Software Cost Estimating: Friend or Foe (to Agilists)?

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WHO AM I?

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ISO project editor for software engineering standards since 1994
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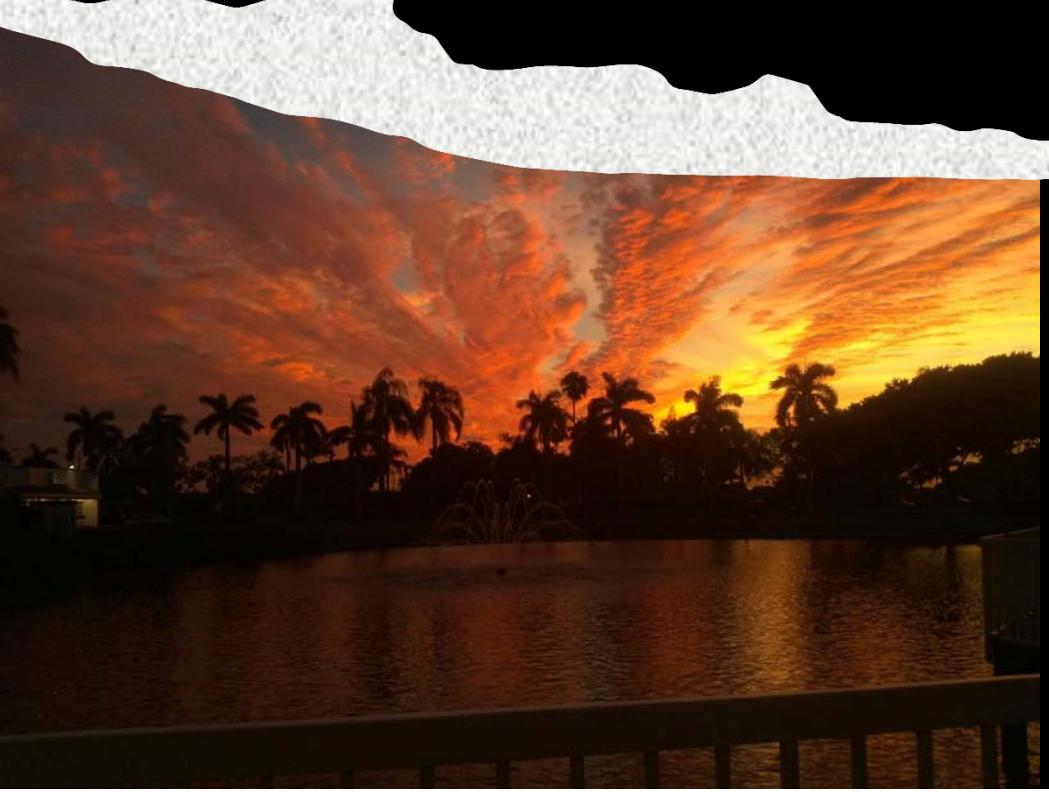
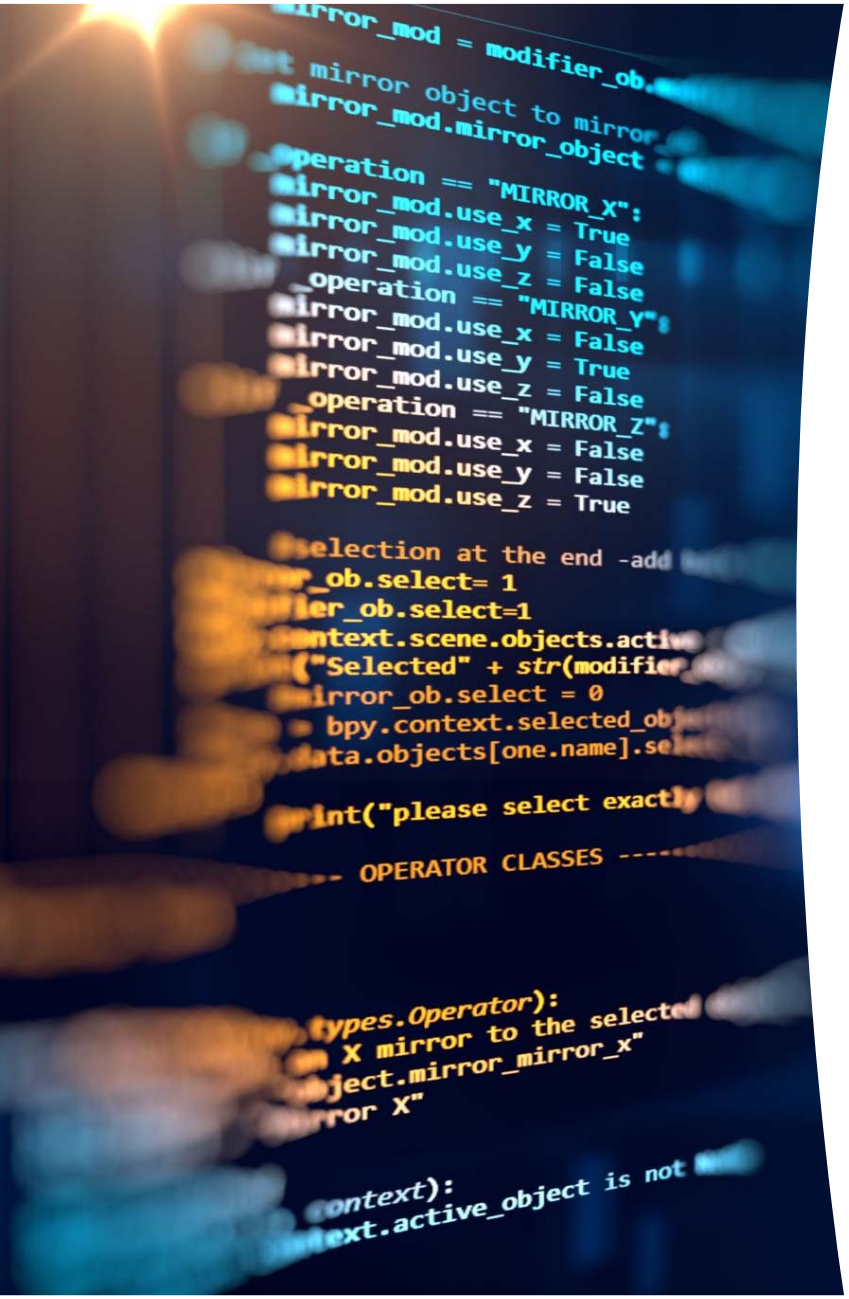
Global consultant, published author, thought leader, speaker

