Future Software Requirements for S2I2 - HEP

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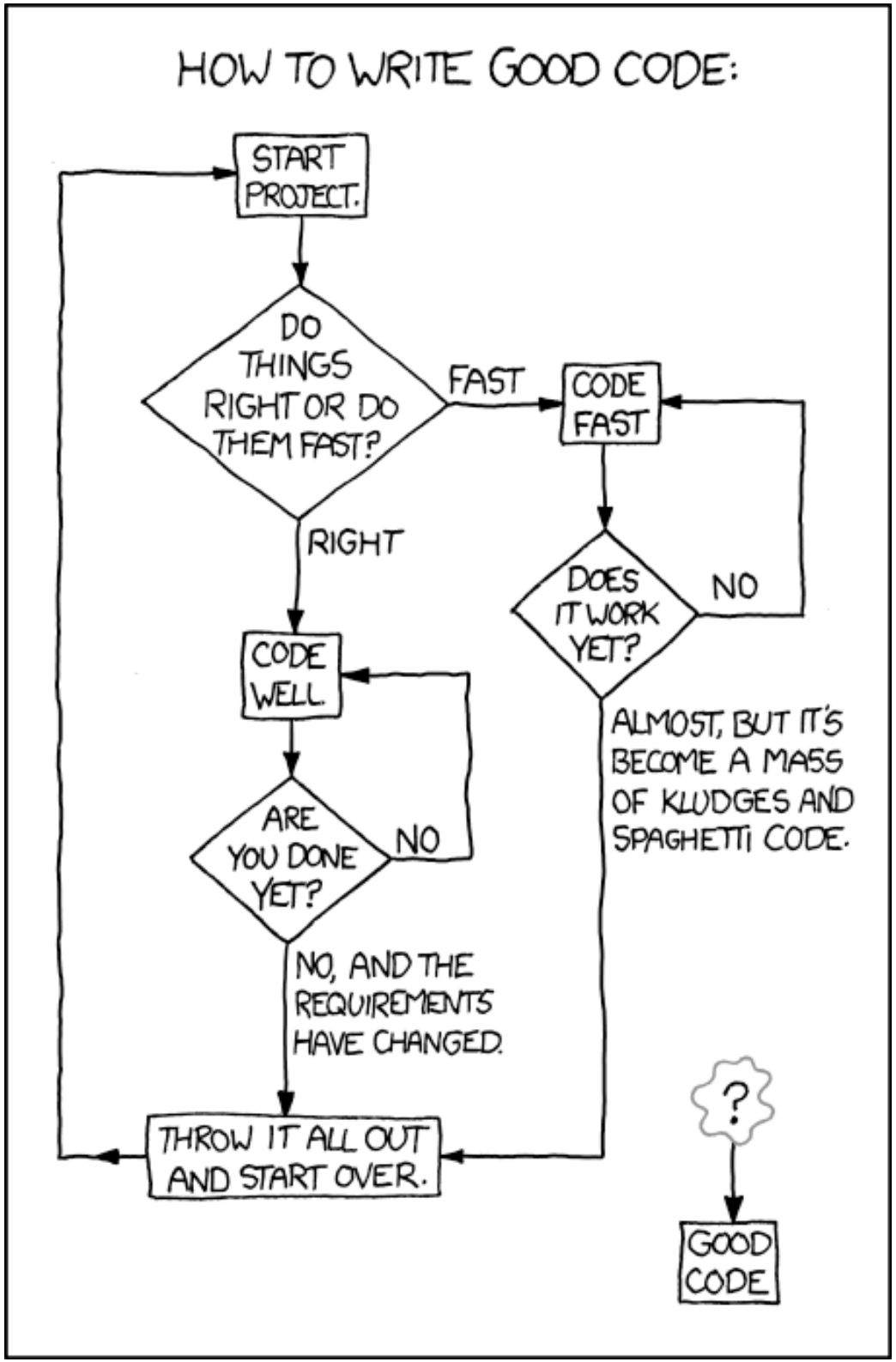
http://xkcd.com/844/



What is “CS”

Physics has a long and storied multi-century legacy

→ CS started formally post-WW2 (see Babbage, Turing, von Neumann as exceptions)

CMU School of CS

- Robotics
- Software Research
  - *Requirements*
  - *Architecture*
- Language Technologies
- Computational Biology
- Machine Learning
- Human Computer Interaction

