CTIS359

Principles of Software Engineering

Software Project Estimation Basics

"In preparing for battle I have always found that plans are useless, but planning is indispensable."

Dwight D. Eisenhower

Today

- What is software project estimation?
- What is Cone of Uncertainty?
- What are the factors to be considered for software estimation?
- Is estimation the basis for credible project management?

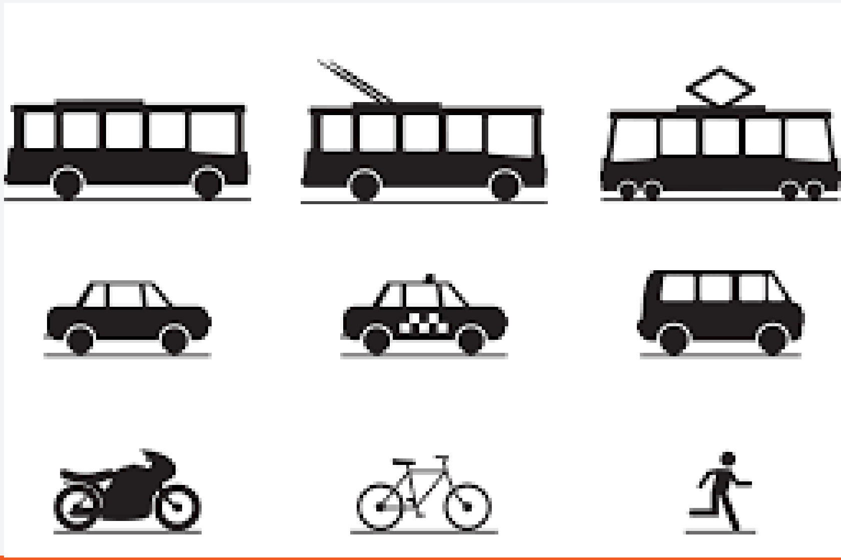
Travel : Estimation

- Let us travel from Ankara to XYZ Camping Place?
- **What estimations do we need?**
  - What is the distance?
  - What is the means of the transportation?
  - What is the (average) speed of the travel?

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Travel : Estimation

- Let us travel from Ankara to XYZ Camping Place?
- **What estimations do we need?**
  - What is the distance?
  - What is the means of the transportation?
  - What is the (average) speed of the travel?



Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Travel : Estimation

- Let us travel from Ankara to XYZ Camping Place?
- **What estimations do we need?**
  - What is the distance?
  - What is the means of the transportation?
  - What is the (average) speed of the travel?

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Travel : Estimation

- Thereby, we can estimate the time of travel.
- Also, based on the means of the travel, we can estimate the cost of the travel.
- Of course, the schedule can be planned based on the travel requirements.
- If we know history of such (similar) travels, then we can also predict some impediments which can cause some risks which can manifest some defects.

Travel : Estimation

- Thereby, we can estimate the time of travel.
- Also, based on the means of the travel, we can estimate the cost of the travel.
- Of course, the schedule can be planned based on the travel requirements.
- If we know history of such (similar) travels, then we can also predict some impediments which can cause some risks which can manifest some defects.

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Travel : Estimation

- Thereby, we can estimate the time of travel.
- Also, based on the means of the travel, we can estimate the cost of the travel.
- Of course, the schedule can be planned based on the travel requirements.
- If we know history of such (similar) travels, then we can also predict some impediments which can cause some risks which can manifest some defects.

Travel : Estimation

- Thereby, we can estimate the time of travel.
- Also, based on the means of the travel, we can estimate the cost of the travel.
- Of course, the schedule can be planned based on the travel requirements.
- If we know history of such (similar) travels, then we can also predict some impediments which can cause some risks which can manifest some defects.

Software : Estimation

- What is the size of the project?
  - Will it be a new development project or an enhancement project?
- Once we know the size and applicable productivity factor, then we can convert this to effort estimation.

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Software : Estimation

- Most of the time, People Cost ≈ Project Cost.
  - Hardware Cost
  - Travel Cost
  - Networking and Infrastructure Cost
  - etc.
- Once we know the effort (PM) estimation AND we have fixed team size (P), then we can estimate time/duration/schedule.