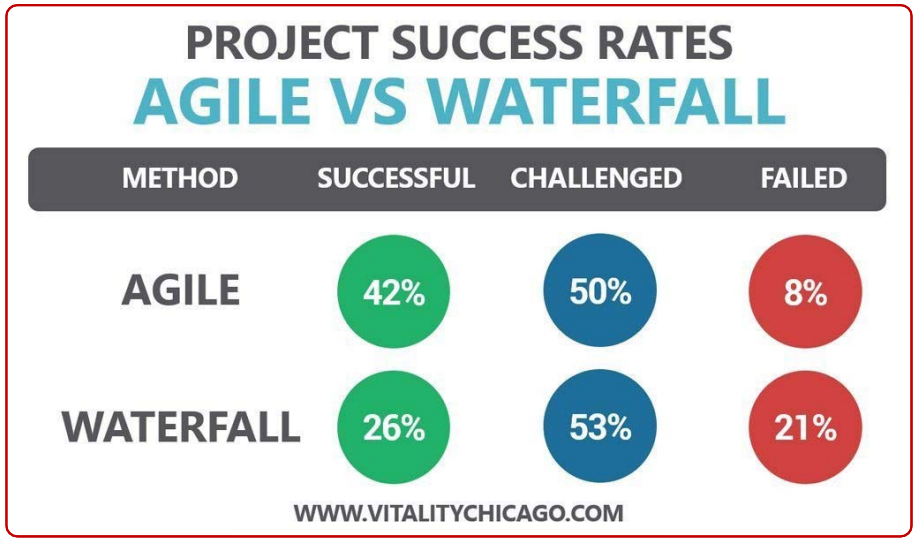




What is the current state of software development?

Software Development Projects: Status Quo

Software Project Success[1]



Software Project Growth[2]

	Olympics	Software/ IT	Dams	NASA/ DoD	Rail	Bridges/ Tunnels	Roads
Average Cost Growth	156%	43-56%	24-96%	52%	45%	34%	20%
Frequency of Occurrence	10/10	8/10	8/10	8/10	9/10	9/10	9/10
Frequency of Doubling	1 in 2	1 in 4	1 in 5	1 in 6	1 in 12	1 in 12	1 in 50
Average Schedule Delay	0%	63-84%	27-44%	27-52%	45%	23%	38%
Frequency of Schedule Delay	0/10	9/10	7/10	9/10	8/10	7/10	7/10

1 COMMON
Multiple Industries Experience Significant Cost and Schedule Growth – Has Been a Problem for a Long Time

2 FREQUENT
70-80% of Projects Experience Cost and Schedule Growth

3 HIGH
Cost: 50% or More on Average (Mean)
Schedule: 30% or More on Average (Mean)

4 EXTREME (FOR COST)
Cost Growth in Excess of 100% Is a Common Occurrence in Most Projects (1 in 6)

1. Standish Group *CHAOS report* (2015). <Note: similar percentages in 2021>
2. Dr Christian Smart, *Solving for Risk Management: Understanding the Critical Role of Uncertainty in Project Management* (2021)

Top 10 Reasons for Project Challenges & Failures

Cause	Customer	Supplier	Comment / Solution
1. Poor user input	X	X	Training, time
2. Stakeholder conflicts	X	?	Project Management
3. Vague requirements	?	?	Terminology
4. Poor cost and schedule estimation	**?**	**X**	**Estimates overly-optimistic, risk (avoidance)**
5. Skills that do not match the job	X	X	Training
6. Hidden costs of going "Lean and Mean"	**X**	**X**	**Unrealistic goals and resources**
7. Failure to plan	?	?	Structure, PM
8. Communication breakdowns	X	X	Blame (He said, she said)
9. Poor architecture		X	Planning
10. Late "failure" warning signals		X	Measurement

Source: Loren May, CrossTalk
http://info.psu.edu.sa/psu/cis/biq/se501/a/a1/MajorCausesofSoftwareProjectFailures.pdf

What is the Impact of Unrealistic* Estimates?

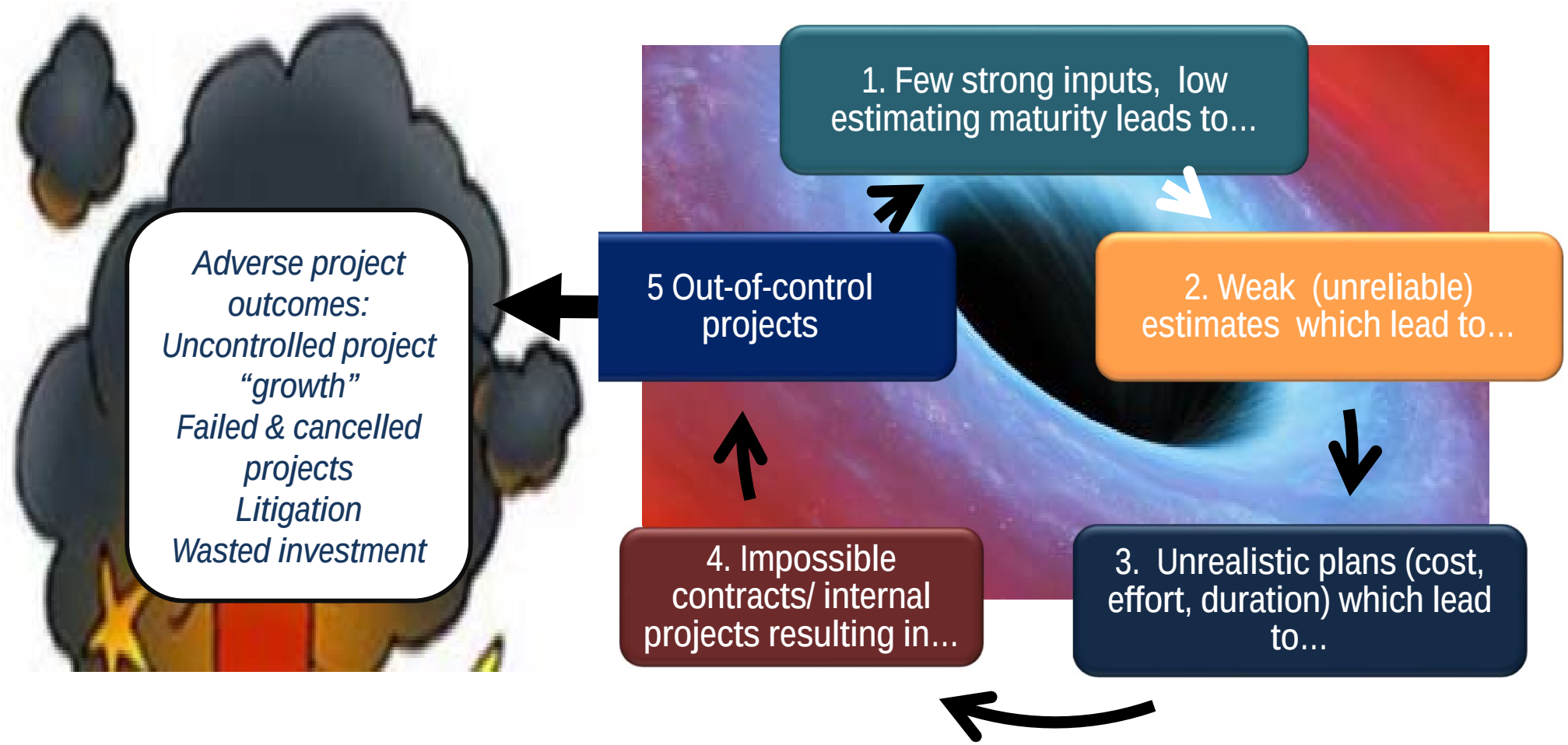
Standish Group on U.S. government / business:

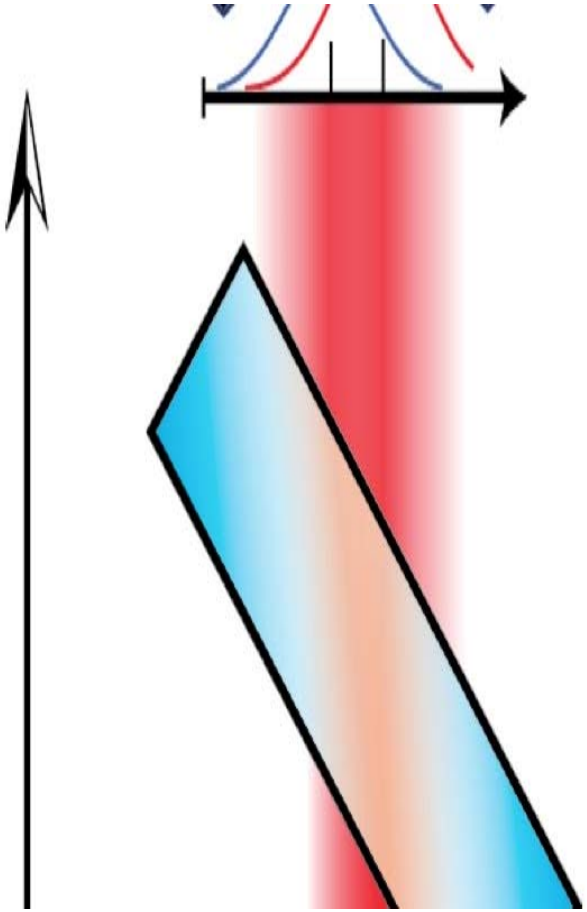
~ $81 B USD = canceled software projects

~ $59 B USD = budget overruns

*** Unrealistic estimates → Overly-optimistic (Cost unreasonably low, and duration too short) and Overlooks (avoids) risks**

Unrealistic estimates lead to poor project outcomes





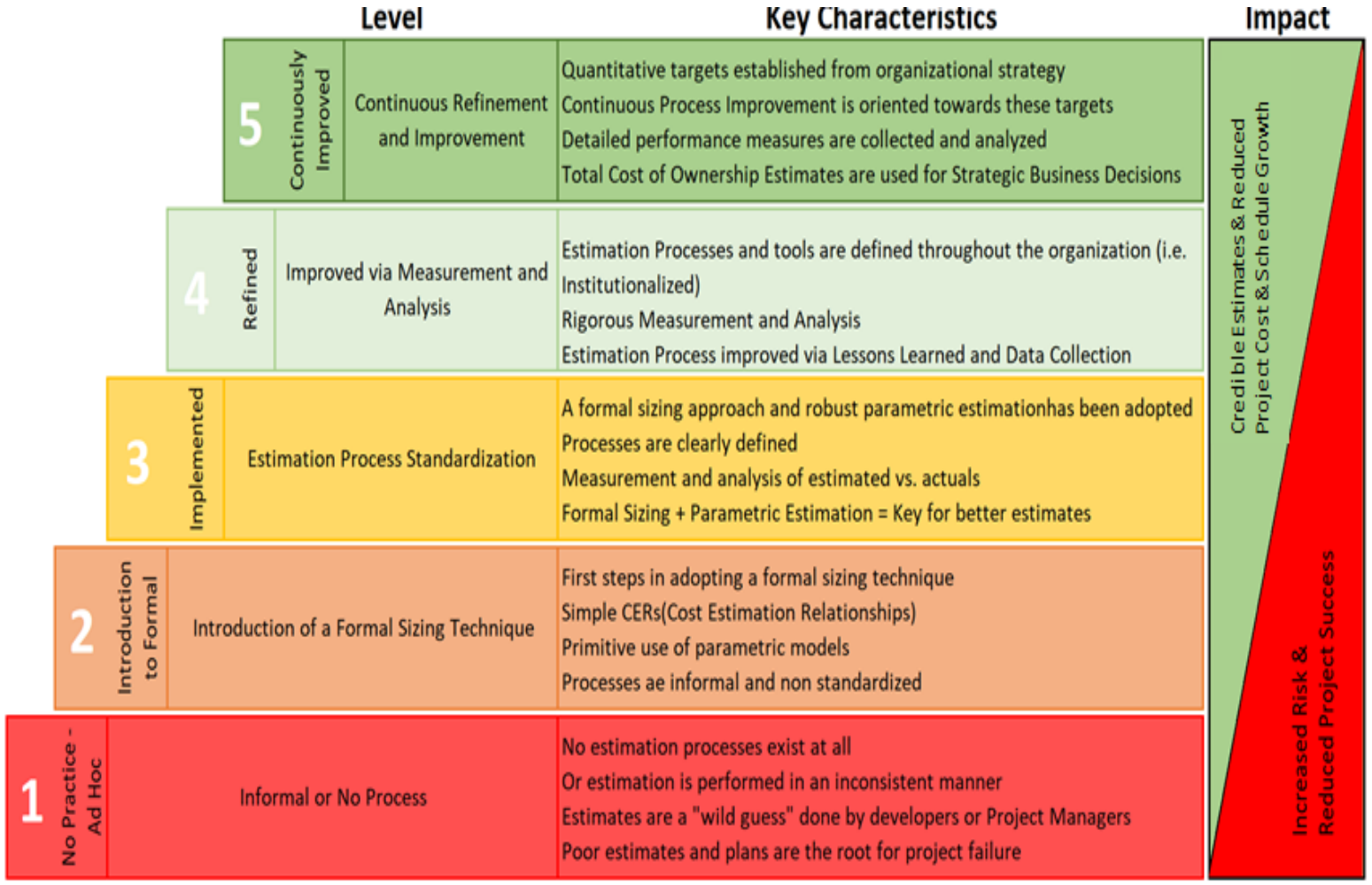
Okay, but isn't agile development (by its nature) unpredictable? Why bother estimating... ?