CS Department

- AI
- Cybersecurity
- Graphics
- Programming Languages
- Systems (Cloud, DB, networks)
- Theory (P/NP etc)

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What is the Software Engineering Institute

- A US federally funded research and development centre (FFRDC)
  - (see also JPL, RAND, Los Alamos)
- Sponsored by Department of Defense and hosted by Carnegie Mellon University in Pittsburgh
- Created in 1985 to respond to DoD software crisis
- Exemplar work:
  - Capability Maturity Model (CMM) (spun off)
  - Early work in s/w architecture (Bass, Kazman, Clements)
  - Ultra large scale systems report (Northrop 06)
  - Team Software Process (Watts Humphrey)
  - Software Product Lines
  - CERT (cybersecurity emergency response) first ‘CERT’ in US

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The Requirements Evolution Problem

Requirements Engineering: acquire, analyse, model and select requirements for system design.

Requirements Problem: given the requirements discovered, find software components that together with domain constraints, satisfy the requirements.

Requirements Evolution Problem: plan to satisfy requirements we may not know we have → transfer Rumsfeld's "Unknown Unknowns" into "Known Unknowns".

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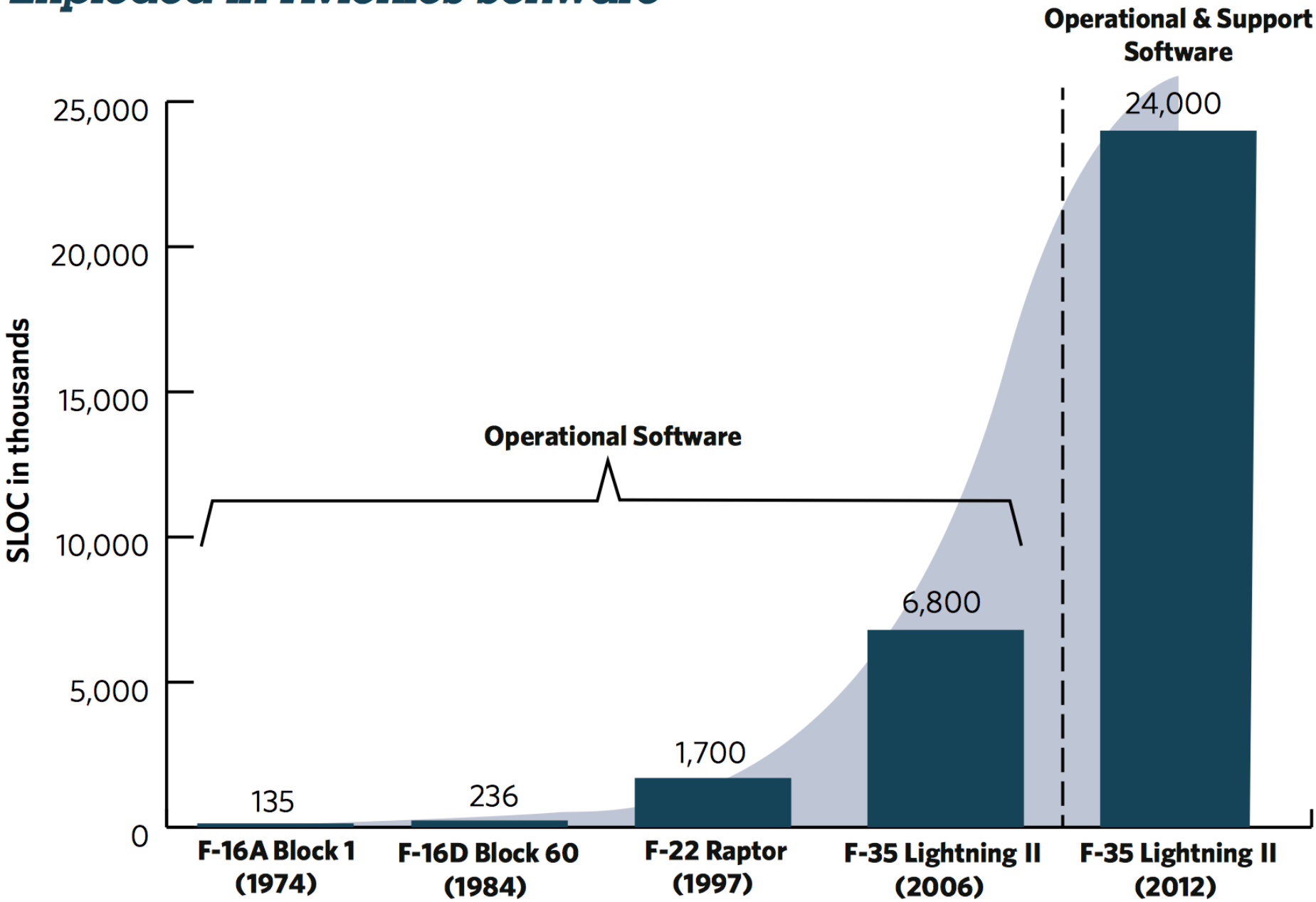
Figure 1. The Number of Source Lines of Code (SLOC) Has Exploded in Avionics Software



