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“They Keep Moving the Cheese”

A Framework for Evolutionary Acquisition of Large Software Intensive Systems

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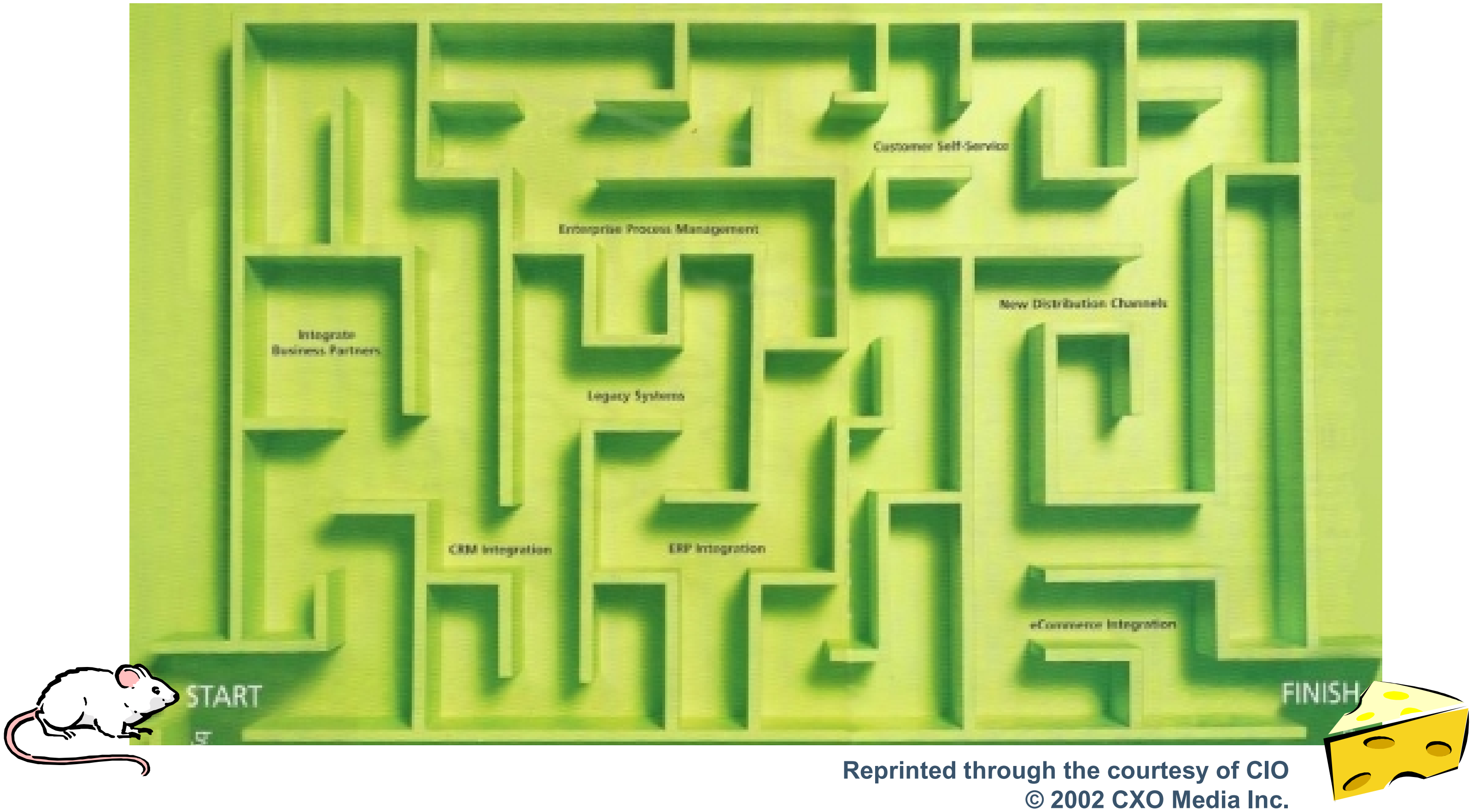
Who Moved My Cheese?



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A Story…

Program goal: provide a tool for strategic, operational, and tactical planners from all services and defense agencies to support joint and coalition engagements and peace keeping efforts

- Run on existing enterprise backbone (managed by another agency)
- Interface with multiple existing and developing systems
- Operate across multiple security levels

Program Start (late ’90s)	2003
• Automate manual process • Client-server architecture • Support 2-3 day planning cycle	• New planning processes • Web-based architecture • Dynamic planning cycles • Collaborative planning
6 increments delivered across 6-7 years • First release in 18-24 months	• Increment 1 is obsolete • Struggling to build/field increment 2 • Users have built “interim” solutions • Future is uncertain

Size Matters!