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Software : Estimation

- Most of the time, People Cost ≈ Project Cost.
  - Hardware Cost
  - Travel Cost
  - Networking and Infrastructure Cost
  - etc.
- Once we know the effort (PM) estimation AND we have fixed duration(M), then we can estimate team size (# of people required).

Software : Estimation

- Most of the time, People Cost ≈ Project Cost.
  - Hardware Cost
  - Travel Cost
  - Networking and Infrastructure Cost
  - etc.
- If we know the defect density of the previous (similar) project team, we can predict the # of defects that can occur in the project.

Software : Estimation

- Most
  - Ha
  - Tra
  - Ne
  - etc
- If we ow the defect density of the previous (simil) project team, we can predict the # of defects that can occur in the project.

These estimates are project specific…

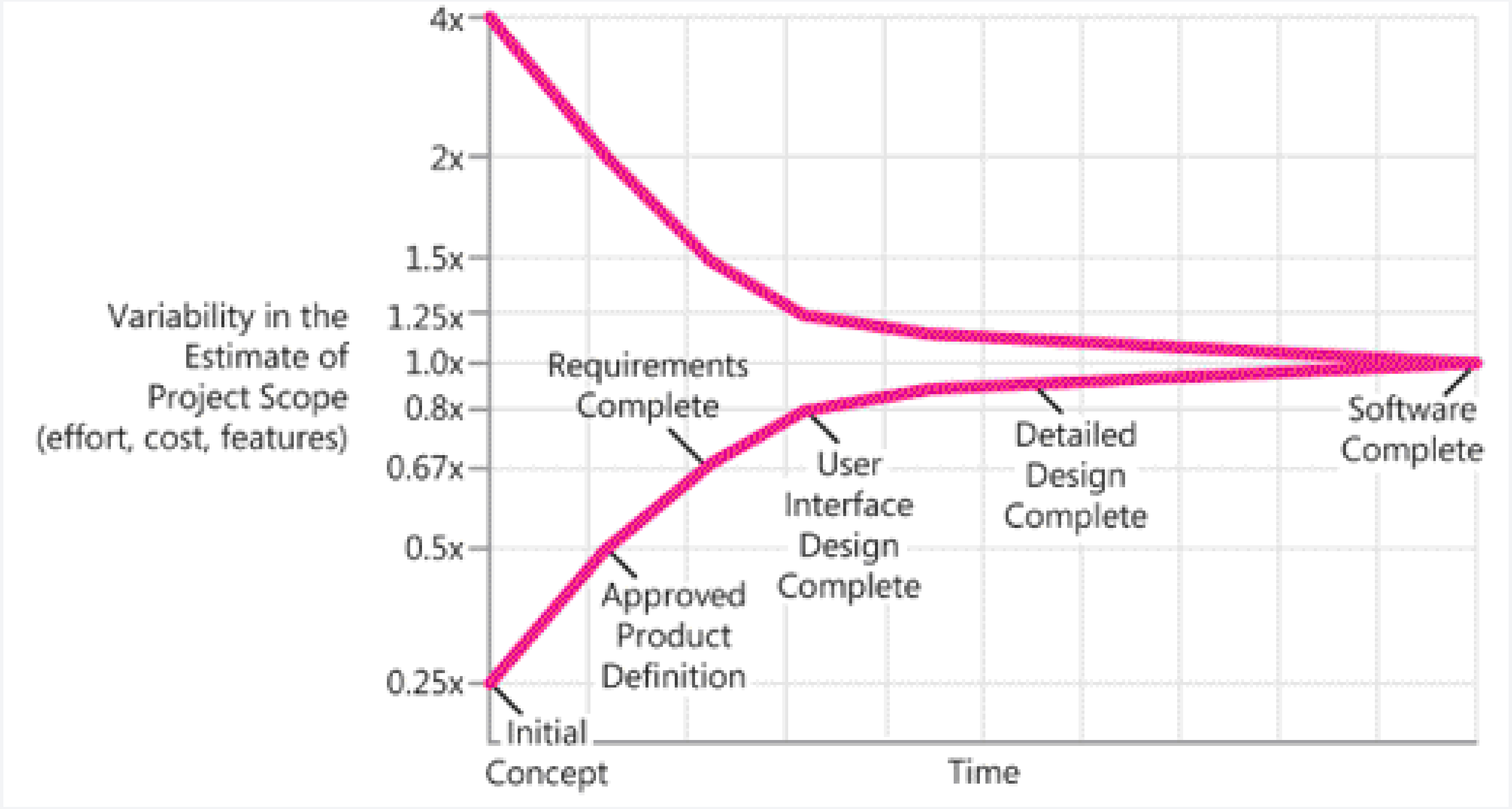
Software : Estimation

- **Q:** What is the right time to make the project estimation?