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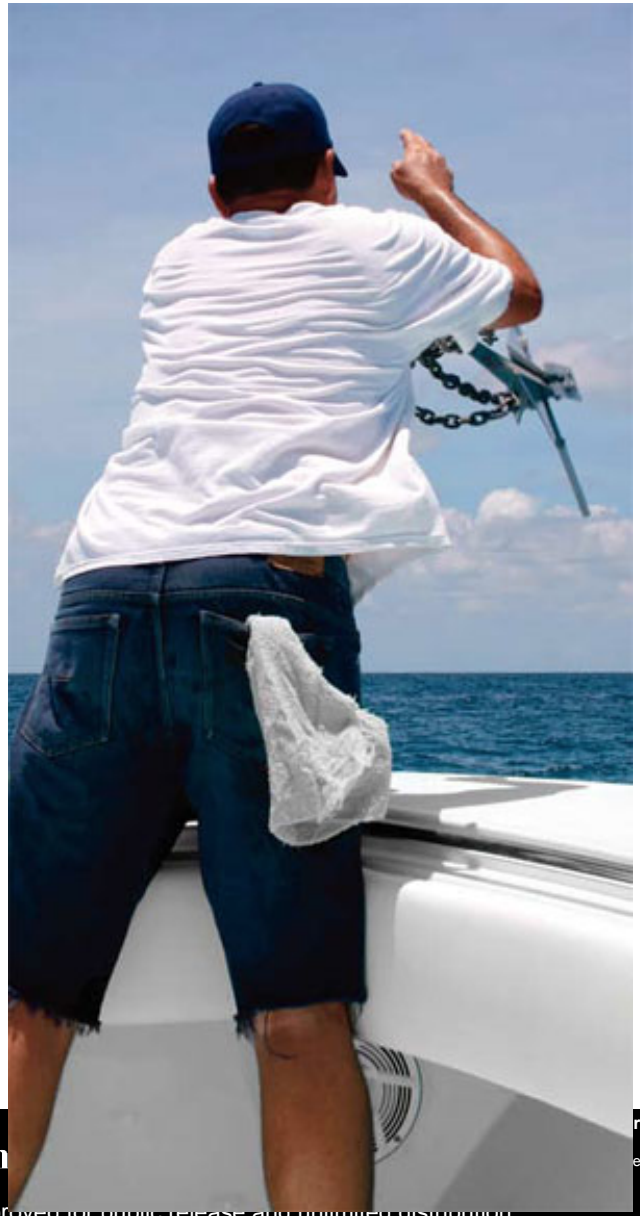
“Traditional” RE

