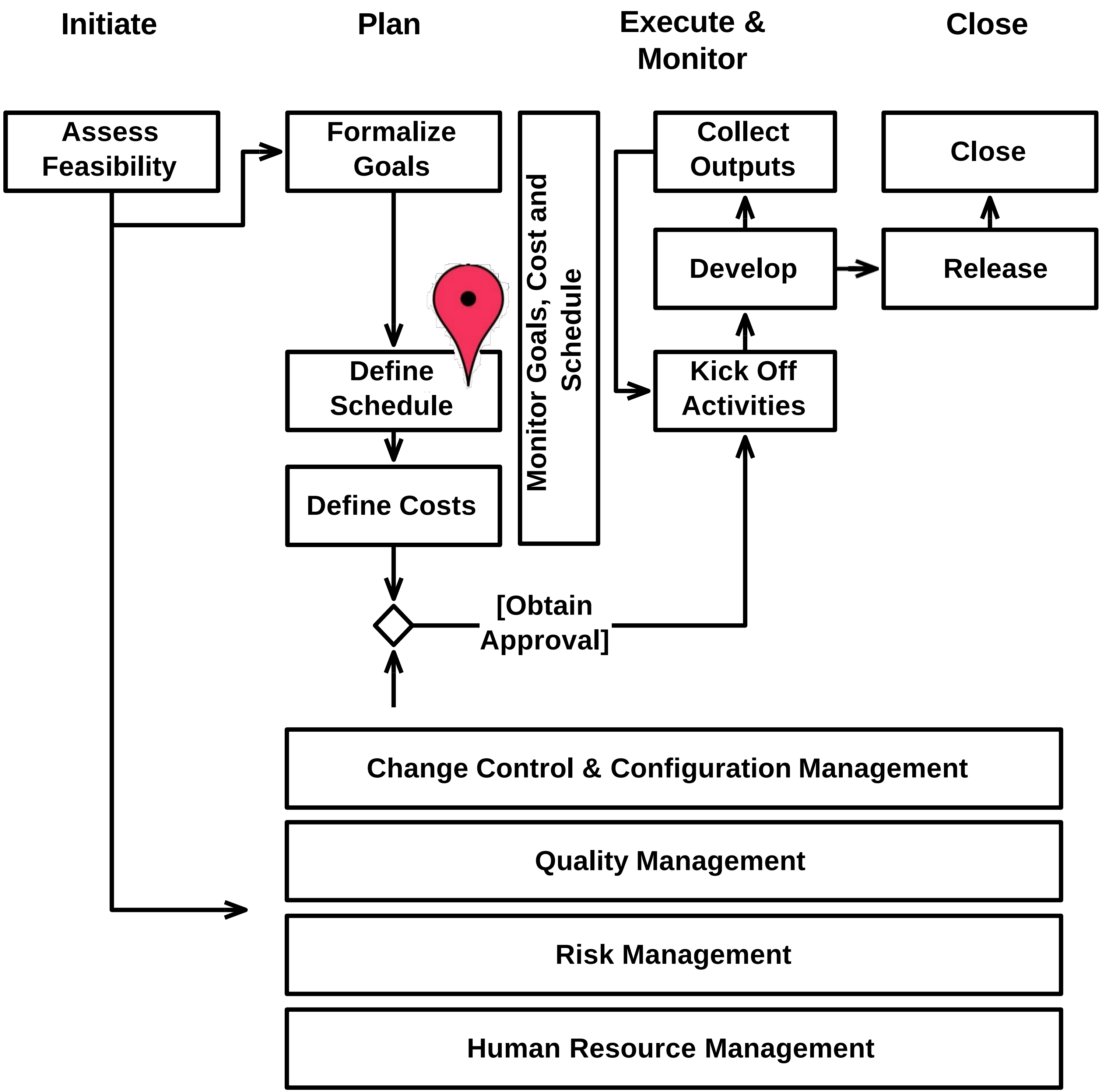

Initiate
Plan
Execute & Monitor
Close
Assess Feasibility
Formalize Go
Monitor Goals, Cost and Schedule
Collect Outputs
Close
Develop
Release
Kick Off Activities
Define Schedule
Define Costs
[Obtain Approval]
Change Control & Configuration Management
Quality Management
Risk Management
Human Resource Management