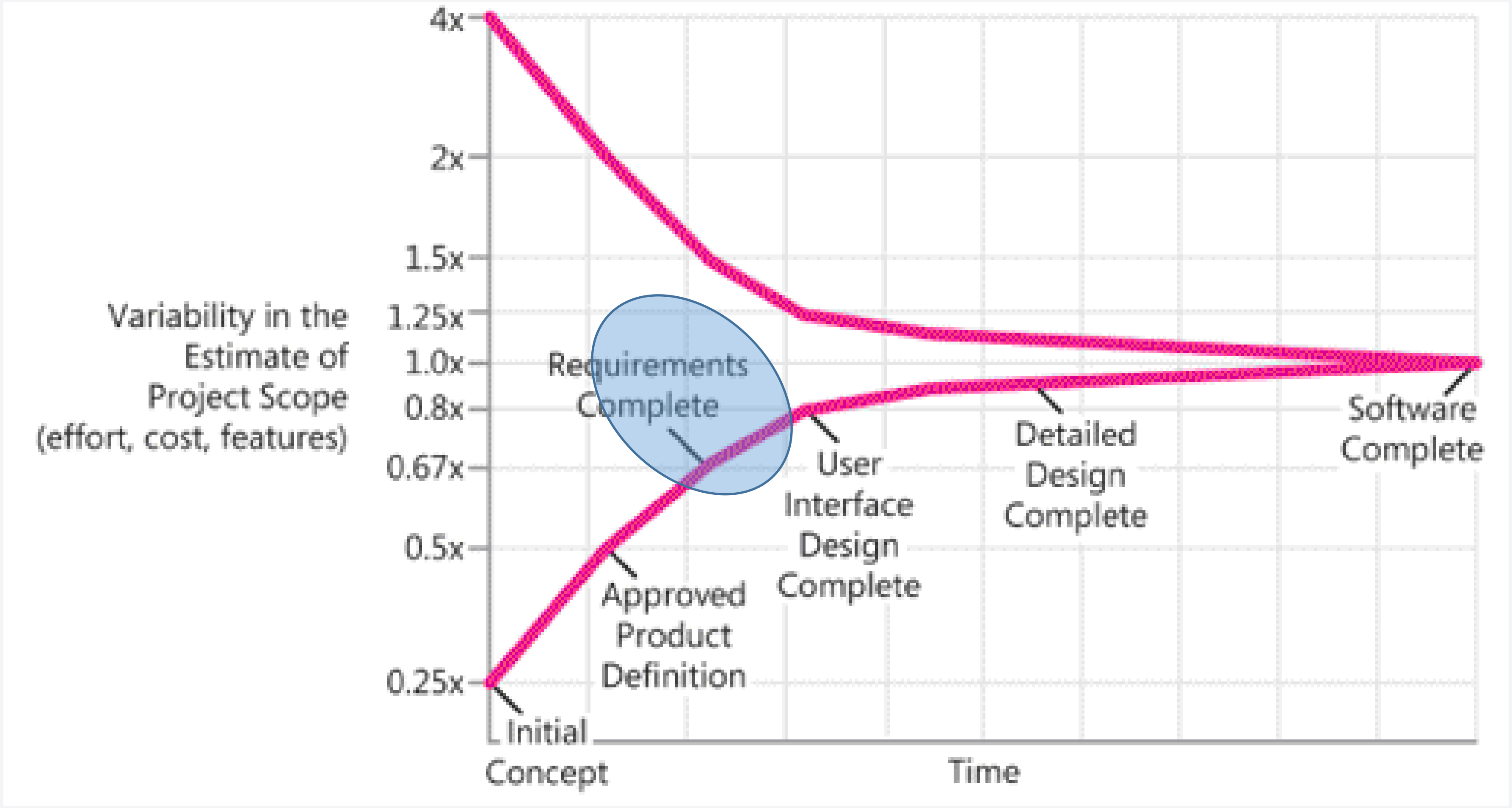
Software : Estimation

- **Q:** What is the right time to make the project estimation?
- **A:** After the requirements are reasonably evolved and high level designs are to some extent frozen.

Cone of Uncertainty



Cone of Uncertainty



Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Factors to be considered for software estimation

- Estimated Effort = Size X Applicable Productivity
- Ex: Assume that we have a project to be developed.
  - Size to be delivered = 700 units
  - Applicable Productivity = 20 units/PM or 0,05 PMs/unit
  - Estimated Effort = 700 X 0,05 PMs/unit
  - Estimated Effort = 35 PMs
- Duration = Estimated Effort / Team Size
- Further, assume that we know the team size.
  - # of full-time SWEs = 7
  - Duration = 35 PMs / 7
  - Duration = 5 CMs (Calendar Months)
- Team Size = Estimated Effort / Duration
- If we are given a schedule constraints of 10 CMs
  - Team Size = 35 PMs / 10 CMs
  - Team Size = 3.5

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Factors to be considered for software estimation

- Defect Level Estimation
- Ex: If the applicable defect density history is 2,3 Defects/100 Units, what is the expected defect density?
- Estimated Defect Density = Total Units X defect density
- Estimated Defect Density = 700 X (2,3/100) = 16 Defects (expected)

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Factors to be considered for software estimation

- **Size** is the basis or foundation of the estimation.
  - The main normalization factor for many critical software

Estimated Parameter		Input
Size	←	Requirements
Effort	←	Size, Productivity
Schedule or Team Size	←	Effort, Team Size or Calendar Months
Number of Defects	←	Size, Defect Density

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