Project Size	People	Time (mos)	Success Rate
< $750K	6	6	55%
$750K-$1.5M	12	9	33%
$1.5M-$3M	25	12	25%
$3M-$6M	40	18	15%
$6M-$10M	+250	+24	8%
>$10M	+500	+36	0%

Source:The Standish Group, 1999

Definitions

A software-intensive system is one that

- Relies on software to provide core/priority mission function(s)

A large software-intensive system is one whose software

- Takes longer than 6 months to implement
- Takes more than 6 people to implement
- Takes more that $750,000 to implement

and/or

- Is comprised of multiple interrelated systems or independently developed components implemented in software (system of systems, family of systems, etc)

Outline

Change Happens

Adapting to Change

Be Ready to Change Quickly

Change Happens

Large software-intensive systems change at a rate faster than the full system capability can be implemented – and they change during development and operation

Sources of change

- Enterprise priorities shift
- Business or operational needs change
- New technologies introduce new opportunities
- COTS products add and delete key features
- Participants rotate
- …

Adapt to Change

DoD 5000* provides mechanisms for coping with change

Evolutionary Acquisition

Delivers capability in increments, recognizing, up front, the need for future capability improvements

- Success of the strategy depends on the consistent and continuous definition of requirements and maturation of technologies that lead to disciplined development and production of systems that provide increasing capability towards a material concept.

Spiral Development

A desired capability is identified but the end-state requirements are not known at program initiation

- Those requirements are refined through demonstration and risk management; there is continuous user feedback; and each increment provides the user the best possible capability. The requirements for future increments depend on feedback from users and technology maturation.

* The Operation of the Defense Acquisition System, 30 Oct 02

Lessons Learned

☑ Going after “low hanging fruit” in the absence of an overarching architecture and coherent plan results in incompatible and stove-piped solutions

☑ System requirements defined without sufficient insight into what can be realistically built, results in systems that cannot be built

☑ There are no “silver bullets” that avoid disciplined system and software engineering (doing the right engineering correctly)

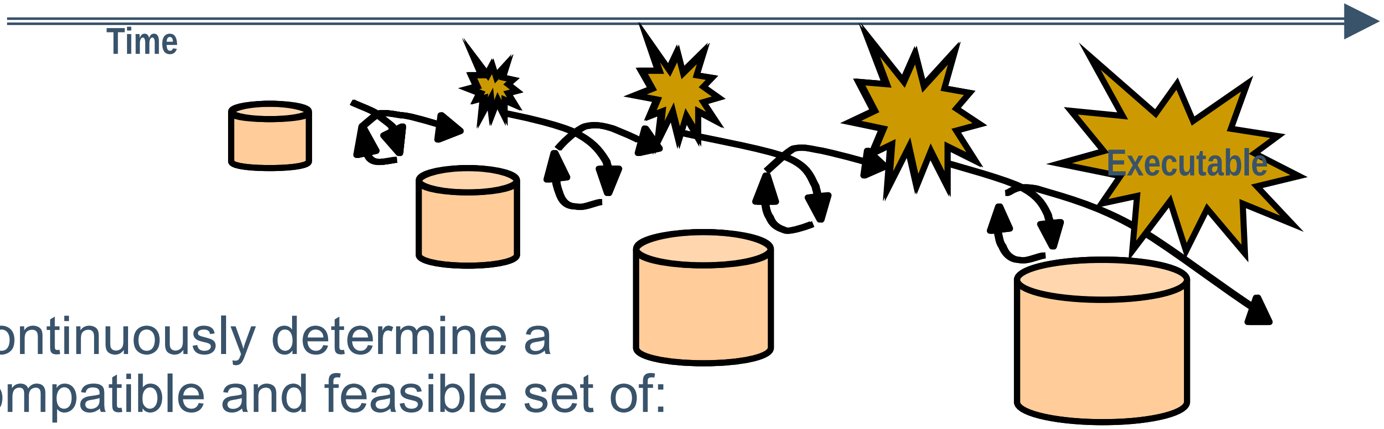
Be Ready To Change Quickly

Consciously apply spiral development practices at 2 (or more) discrete levels – with continuous interaction between the levels

- Program or system level
  - Evolve definition and implementation plan for system end-state
  - Define and spawn increments of useful capability that will build to full system functionality and performance

- Project or increment level
  - Define and implement plan for delivering the defined increment in the context of the system end-state