Requirements team separate and siloed, “over-the-transom-style” handoffs



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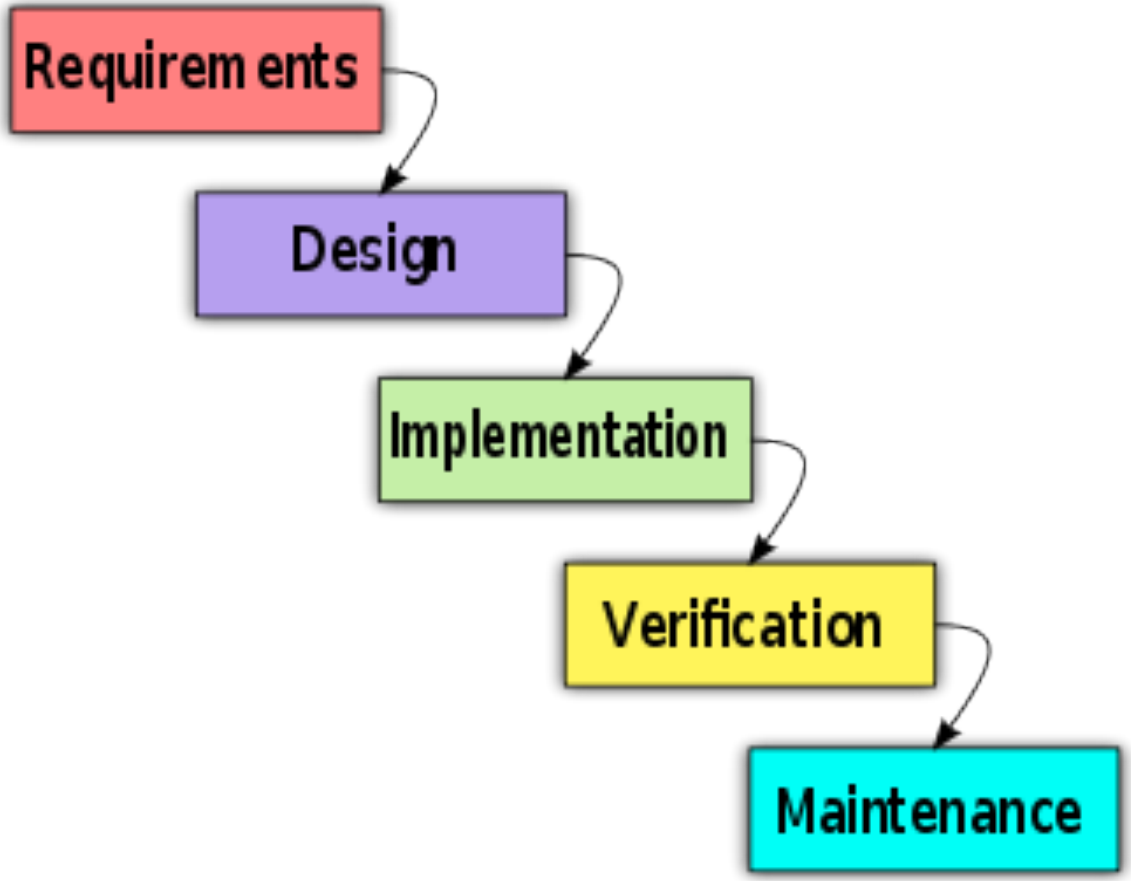
“Traditional” RE

Typically (if not ideally) done once, at inception



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“Traditional” RE

Store artifacts in management tool

blueprint

Rational. software

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Pejoratively called:

Big Requirements Up Front

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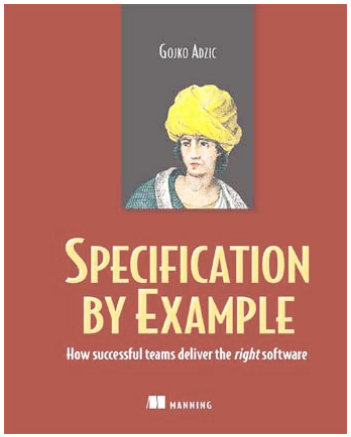
Just-In-Time RE

assume change and react, rather than plan

RE is ongoing and continuous

lightweight and iterative

developers talk to "Product Owner"



e.g. specification by example, behavior-driven development (BDD), feature driven development, user stories, acceptance testing.

Understanding change

Just-in-time is a response to this

Context: evolving and agile software development

Note that in some cases

Funders insist on documentation

Planning ahead can be done (probabilistlically)

Safety and budget allow for expensive requirements analysis

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Architecture And Requirements