Estimating

“It is difficult to make predictions, especially about the future” - Attributed to Yogi Berra
(… but also to Niels Bohr and others)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Effort, Duration, and Resources

Estimation

- **Effort (Work):** how much work will the activity need to be completed
- **Resources:** type and quantity of resources available the activity
- **Duration:** how long will the activity last for

Effort

- The **amount of work** an activity requires to be completed. A very good starting point.
- Measured in (work-)days, (work-)weeks, (work-)months
- Often the term man-* is also used (e.g. 3 man-months = 1 person working for 3 months; 3 people working for one month)

Project Manager is a Person who thinks nine women can deliver a baby in One month.

Resources

- The resources needed to carry the work out. Typically a **constraints** (limited)
- Expressed as **manpower**, that is, number of people and percentage of availability
- For instance: 1 person full time; 2 people at 50%
- Certain tasks might require **material resources** (e.g. bricks & pipes) or **equipment** (e.g. a machine for DNA sequencing)
- Material resources are consumed by the execution of an activity; equipment can be reused
- In software development usually resources = manpower

Duration

- How long the activity will last for
- Measured in **hours**, **days**, **months**, …
- Often:
  - 1 week = 5 days = 40 hours
  - 1 month = 20 days ... why?
- In some countries:
  - 1 week = 36 hours (7.12 hours/day)
- Calendar time differs from duration: calendar time includes non-working days, holidays, …

A (simplistic) view

$$D = E / M$$

- Fix any two among D, E, and M (= manpower), and you get the third
- Typically effort and man power are the variables you will be working with (and derive duration from it)
- The equation is a simplification… good enough for various cases (do not take it to extremes)

Some Examples

- 1 week = 40 hours

- Effort: 40 man-hours; Resources: 1 @ 100% →
  D = 40 man-hours / 1 man = 40 hours = 1 week

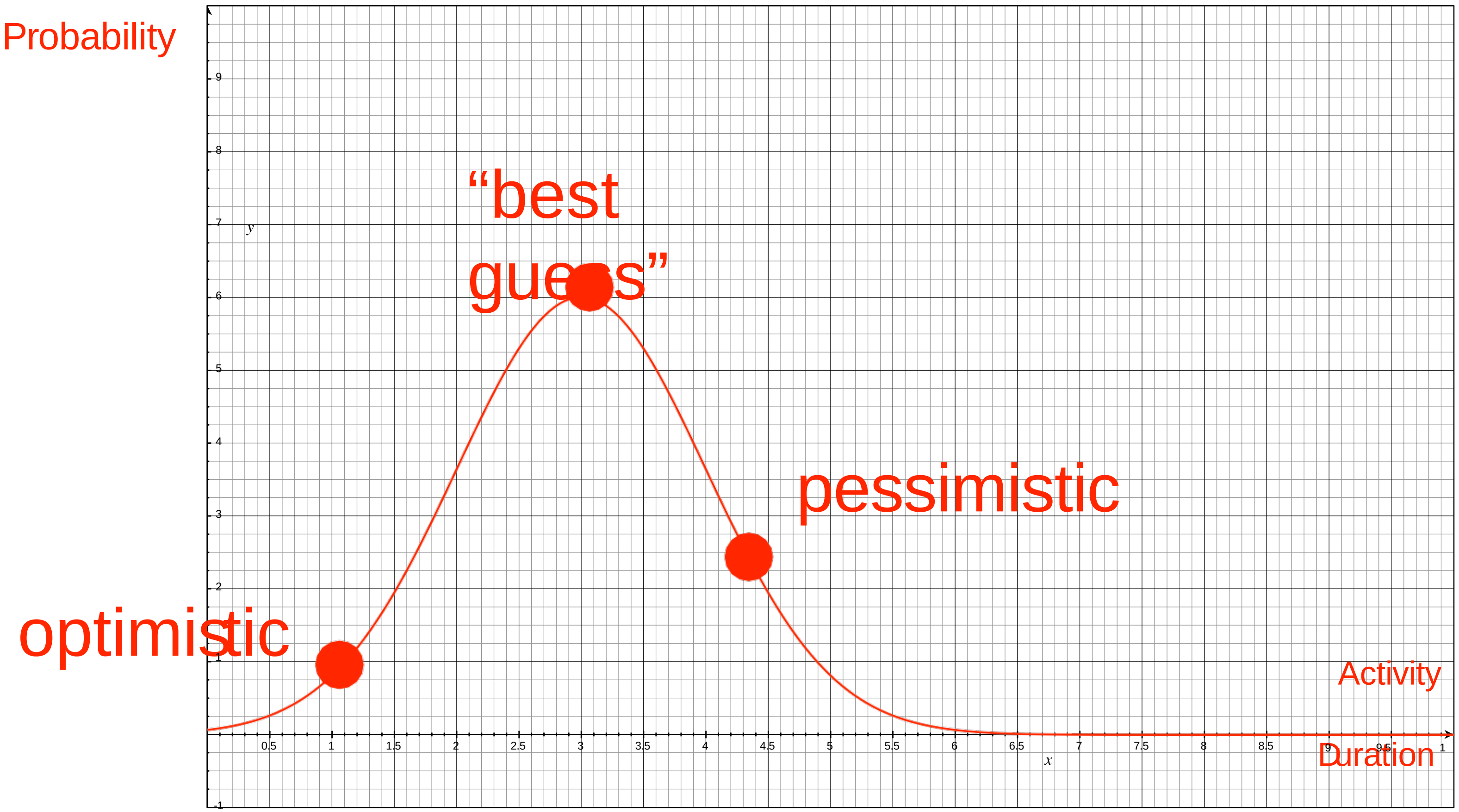
- Effort: 80 hours; Resources: 2 @ 100% →
  D = 80 man-hours / 2 man = 40 hours = 1 week