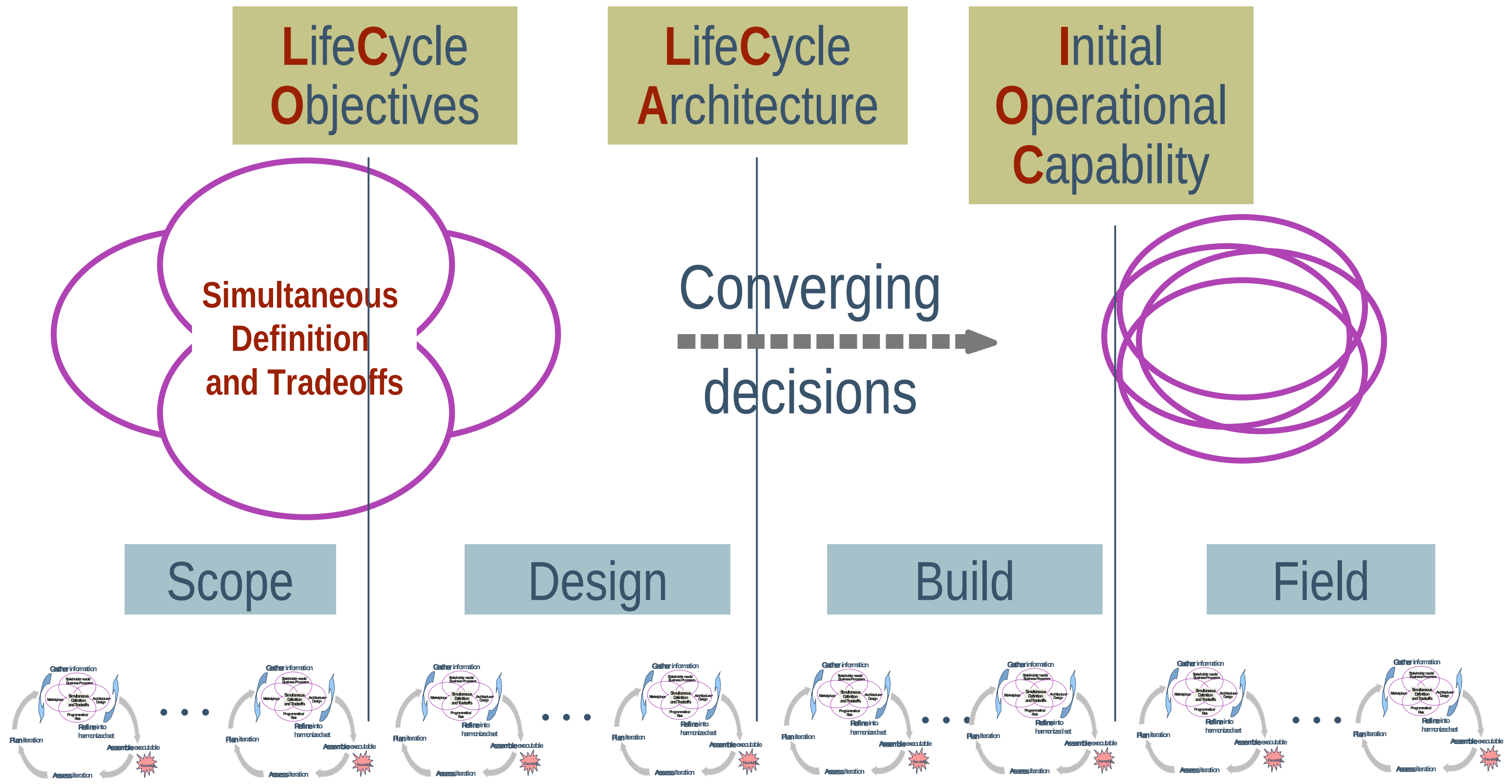
Disciplined Spiral Development



- Continuously determine a compatible and feasible set of:
  business processes, requirements, plans, architecture, COTS products and other components
- Enterprise <u>business objectives</u> drive solution definition
- <u>Risk </u>considerations drive degree of detail
- <u>Executable representations</u> demonstrate current understanding and agreements

Spiral development facilitates evolving a viable solution –
at both system and increment levels