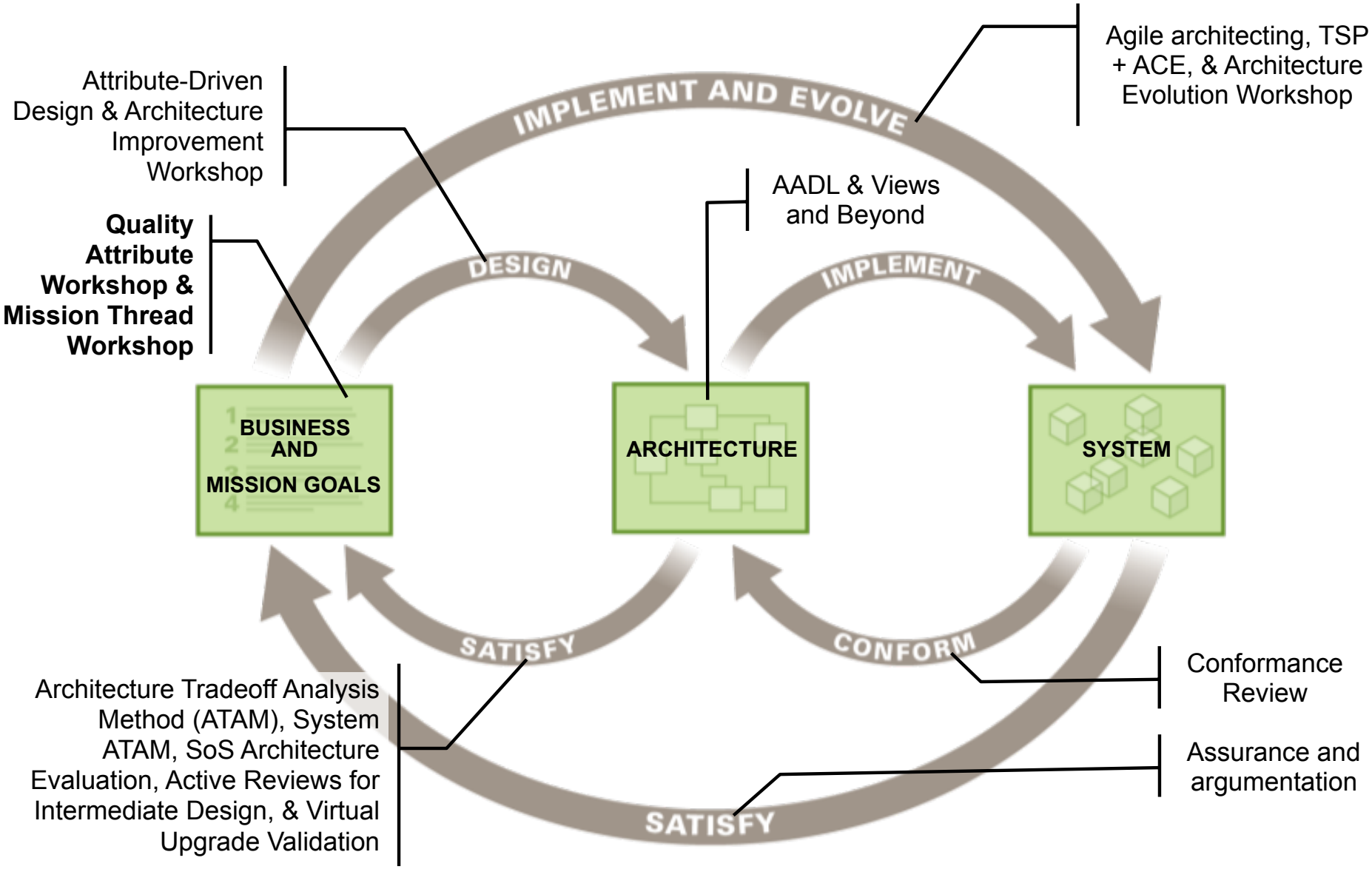

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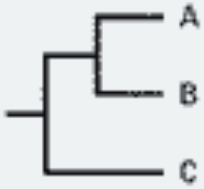
Figure 7-2 Approaches for Monitoring and Updating Strategies Based on the Level of Residual Uncertainty

1. A clear enough future

. Traditional strategic planning and decision-making processes



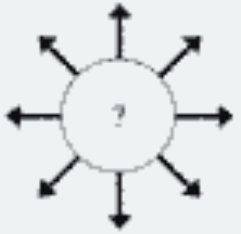
2. Alternative futures

. Contingent road maps

3. A range of futures

. Contingent road maps (if limited number of uncertainties with clear resolution paths over time)