10 Lessons Learned about Software Cost Estimating (in Agile)

1. Historical data based estimates are more reliable than theory (or guesses)

- **Data analysis** is important (data must be similar, relevant, comparable)
- **Data normalization** is critical (units of measure, scope, who, what, OT)
- **Historical data is valuable** → tells a factual story (CER, SER)

2. Cost estimating Maturity Model

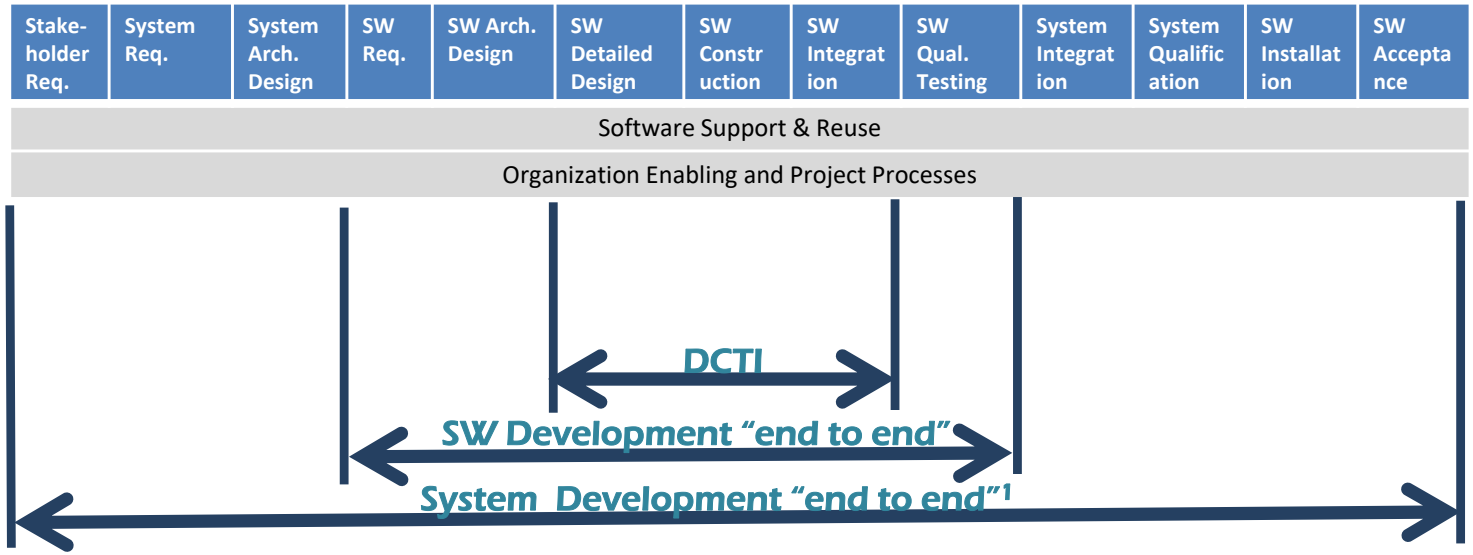


Many companies do not follow formal estimating practices (Level 1)

Source: Adapted from Estimation Maturity Model by Dan Galorath and Esteban Sanchez, Galorath.com

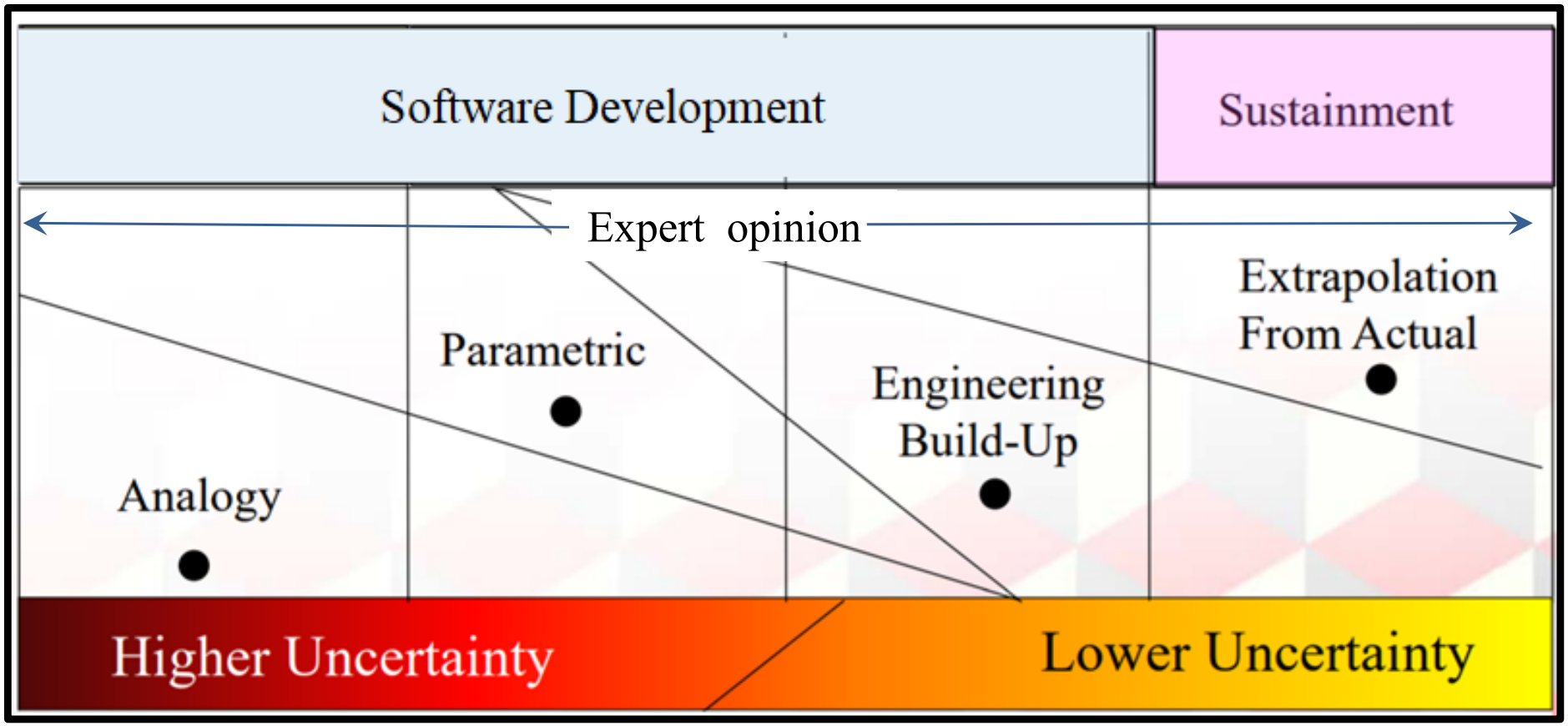
3. Estimation Scope is critical: Range of software activities included