Phases Bounded by Anchor Points



LifeCycle Objectives

LifeCycle Architecture

Initial Operational Capability

Simultaneous Definition and Tradeoffs

Converging decisions

Scope

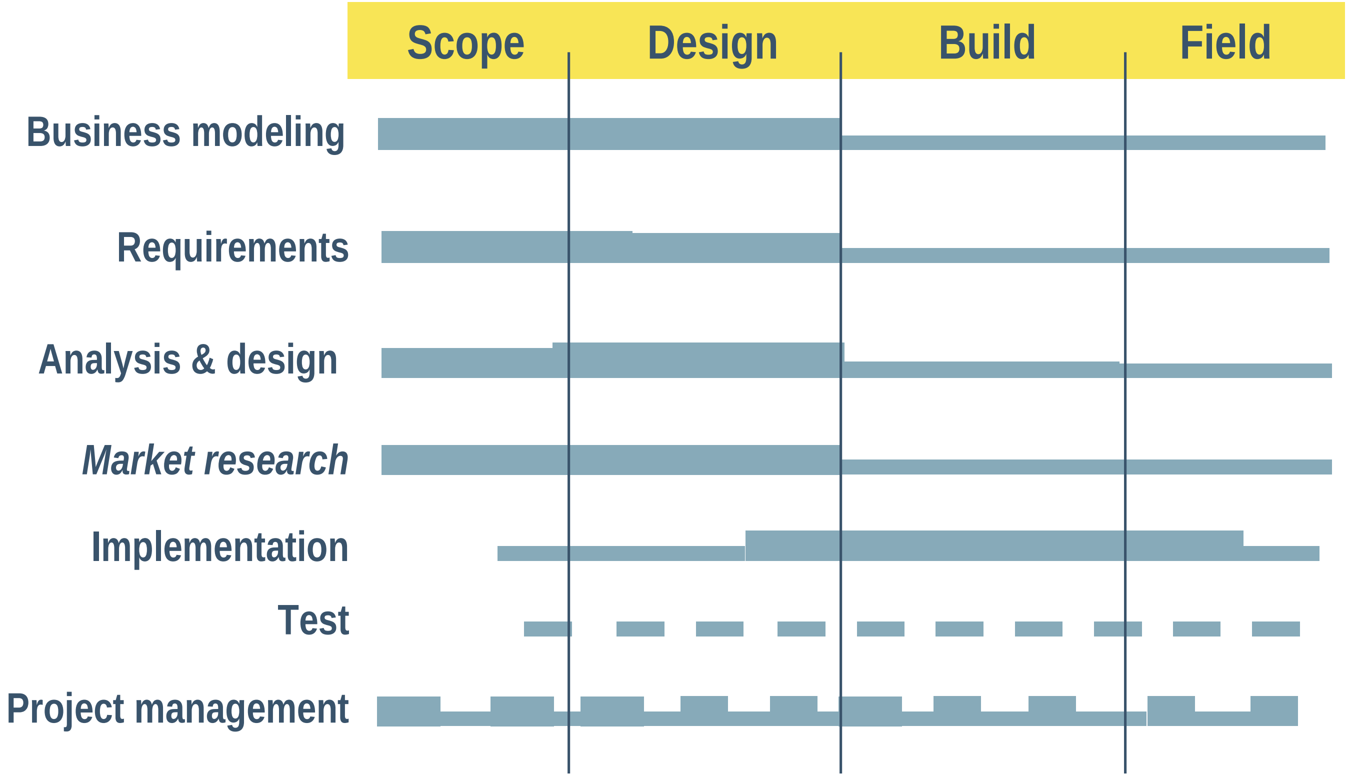
Design

Build

Field

Multiple iterations per phase

Disciplines* Extend Across Phases



*adapted from Kruchten; shows partial set of disciplines