- Effort: 80 hours; Resources: 1 @ 50% →
  D = 80 / 50% = 160 hours = 4 weeks
  (a person at 50% will be able to work 20 hours/week; it takes 4 weeks to get to the 80 hours needed for the activity)

Uncertainty in Planning

Uncertainty in planning

- Planning has a certain degree of uncertainty
- (In software and not only) we are over-optimistic
- “best guess” might also be a problem



Uncertainty in planning

- Three practices (not necessarily good) to account for uncertainty
  - **Implicit padding:** each activity includes some contingency time
  - **Explicit padding:** the contingency time is explicitly modeled as an activity
  - **React and re-plan:** when a delays occurs, you re-plan and re-define a new realistic schedule
- Some suggestions:
  - Always evaluate the cost of delays
  - Choose a strategy and make it clear (with yourself and with your stakeholders, if possible)

Estimation Techniques

Approaches to Estimation

- **Expert Judgement** is “quick and dirty” and based on experience. It can be applied either top-down or bottom-up
- **PERT (Program Evaluation and Review Technique)** takes into account the probabilistic nature of estimations
- **Algorithmic Techniques** provide estimations by measuring specific qualities of a system and applying algorithms (Function Points, COCOMO, WebObjects)

Expert Judgement

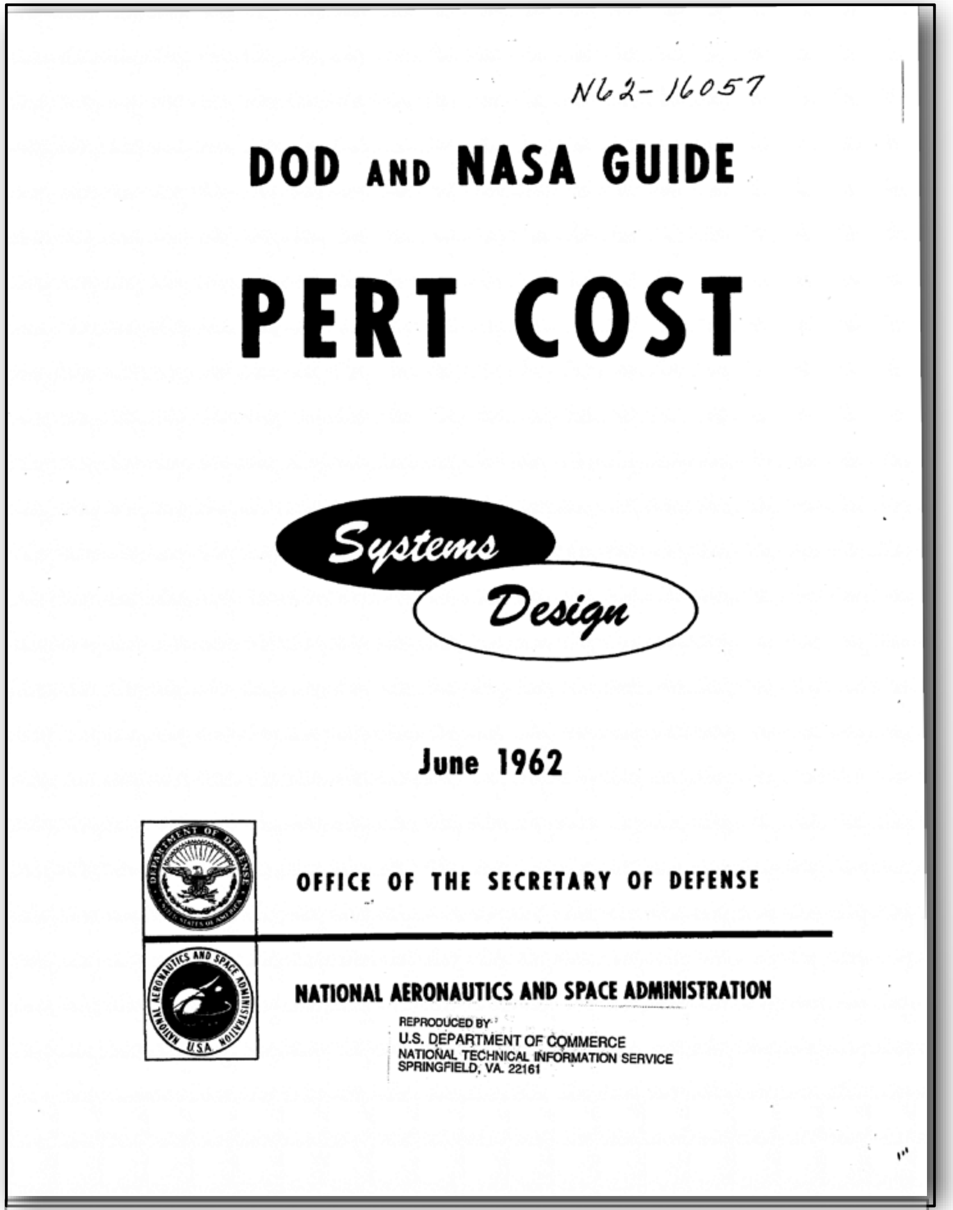
- Efficient and fast. Based on personal (rather than organizational) assets
- Underlying assumption: the project uses a product WBS
- Top-down
  - Start at the top of the WBS and break estimations as you move down
- Bottom-up
  - Start at the bottom of the WBS and sum as you move up

PERT

Program Evaluation and Review Technique

PERT

- Program Evaluation and Review Technique
- Developed in the sixties
- It is a **methodology** to define and control projects
- Variations exists (e.g. PERT/COST developed by NASA/DOD)