Factors to be considered for software estimation

- Other Factors → Effort (Productivity, …) → Productivity (….these factors)
  - Team Experience
  - Cohesion of the Project Team
  - Team familiarity with Technology, Domain, Customer
  - Tools used
  - Project Methodology
  - Reuse
  - Nature of Development
  - Phase scope of the project

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

PM → Estimation

- PM is all about
    - Planning
    - Monitoring
    - Controlling

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

PM → Estimation

- PM is all about
  - Planning (You make estimations about the project)
  - Monitoring
  - Controlling

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

PM → Estimation

- PM is all about
  - Planning (You make estimations about the project)
  - Monitoring (You check the actual progress with the estimations)
  - Controlling

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

PM → Estimation

```
EV = Effort Variance
AE = Actual Effort
PE = Planned Effort
```

- Ex: A project
  - Total effort = 300 PMs
  - # of SWEs = 10
  - Duration = 30 CMs
    - @ Delivery Milestone 1 (Monitoring Checkpoint)
      - EV = 90 -30 (AE-PE) = +200%
      - Or
      - EV = 15 -30 (AE-PE) = -50%

Source: https://www.youtube.com/watch?v=uTECToTO9Ec

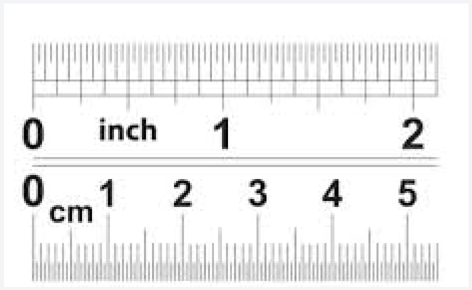
Software Domain vs. Other Domains

- Software domain is **Unique** with respect to estimations.
- **Absence of physical dimensions**
  - No way to weigh, see, touch, and feel the measured software
- **Reusing and duplication is possible**
  - Reuse already written code and/or already developed components
    - But, we cannot reuse a medicine.
  - We can duplicate the applications
    - But, we cannot copy+paste a wall of a building or a t-shirt.