Keep a Long View in Systems Planning

JAPAN
ASIA
EUROPE
AMERICAS
IP-VPN
(IP Sec Type: Global IP
Security Gateway Service)
(Multi-protocol label
switching (MPLS) Type)
DATA CENTER
GLOBAL SERVER LOAD BALANCING
(Smart Content Delivery)
GLOBAL IP NETWORK
GLOBAL SLA

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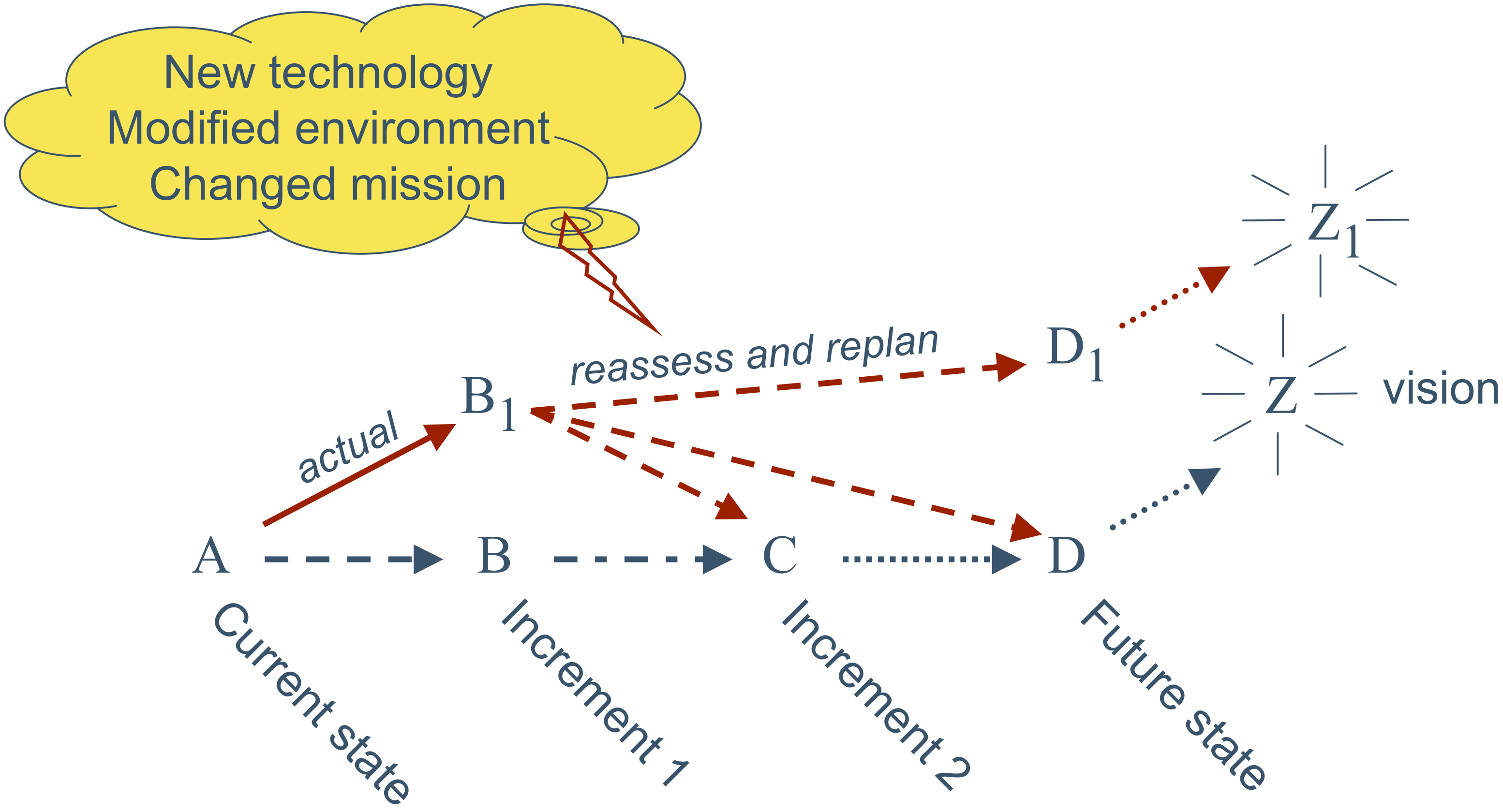
Evolving System Definition