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DOD AND NASA GUIDE

PERT COST

Systems Design

June 1962

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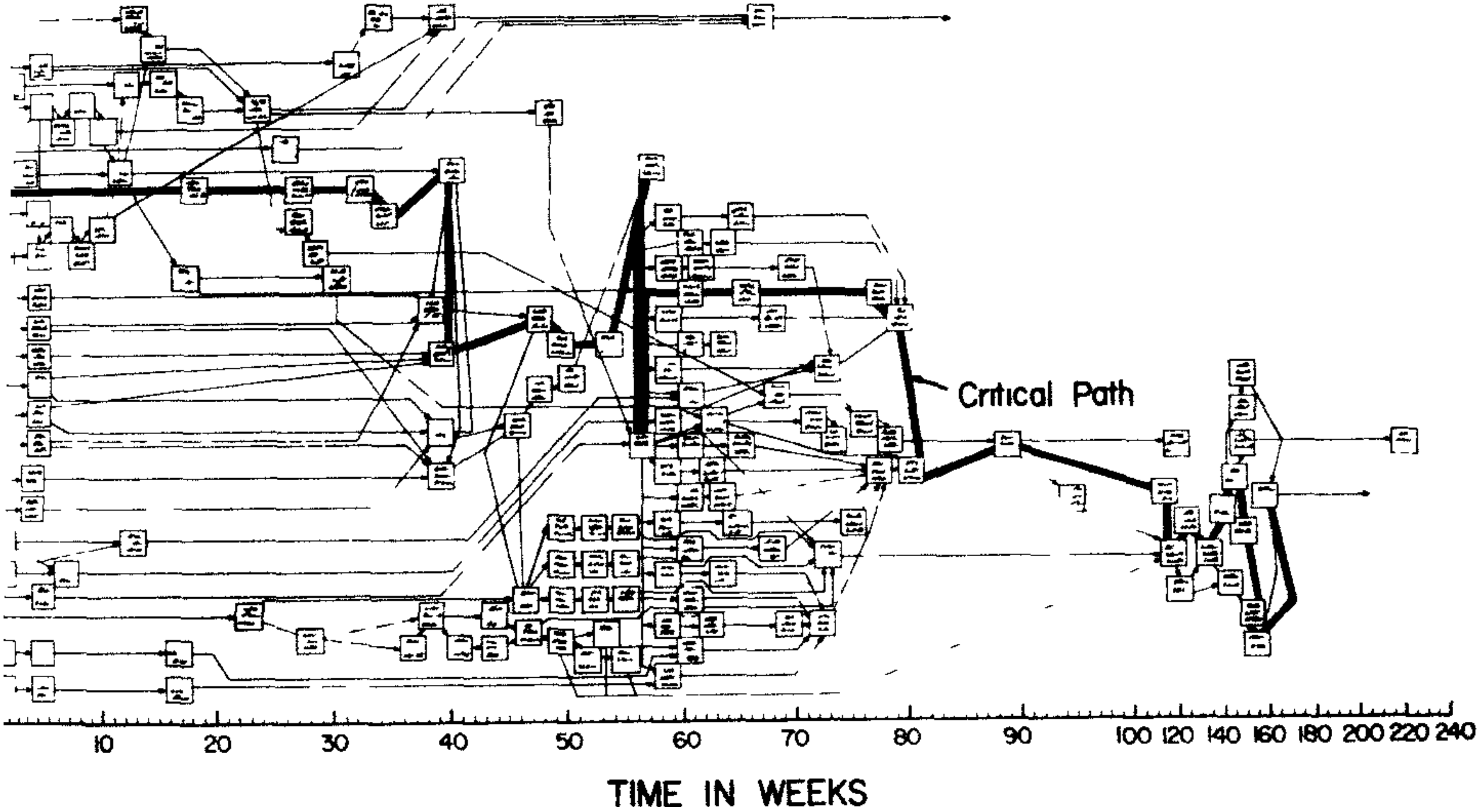
A Motivating Example