- Design, Code, Test, Integration (DCTI) factors cover the "core" parts of the process; other activities must be estimated separately or significant omissions will occur in the estimate
- Software "end to end" productivity attempts to cover all "software-specific" activities; higher level systems engineering activities must be estimated separately where relevant



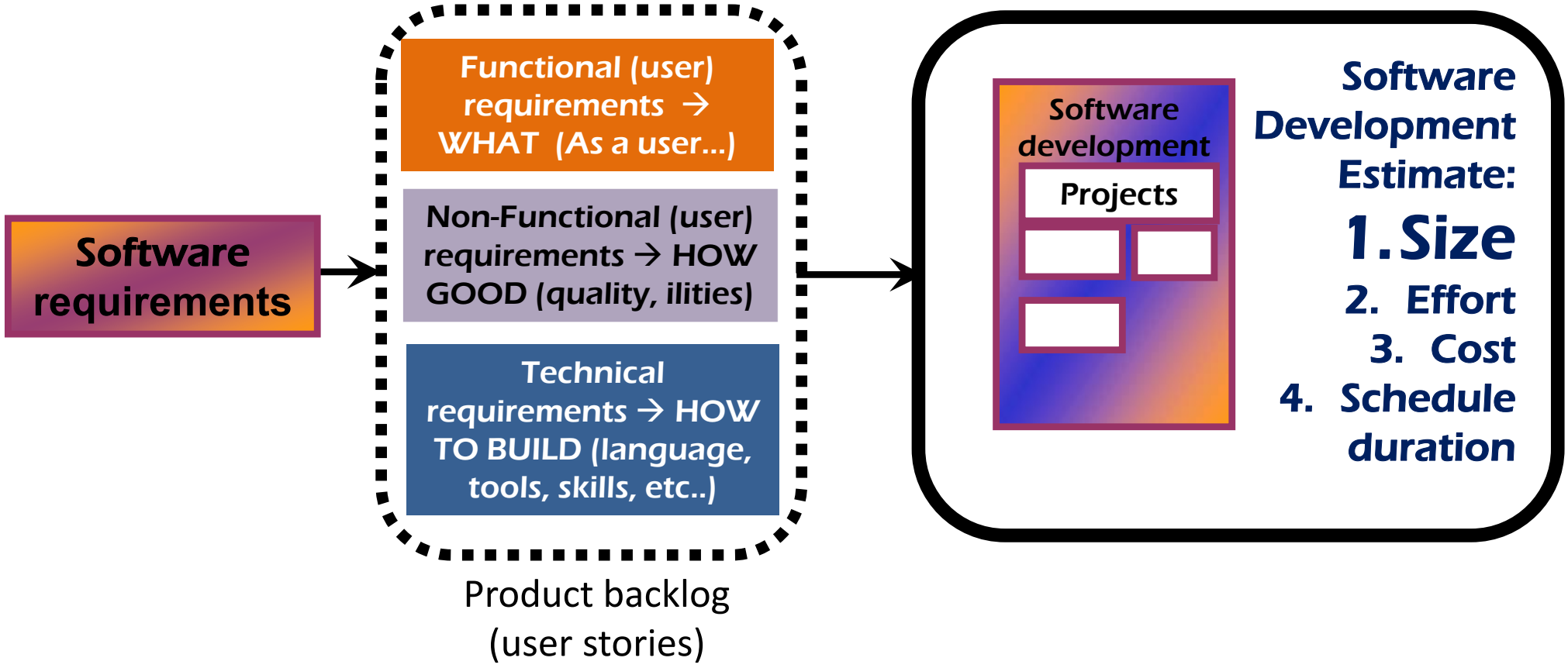
Source: ICEAA CEBOK-S Draft (2021)

4. There is no "one size fits all" estimating approach



Source: ICEAA CEBOK-S Draft (2021)

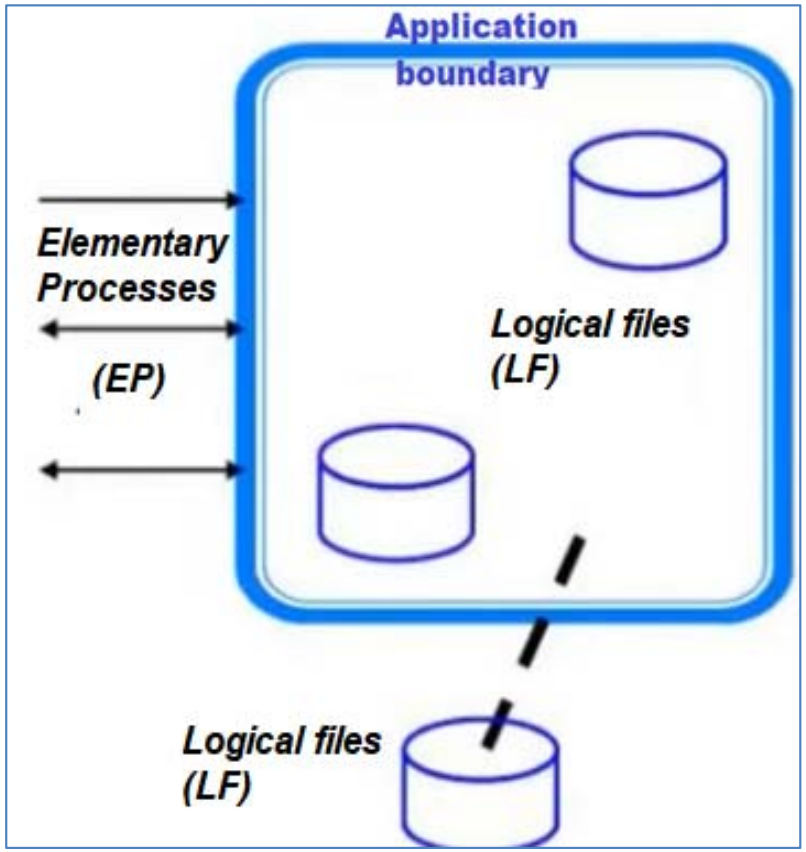
5. Quantifying software size is fundamental to a good estimate