Take a Short View on Increment Planning

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Allows a stable development environment – if a short timeframe (6-18 months)

Allows focused discovery, experimenting, and learning on a manageable scale to find optimum way to understand and meet user needs

Increment Activity Mapping

Scope	Design	Build	Field
Define feasible scope	**Refine, experiment, & select solution**	**Implement selected solution**	**Rollout and support solution**
Survey/try components	***Try/select components***	***Apply/track components***	***Use/track components***
Agree to business changes	***Prototype business changes***	***Prepare to change business processes***	***Change business processes***
Establish project plan Develop business case Outline candidate architectures Study COTS market; screen candidates Prepare demos of candidate solutions Identify key risks Determine business changes	Update project plan Define, baseline and demonstrate solution Evaluate COTS products and components Stabilize requirements and architecture Develop plan to manage business process change	Update project plan Build production quality solution for beta test Continue market/COTS surveys and evaluation Prepare end users for initial fielding	Complete rollout Fix bugs, adjust features, make minor enhancements Achieve user satisfaction / self-supportability Continue market/COTS surveys and evaluation Support solution until retirement

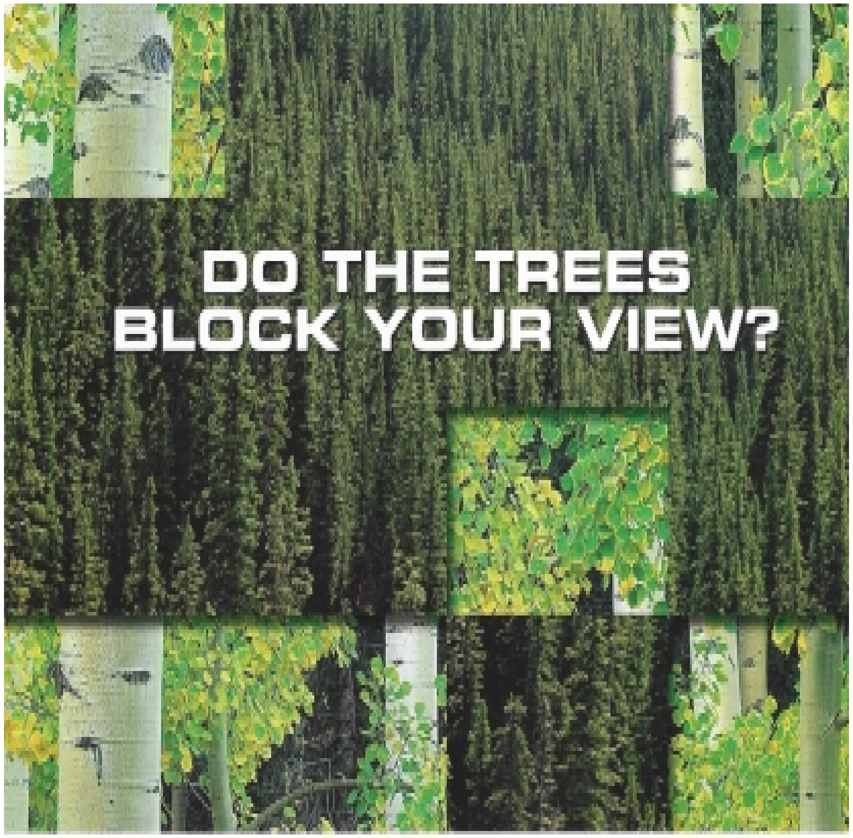
6 to 18 months

Leverage Feedback between Long- and Short-Term

Maintain long-term strategy (system level) aligned with enterprise improvement

Make short-term implementation decisions (increment level) aligned with long-term strategy

