The Illusion of Certainty

Grady Campbell

12 May 2010

**Software Engineering Institute
Carnegie Mellon University
Arlington, VA 22203**

Sponsored by the US Department of Defense

Software Engineering Institute | **Carnegie Mellon**

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

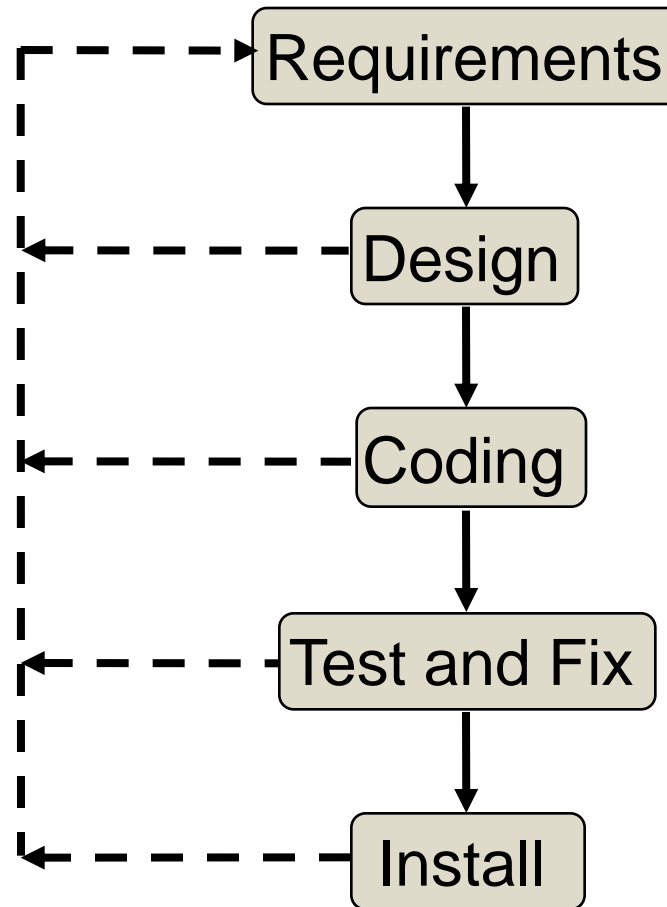- Analyze alternative resolutions and tradeoffs

Reduction

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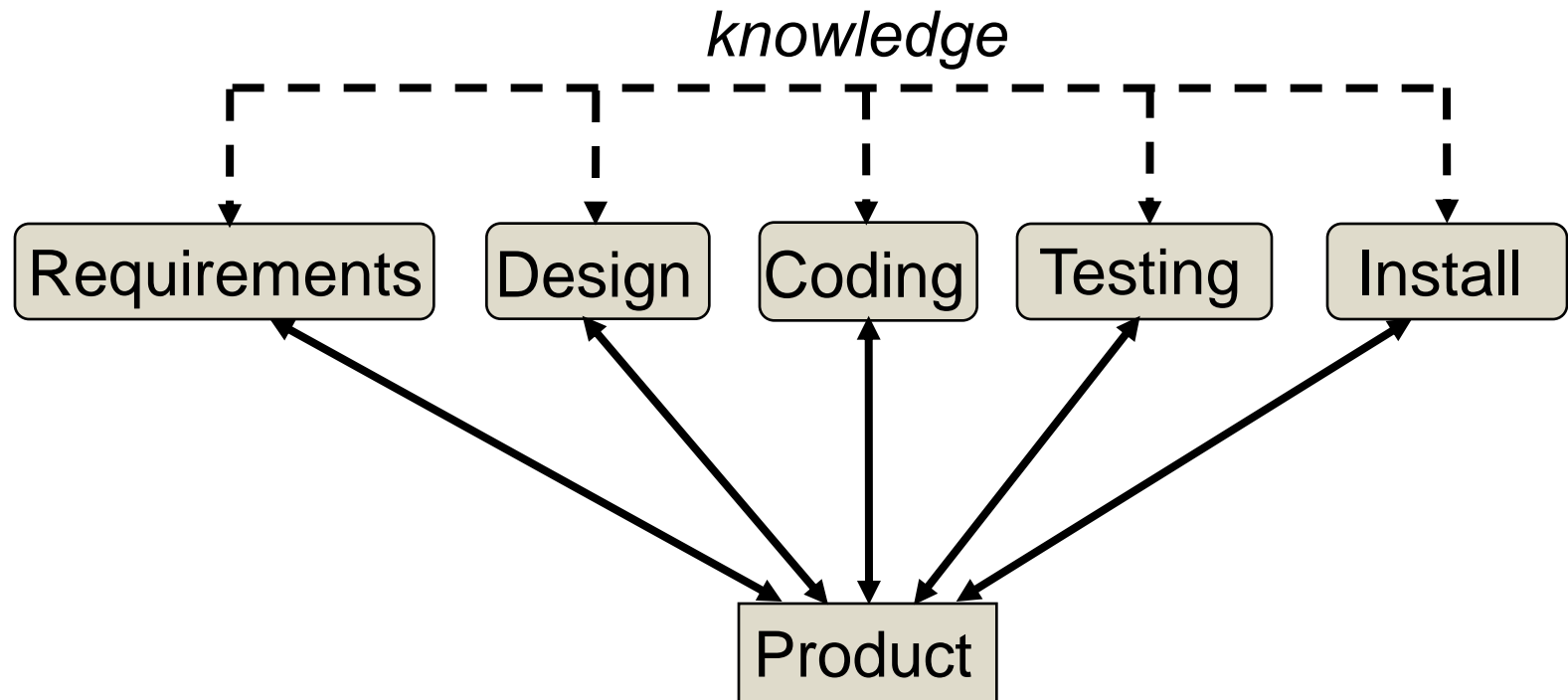
Accommodation

