The Illusion of Certainty

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Summary

- Traditional acquisition practice relies on certainty in requirements

- Uncertainty is unavoidable but seen as a weakness to be eliminated

- Ill-founded resolutions of uncertainty provide an illusion of certainty, preempting proper analysis

- Some uncertainty, due to incomplete knowledge or information, can be resolved with due effort

- Some uncertainty, due to diverse and changing needs, requires changeable solutions

Requirements is a *model* of a product

A model exists to answer specific questions:

- What is the product's purpose and value?
- What behavior does its users need it to exhibit?
- What is the context in which it operates?
- What interfaces does it have with other devices and systems?
- What are constraints on a solution?

Complete answers are possible only with

- The existing as-built product
- Full documentation of the product's development

An empirical premise

Requirements certainty is always an illusion

- Incomplete knowledge or understanding
- Incomplete or inaccurate information
- Differing experiences and opinions (among subject matter experts or experienced users)
- Inability to envision all implications of a solution
- Needs and technology that change over time

Normal acquirer viewpoint

- Indecision causes delay
- Make decisions – eliminate uncertainties

When is a requirement not certain

- When it is tradeable (conflicts with a higher priority, costs too much, …)
- When it is only a preference (wished for, not essential)
- When it has unacceptable side effects (performance, security, …)
- When the need has since changed

The acquirer's dilemma

Reactions to finding uncertainties in requirements:

- Indecision and delay ("somebody has to decide")
- An ill-founded decision, without proper rationale or exposure, for an inferior product and rework
- Acceptance and accommodation
  - Identify and document uncertainties
  - Analyze implied alternatives, tradeoffs, and rationale to reach a substantiated decision
  - Establish unresolvable uncertainties as product variabilities with decision criteria, enabling deferred change at will

Dealing with uncertainty

Uncertainty   *Weak*   →   Best "guess"

Better ↓

Investigate   *Best*

Decision
+ Rationale

Changeable
Decision
+ Criteria

Sources of uncertainty in requirements

Transient (second order) uncertainty

- Incomplete knowledge or information
- Disagreements among experts or users
- Complex alternatives requiring tradeoff analyses or experimentation

Persistent (first order) uncertainty

- Changing circumstances, capabilities, or expectations across time or place
- Differing needs or preferences of customers having similar needs *(a product line)*

Goals for addressing uncertainty

Awareness

- Expose and characterize all uncertainty

Understanding

- Analyze alternative resolutions and tradeoffs
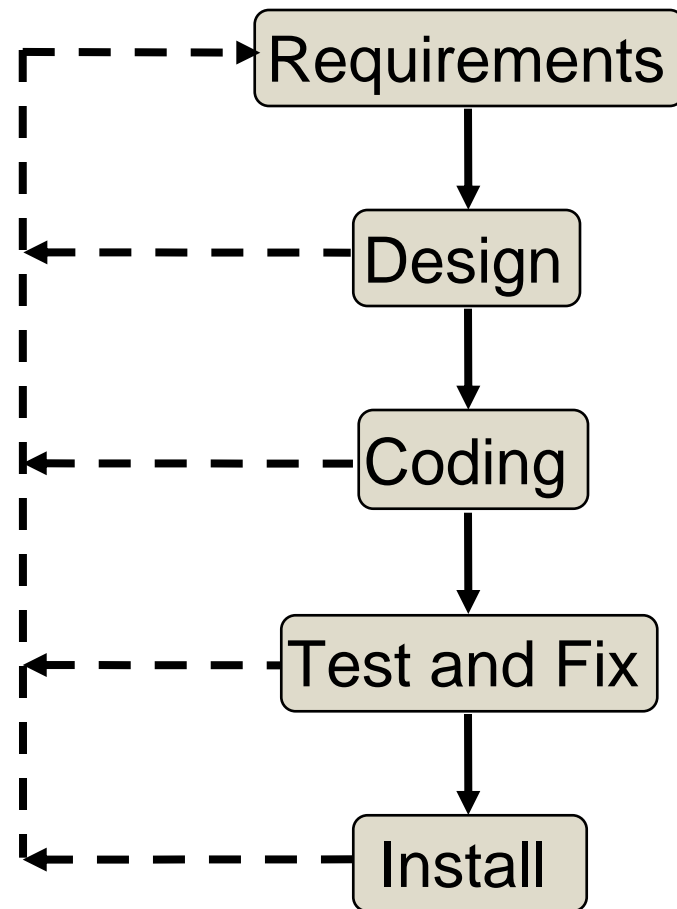
Reduction