. Six-region option portfolio management framwork



4. True ambiguity

. Strategic evolution principles
- scanning
- experimenting
- monitoring
- committing
- supporting organizational norms

http://www.youtube.com/watch?v=GiPe1OiKQuk

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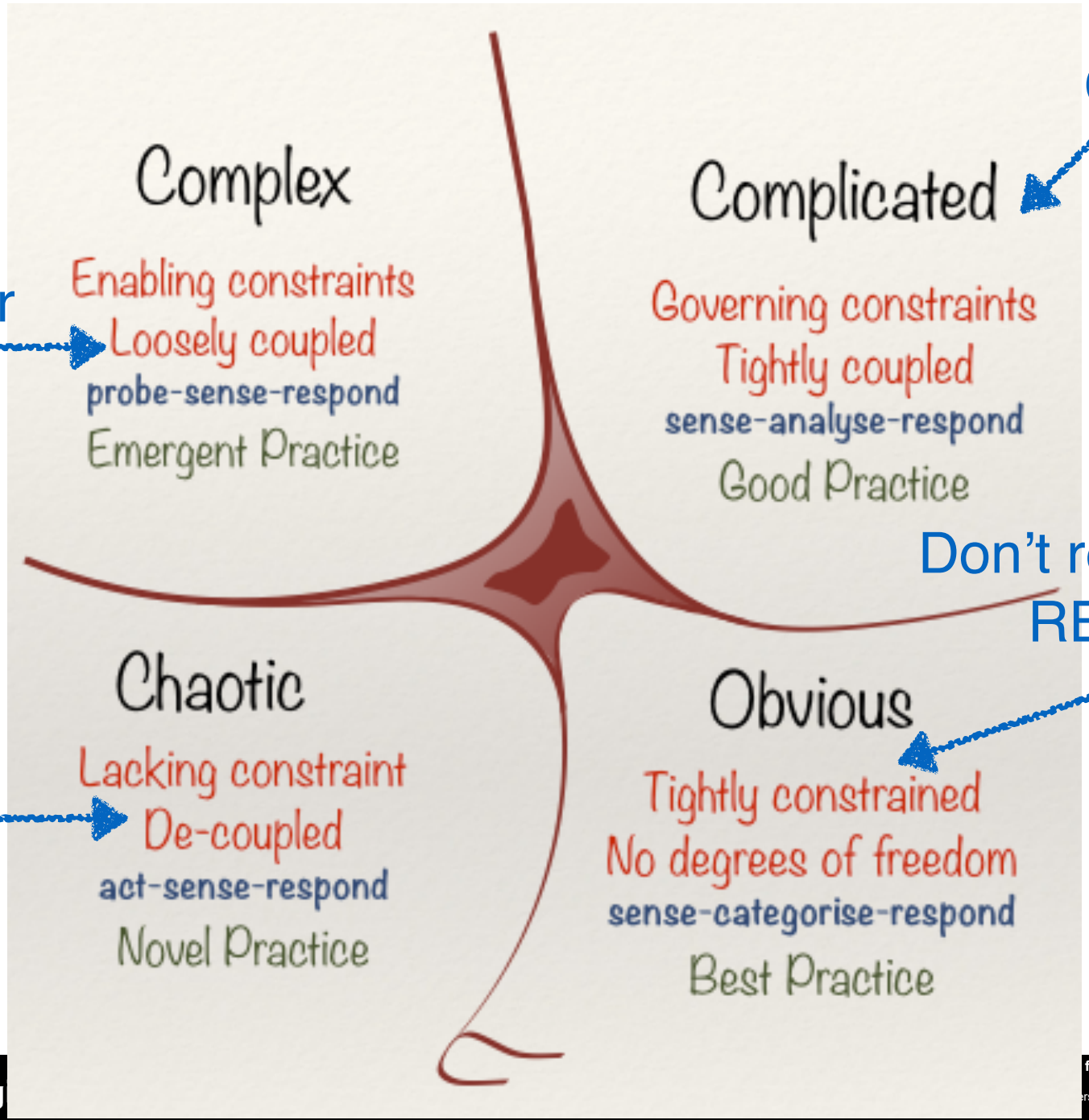
HISTORY

Cynefin (Kih-Neh-Vin)



Get these right!