- Track and manage implications of persistent uncertainty throughout the product life cycle
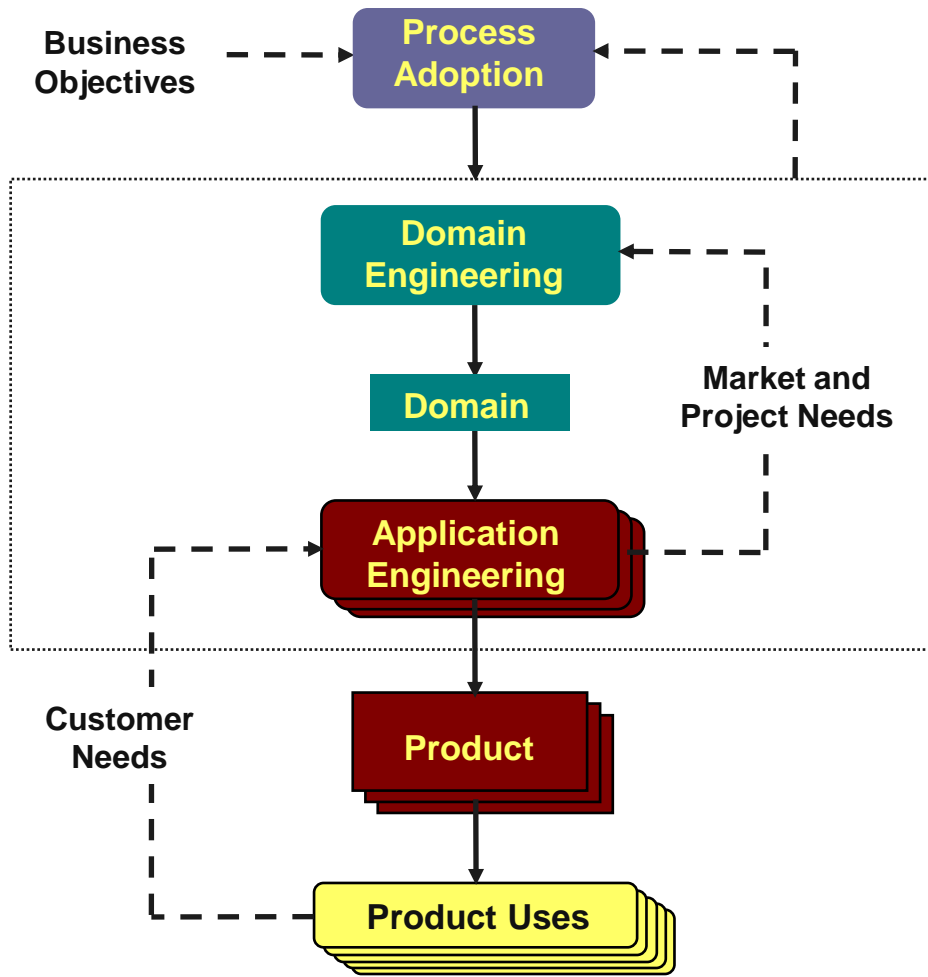
A traditional software process

Software Engineering Institute | **Carnegie Mellon**

A concurrent software process

knowledge

Requirements — Design — Coding — Testing — Install

Product

A product line software process

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

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

Software Engineering Institute | **Carnegie Mellon**