Use knowledge gained in short-term increments to evolve long-term strategy



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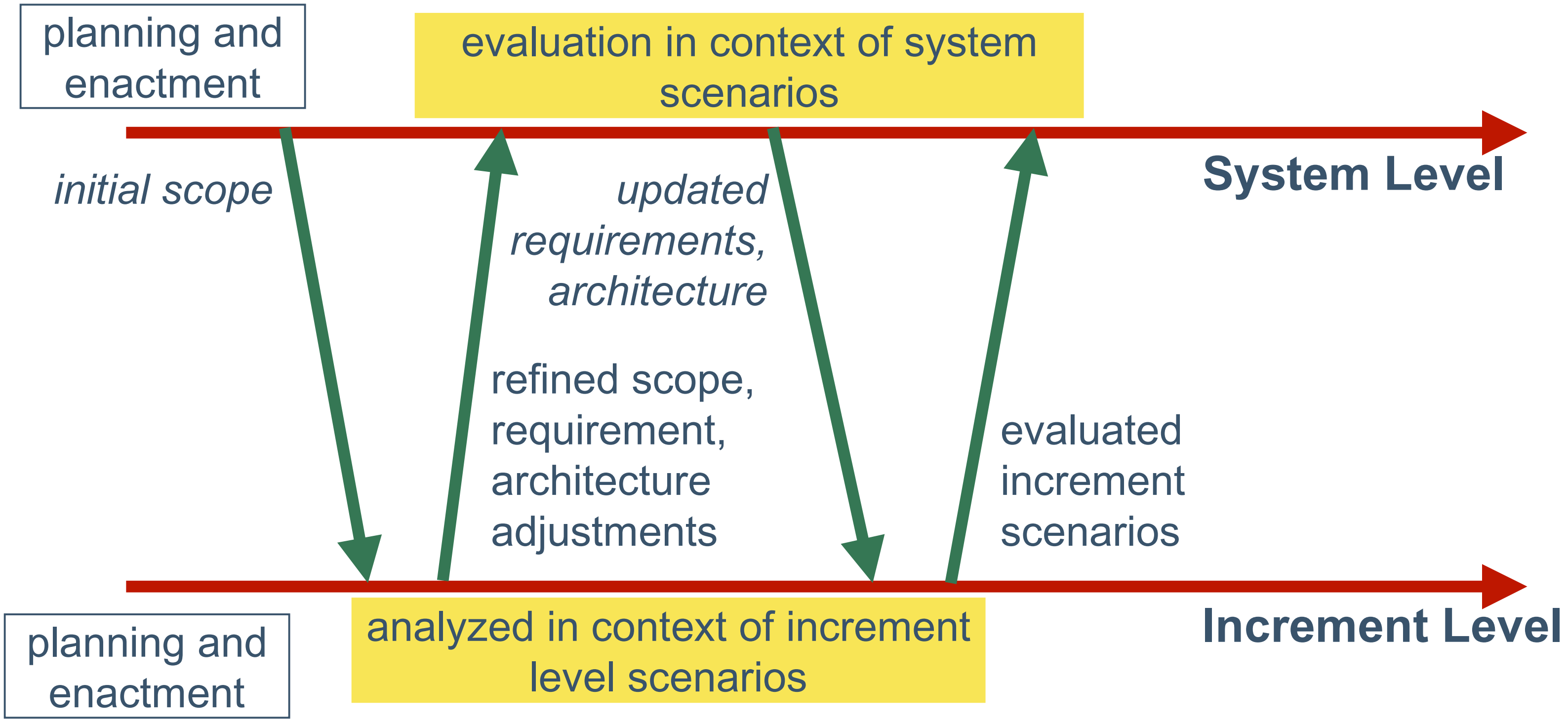
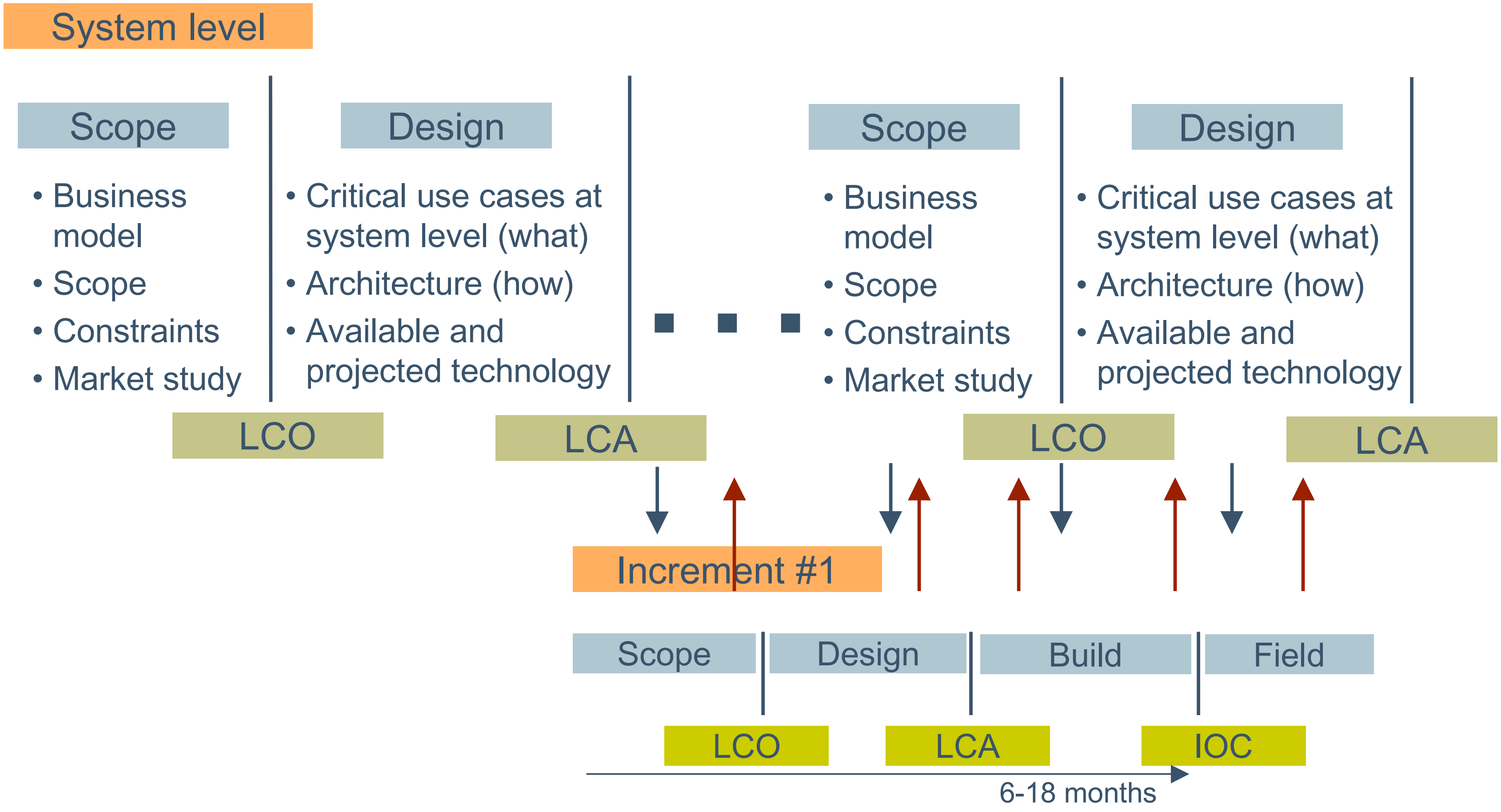
Anticipate continuous change