Cannot gather upfront

Don't really need RE here

Creativity

http://cognitive-edge.com/library/more/video/introduction-to-the-cynefin-framework/

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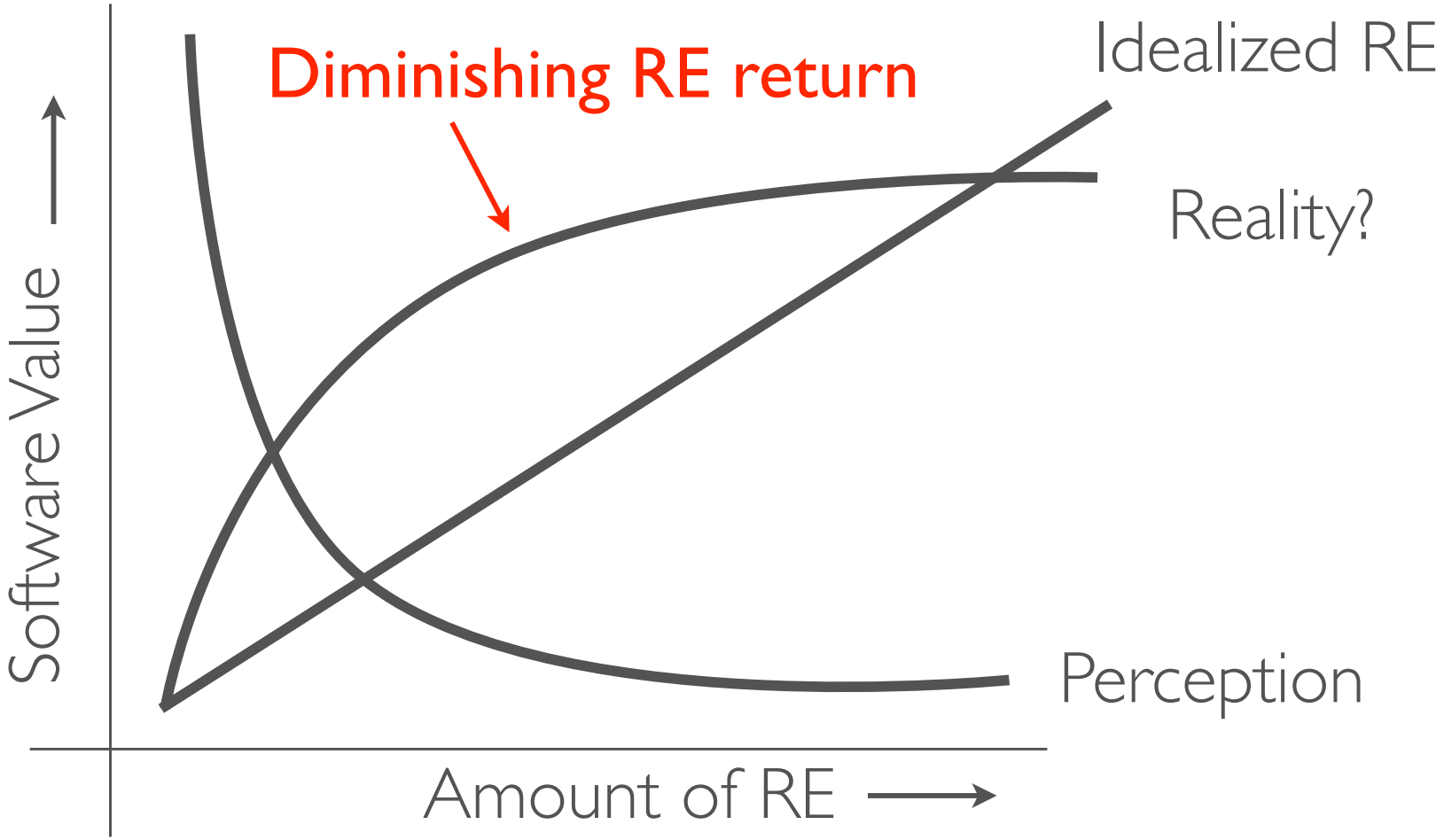
Ultimate Empirical Question



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Software ecosystems

Software in a ‘dissolving system’ world

Increasingly about ‘ecosystem’ and not central control. Unlikely to be many BDFLs. HSF seems like a good start

Case study: Robot Operating System ecosystem

- Central ‘groundskeepers’
- Low barrier to entry
- Use it if you want
- (But not perfect)

In addition to technical requirements, think about the collaborative, social requirements:

- where to keep code
- versioning and dependency management
- how to set guidelines
- encourage diverse and non-traditional audiences

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Technical Debt

"a design or implementation choice that is expedient in the short term, but sets up a technical context that can make a future change more costly or impossible."

Does HEP software have Technical Debt?