- Eliminate transient uncertainty, minimize persistent uncertainty, document rationale
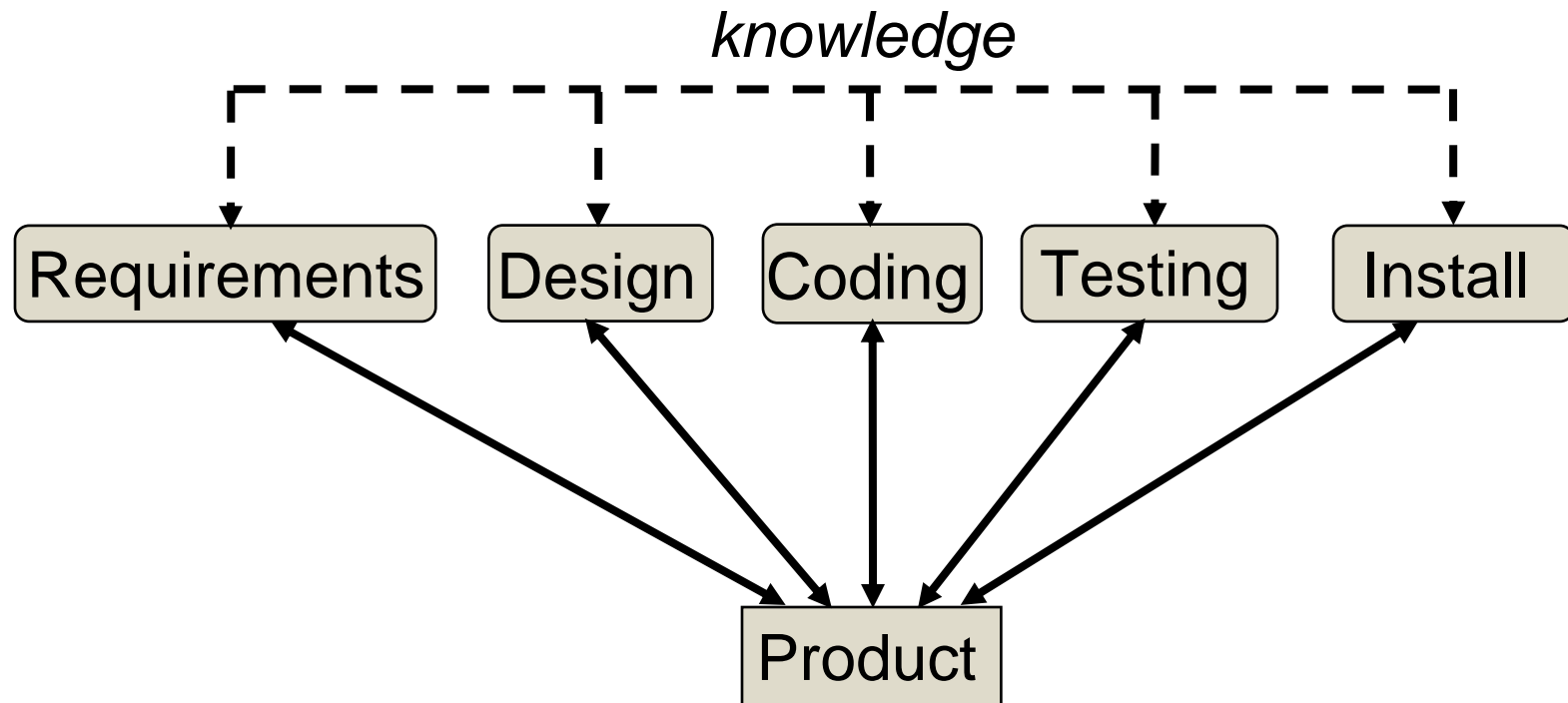
Accommodation