Source: Quality Plus Technologies, Inc.

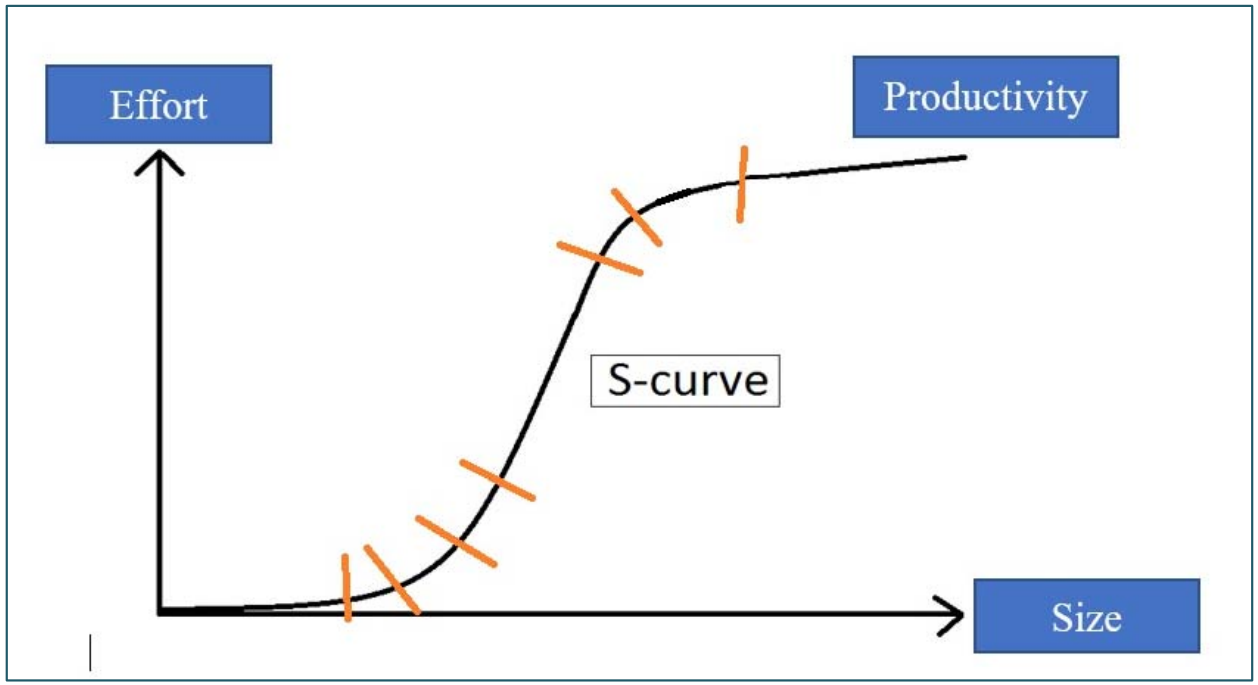
6. Estimate the product backlog using functional size (Simple FP or FP)

- Simple Function Points is standardized (International Function Point Users Group SFP v2.1 method)
- Size based on number of Logical Files (LF = 7 SFP each) and Elementary Processes (EP = 4.6 SFP each)
- Examples:
  - CRUD + entity = 4 EP + 1 LF = 25.4 SFP
  - 10 unique reports = 10 EP = 46 SFP
  - Data sent from other system = 1 or more EP
  - Data sent to other system = 1 or more EP