Source: https://www.youtube.com/watch?v=aODNWrJ8E0c

Why do we use FPs, OPs, UCPs as the Unit of measurement for Software?

- Weight →kg, pound
  - Length → inch, cm



- Volume → cm^3, liters

→ Products and their size

Source: https://www.youtube.com/watch?v=aODNWrJ8E0c

Why do we use FPs, OPs, UCPs as the Unit of measurement for Software?

- Weight →kg, pound
  - Len
- Volum →
  cm^3, liters

These are applicable to physical products

→ Products and their size

Source: https://www.youtube.com/watch?v=aODNWrJ8E0c

Why do we use FPs, OPs, UCPs as the Unit of measurement for Software?

- # of service requests handled in a specific period of time.
    - # of customer requests processed / week
- # of tickets resolved / secs

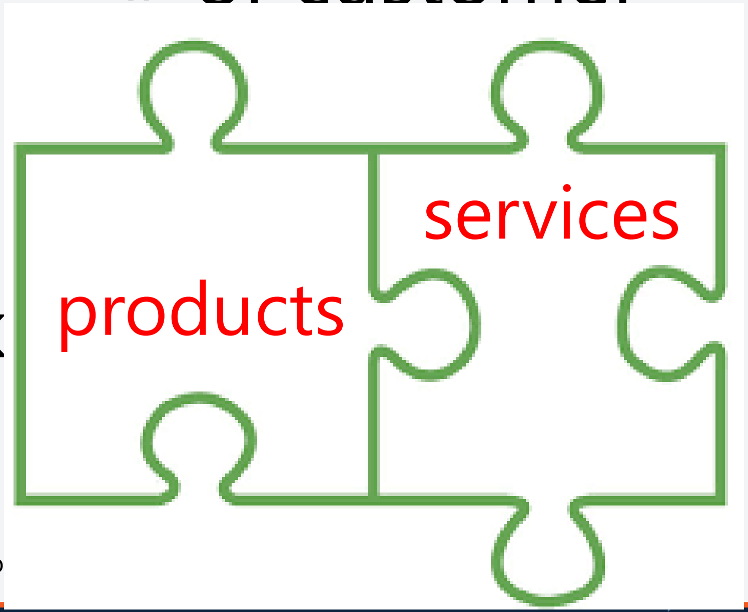
Services and their size

Source: https://www.youtube.com/watch?v=aODNWrJ8E0c

Wh the Un ?

Software is a combination of products and services.

- # c d of tim
  - # of customer ed /
- # of tick secs



Services and their size

Source: https://www.youtube.co

What aspect of software shall we measure to assign a size?

- FPs, OPs, UCPs → benefit provided to the users in terms of tasks and services performed by the software for satisfying the business information processing needs of the users.

Source: https://www.youtube.com/watch?v=aODNWrJ8E0c

Why not LOC?

- Why we do not use LOC as a unit of measuring the size of a software as these software are built in LOCs?
- **Late availability**
  - they are only available when the application is built
  - Not make sense when it comes to estimation.
- **Vague definition of a LOC**
  - Logical lines, Physical lines
    - 1 LOC → with many logical functions
    - 1 LOC → with separated logical functions
    - What about looping?
- **LOC is very much programmer/PL dependent**
  - Efficient programmer might write less number of codes than an inefficient programmer to build the same functionality

Source: https://www.youtube.com/watch?v=aODNWrJ8E0c

Why not LOC?

- Why we do not use LOC as a unit of measuring the size of a software as these software are built in LOCs?
- **Late**
  - t
  - N
- **Vag**
  - L
- **LOC very much programmer/PL dependent**
  - E ciient programmer might write less number of codes than an inefficient programmer to build the same functionality

LOC is of not much use when it comes to estimation

Source: https://www.youtube.com/watch?v=aODNWrJ8E0c