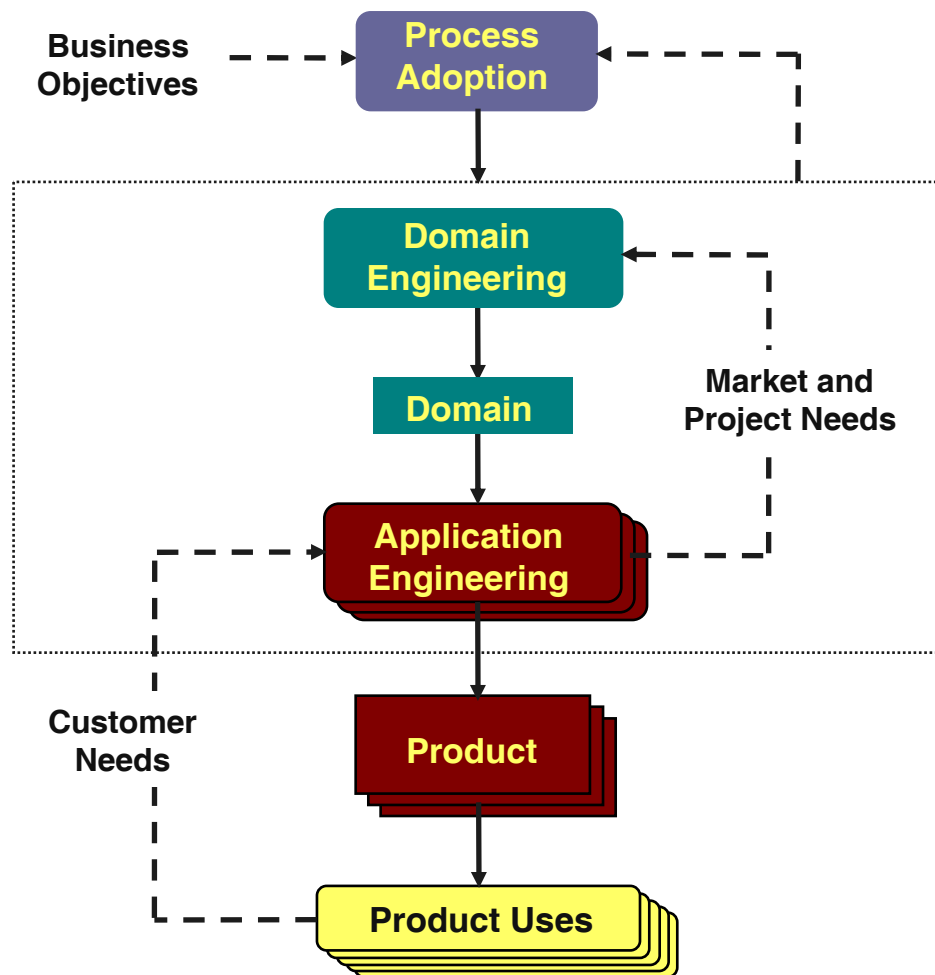- Track and manage implications of persistent uncertainty throughout the product life cycle

A traditional software process

A concurrent software process

A product line software process

Business Objectives

Process Adoption

Domain Engineering

Domain

Market and Project Needs

Application Engineering

Customer Needs

Product

Product Uses

Institute & improve a product line business

Develop and evolve a capability for building similar products

Build customized products for customers

source: *www.domain-specific.com*

DoD acquisition life cycle, recast

Mission Need → **Concept & Technology Development**

Requirements (RFP)

System Development & Demonstration

Production Capability

Production & Deployment

Customized Products (*Mission Capability*)

Operations & Support

Key
→ Baselined information
⇠ Feedback

G. Campbell, "A Software Product Line Vision for Defense Acquisition" (*CMU/SEI-2002-TN-002*), *2002*.