7. Software development is subject to Diseconomies of Scale (Exp > 1)

Effort = Size^Exp * 1/Productivity



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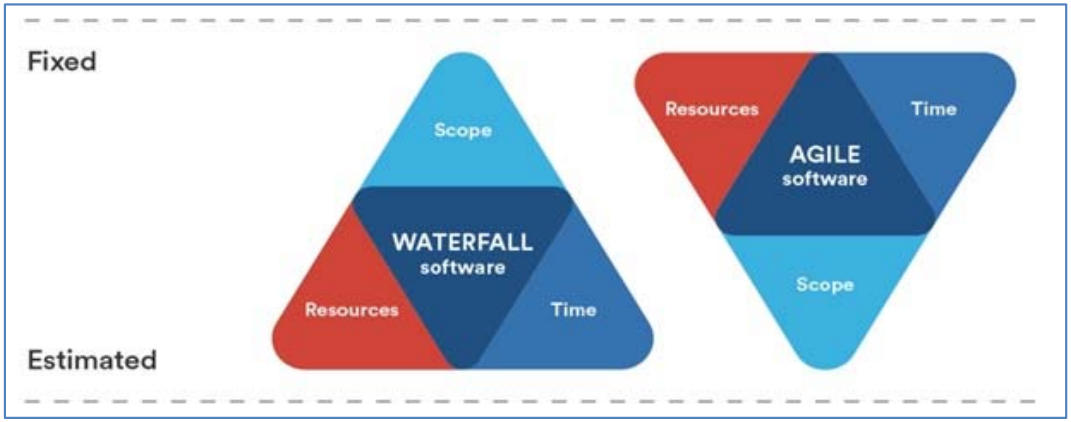
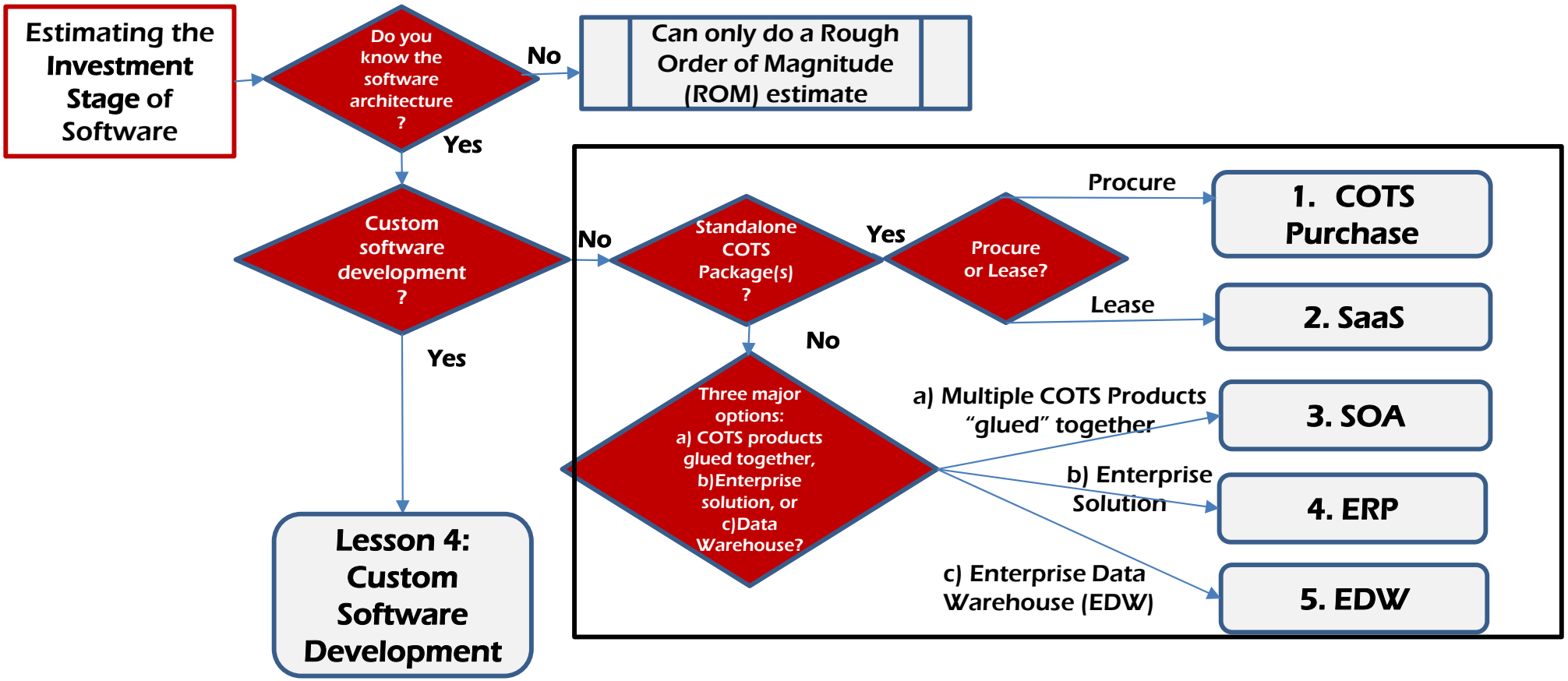
8. Agile versus Waterfall: different cost (estimating) considerations



Adapted from
https://www.process.st/waterfall-vs-agile/

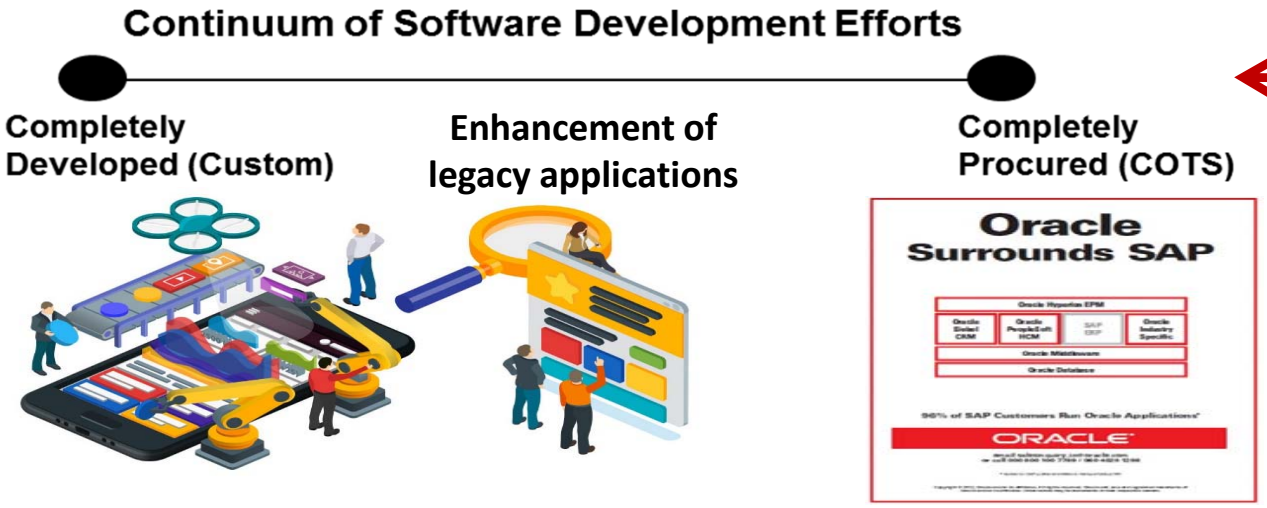
Topic	Agile	Predictive / waterfall	Hybrid-agile (Partly predictive/partly agile) TYPICALLY GOV"T
Fixed variables	Cost & schedule	Scope (requirements)	Initial high-level scope fixed, but is flexible to prioritization and change during development
Estimated	Scope (features)	Cost & schedule	Cost & schedule initially estimated, but becomes fixed during development
Driver	Change-driven	Plan-driven	Hybrid
Development risks[1]	Cost & schedule mostly fixed. Delivered size may fall short	Scope fixed → cost & schedule overruns	Cost & schedule mostly fixed during build. Delivered scope may fall short

9. Hybrid software solutions are Non-trivial: Development vs Procurement



Source: ICEAA CEBOK-S Draft (2021)

10. Continuum of Development vs Procurement



Software development paradigms

Configuration, licensing, integration, customization

All software efforts (with or without system activities) lie on a continuum of completely developed (custom) to completely procured[1]

Procured software involves effort to configure, integrate, and customize (see Lesson 6)

1 Commercial Off-the-Shelf (COTS) and Information System (IS)/Business Systems software (packages) are covered in Lesson 6
This slide is used here to depict where software development paradigms fit in the context of software development