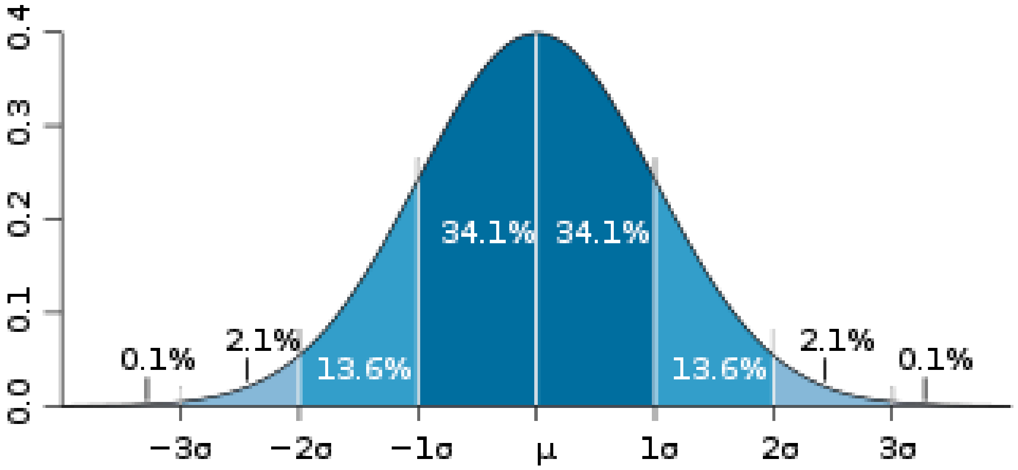
PERT Formula

- Estimation in PERT is based on the idea that estimates are uncertain
  - Therefore uses duration ranges
  - And the probability of falling to a given range

- For each task, three estimates:
  - Optimistic
    - (would likely occur 1 time in 20)
  - Most likely
    - (modal value of the distribution)
  - Pessimistic
    - (would be exceeded only one time in 20)

Variance and Standard Deviation

- Variance (σ^2) and standard deviation (σ) measure how spread a population is from the average
- Standard deviation (σ) is the square root of variance
- **Example: normal distribution**: a bell shaped probability distribution function



Source: http://en.wikipedia.org/wiki/Normal_distribution

PERT Formula

- Task duration is an average of three estimations:

$$t_e = \frac{(a + 4m + b)}{6}$$

t_e = *expected time*

a = *optimistic time estimate (1 in 20)*

m = *most likely time estimate*

b = *pessimistic time estimate (1 in 20)*

Beta Distributions

- Average is given by the formula:

$$t_e = \frac{(a + 4m + b)}{6}$$

- Variance (σ^2) and standard deviation (σ) are given by:

$$\sigma^2 = \left(\frac{b - a}{6}\right)^2 \qquad \sigma = \frac{b-a}{6}$$

Algorithmic Techniques

Introduction

- Goal: find a way to systematically determine the effort (duration) required for an (arbitrary) task/project
- Ideally:
  - Identify a set of **measurable** characteristics of a project that determine the project's **effort/duration**
  - Define a function that, given the characteristics mentioned above, computes the **effort/duration**

$$f(x_1, \ldots, x_n) = e$$

Problem: how do you find $f, x_1, \ldots, x_n$?

Solution

- Look at existing projects/datasets; each project is represented by a vector:

$$< a_1, \ldots, a_n, effort >$$

- Find correlations between (some of the) variables in the datasets:

$$f(a_1, \ldots, a_k) \propto effort$$

- Find appropriate measurement means for the variables at the beginning of a project (so that we can apply the function to a new project)

Discussion

- Advantages:
  - Replicable
  - Objective
- Limitations of the models:
  - Size of the dataset used for defining the model and accuracy of the model
- Limitations of their application:
  - Resources needed to collect the data (time and expertise)
  - Applicability of the model to the system at hand
  - Accuracy of the data collected to estimate for a new system

Main Techniques

- Function Points (FP)
  - **Function-based**, it estimates effort based on its functional characteristics
  - **Duration/Team** size computed through productivity metrics
  - It requires a critical analysis of the requirements
- Constructive Cost Modeling (COCOMO)
  - **Size-based**, it estimates effort, duration, and team size based on the (presumed) size of a system in source lines of code
  - Different families of models
- Sometime used in conjunction

Group Assignment

- Build a WBS for your graduation project
- Deliverables:
  - WBS diagram
  - WBS dictionary (Template available on https://drive.google.com/open?id=1IHjBDz4FpubLVZFSibZWxHYOOJ8WET3s)
- Deliver a hard copy to your TA in your own lab next week.

Questions

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