Plan and Manage *Efficient* Feedback


planning and enactment
evaluation in context of system scenarios
System Level
initial scope
updated requirements, architecture
refined scope, requirement, architecture adjustments
evaluated increment scenarios
Increment Level
planning and enactment
analyzed in context of increment level scenarios

Decisions take place simultaneously at both levels – one informs the other

Managing Continuous Evolution



System level

Scope

- Business model
- Scope
- Constraints
- Market study

Design

- Critical use cases at system level (what)
- Architecture (how)
- Available and projected technology

LCO

LCA

Scope

- Business model
- Scope
- Constraints
- Market study

Design

- Critical use cases at system level (what)
- Architecture (how)
- Available and projected technology

LCO

LCA

Increment #1

Scope

Design

Build

Field

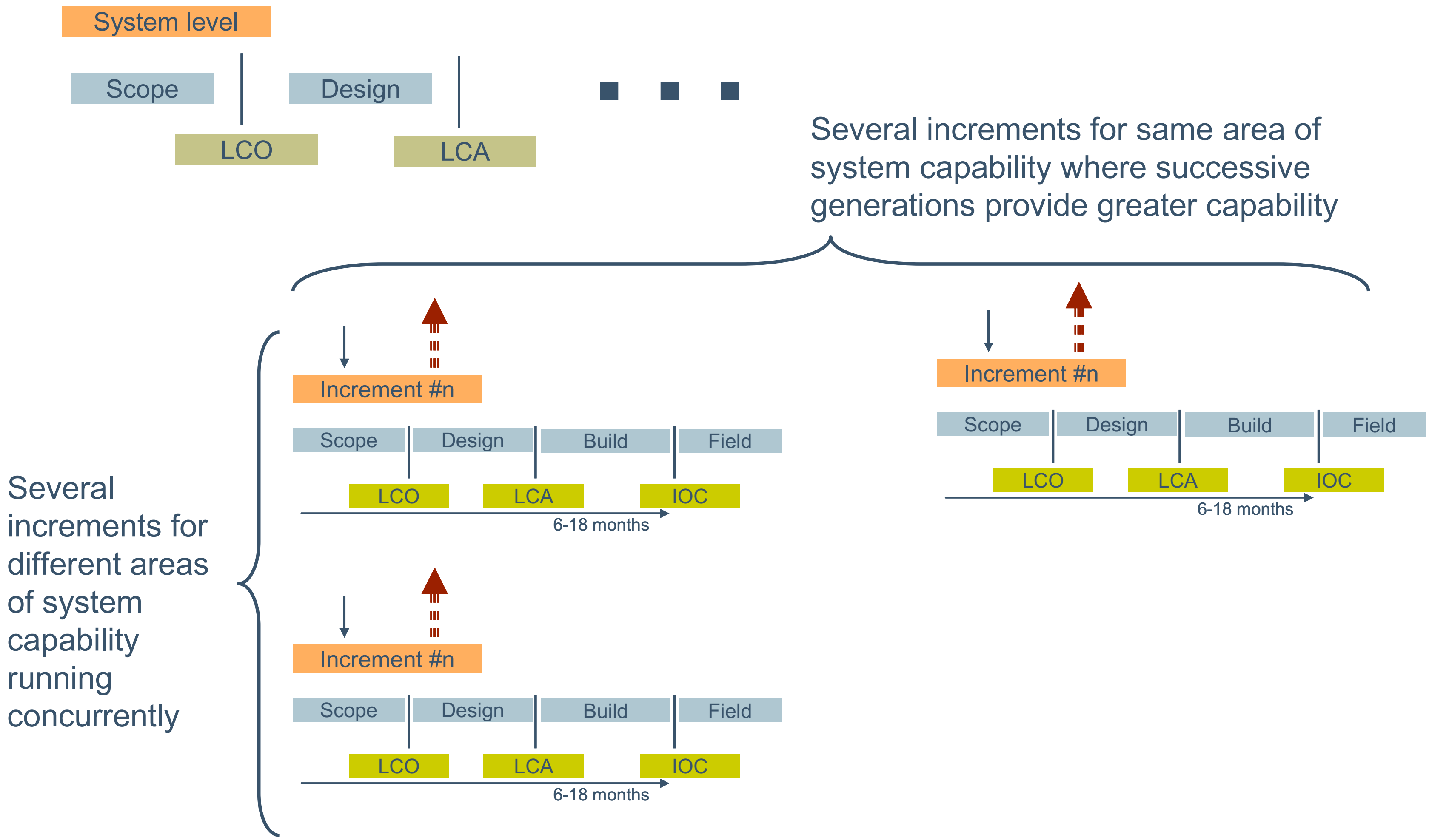
LCO

LCA

IOC

6-18 months

Scenarios of Multiple Increments



Several increments for same area of system capability where successive generations provide greater capability

Several increments for different areas of system capability running concurrently

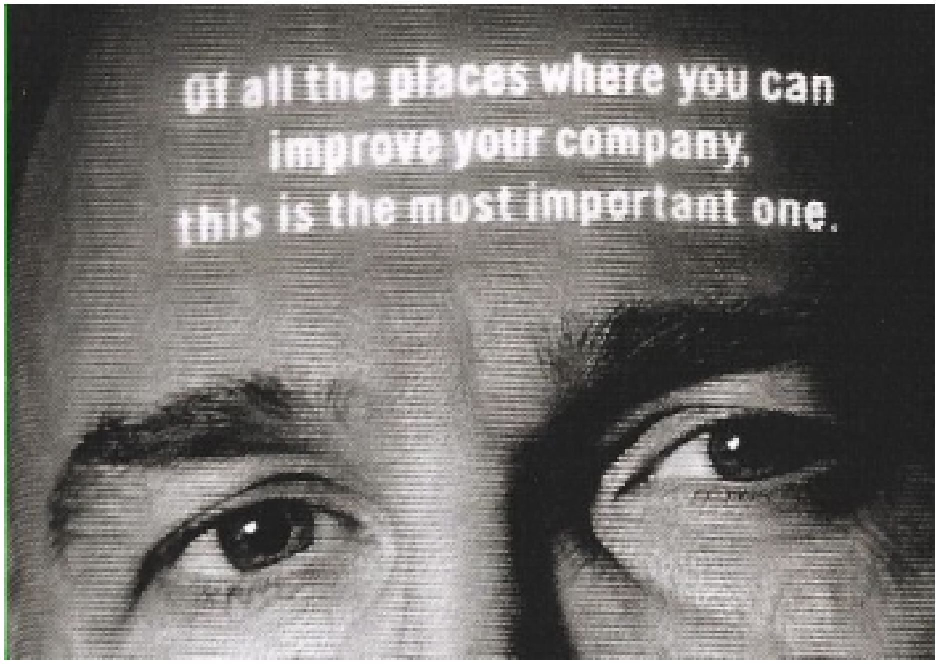
The Handwriting on the Wall

Change Happens

Adapt To Change Quickly

- Anticipate Change
- Monitor Change
- Change
- Enjoy Change!

Be Ready To Change Quickly
And Enjoy It Again


Of all the places where you can
improve your company,
this is the most important one.

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Cecilia Albert is a senior member of the technical staff in the Commercial-off-the-shelf- (COTS)-Based Systems (CBS) Initiative at the Software Engineering Institute (SEI). Before joining the SEI, Cecilia was in the Air Force where she served in a variety of information technologies related positions including: developing major software programs for simulation, command and control, and mission processing of national satellite systems; teaching acquisition and leading an industry study on telecommunications and information systems at the Industrial College of the Armed Forces; and managing the archive and dissemination programs at the National Imagery and Mapping Agency.