Agile and Cost Estimation

- Poor cost and schedule estimates can doom a project or initiative from the “get go”
- ***Software*** cost and schedule estimates are especially challenging to cost estimators, **and** the team (TLA’s, types of requirements)
- Communication between the two disciplines (cost estimating and development) can lead to far better outcomes
- Software cost estimation is a professional endeavor (ICEAA CEBOK-S)

Draft: Software Cost Estimation Body of Knowledge CEBOK-S

ICEAA International Cost Estimating and Analysis Association

LESSON 0: INTRODUCTION TO CURRICULUM

LESSON 1: IMPORTANCE AND MOTIVATION FOR CEBOK-S

LESSON 2: SOFTWARE DEVELOPMENT PARADIGMS

LESSON 3: CEBOK-S FIVE-STEP ESTIMATING PROCESS

LESSON 4: ESTIMATING CUSTOM SOFTWARE DEVELOPMENT

LESSON 5: SOFTWARE SUSTAINMENT

LESSON 6: ESTIMATING PROCURED SOFTWARE SOLUTIONS

LESSON X: SOFTWARE SIZE

LESSON Y: PRODUCTIVITY

LESSON Z: COMMERCIAL ESTIMATING MODELS

Builds on Pre-requisite Knowledge: ICEAA CEBOK Modules

Contents [hide]

1 Unit I - Cost Estimating
- 1.1 Module 1 - Cost Estimating Basics
- 1.2 Module 2 - Costing Techniques
- 1.3 Module 3 - Parametric Estimating

2 Unit II - Cost Analysis Techniques
- 2.1 Module 4 - Data Collection and Normalization
- 2.2 Module 5 - Inflation and Index Numbers

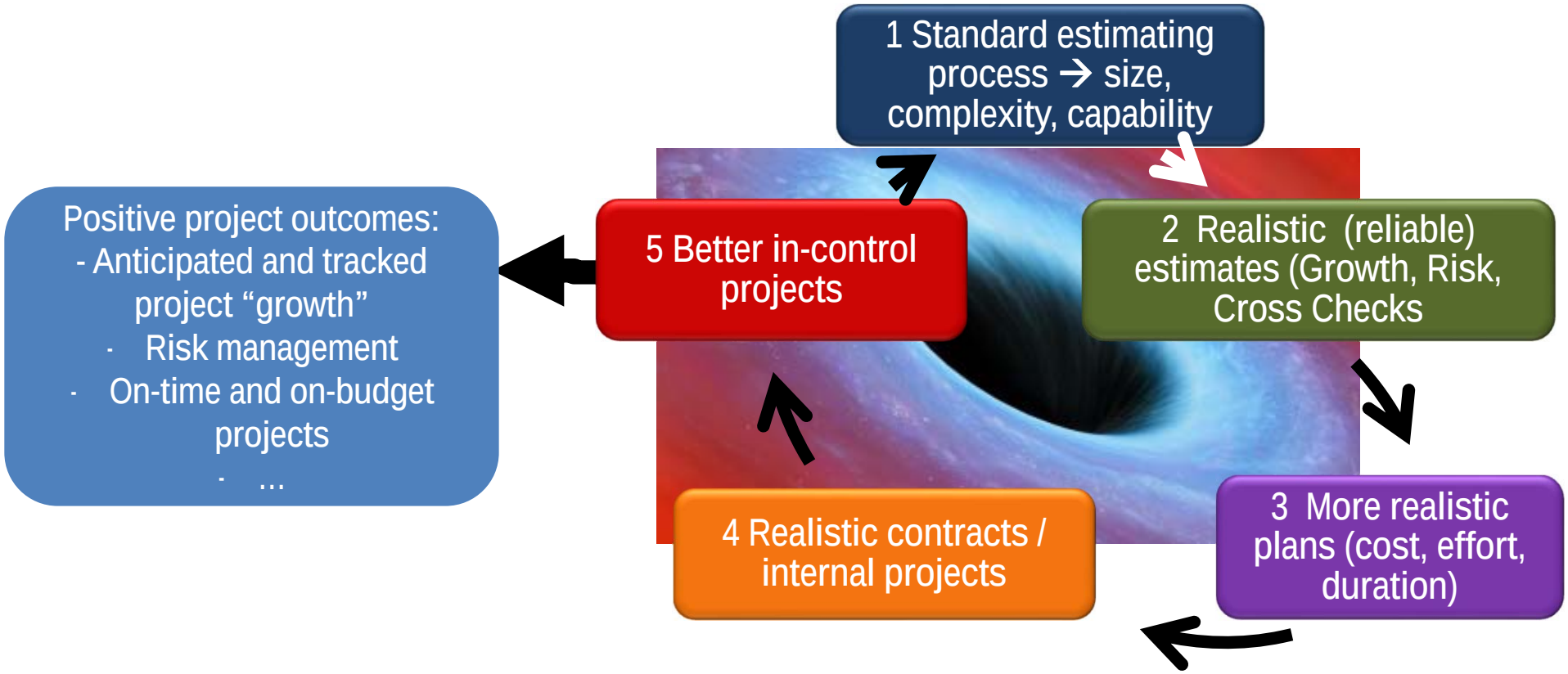
3 Unit III - Analytical Methods
- 3.1 Module 6 - Basic Data Analysis Principles
- 3.2 Module 7 - Learning Curve Analysis
- 3.3 Module 8 - Regression Analysis
- 3.4 Module 9 - Cost and Schedule Risk Analysis
- 3.5 Module 10 - Probability and Statistics

4 Unit IV - Specialized Costing
- 4.1 Module 11 - Manufacturing Cost Estimating
- 4.2 Module 12 - Software Cost Estimating

5 Unit V - Management Applications
- 5.1 Module 13 - Economic Analysis
- 5.2 Module 14 - Contract Pricing
- 5.3 Module 15 - Earned Value Management
- 5.4 Module 16 - Cost Management

- **Basic knowledge of cost estimating content as highlighted**
- **Available to ICEAA members https://wikidev.iceaaonline.com/wiki/Main_Page**

Data-based, realistic agile development estimates → positive project outcomes



A Final Note…

'The software industry has the worst metrics and measurement practices of any industry in human history' – Capers Jones (2018)[1]

"Size- and data-based software estimates are the key to better project outcomes, and in time, better metrics." – Carol Dekkers, Dec 2021

1. Source: Capers Jones, **Quantifying Software – Global and Industry Perspectives**, 2018

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