"Most of the current software, which defines our capabilities, was designed 15-20 years ago: there are many software sustainability challenges."

Decisions are being made today that you will have to live with for 20+ years.

Can't always "know the unknowns", but can plan for periodic refactoring, new requirements, and labeling shortcuts as such.

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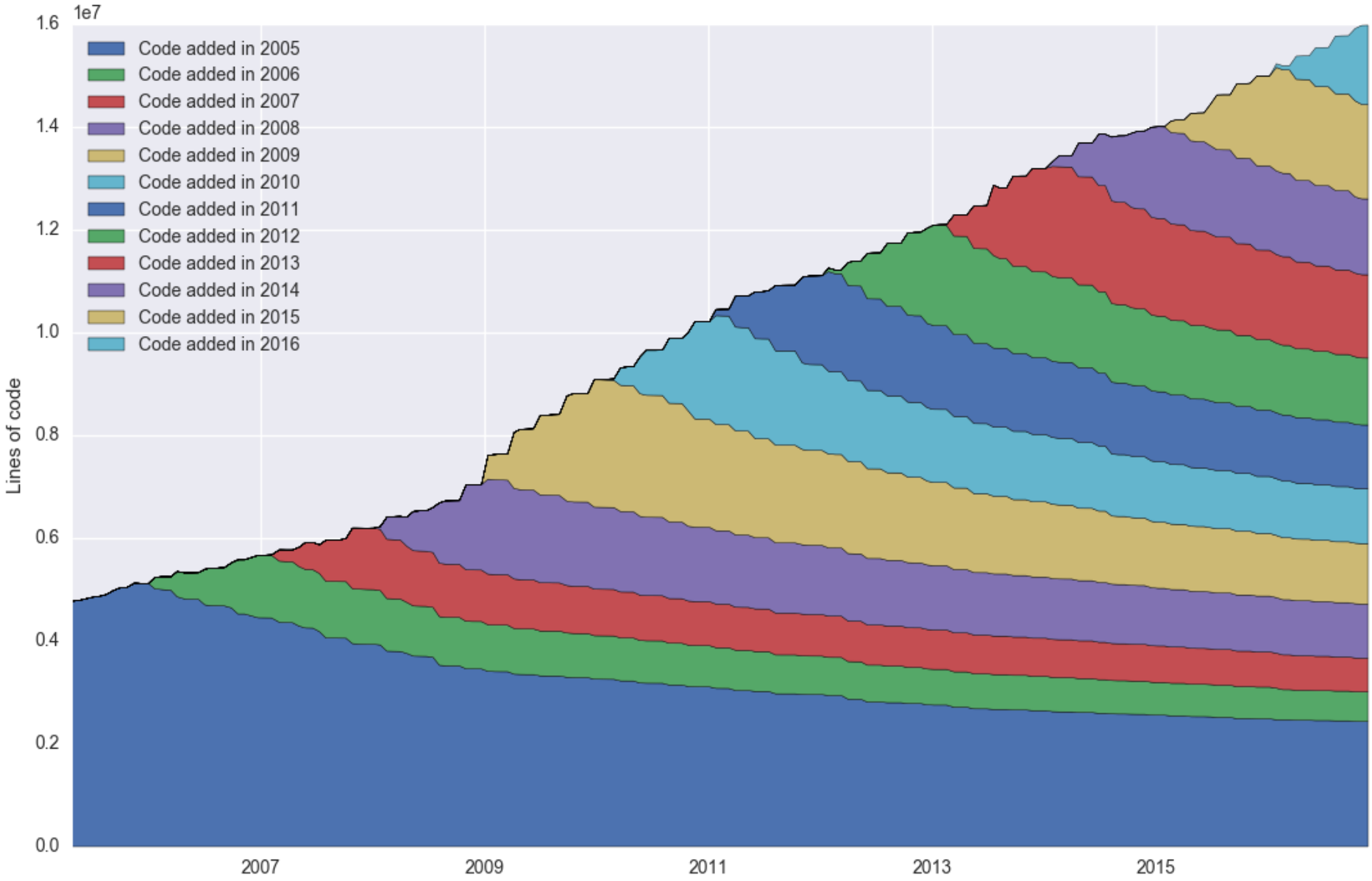
source: https://erikbern.com/2016/12/05/the-half-life-of-code.html

Software Will Not Go Away



Linux Kernel, additions by year

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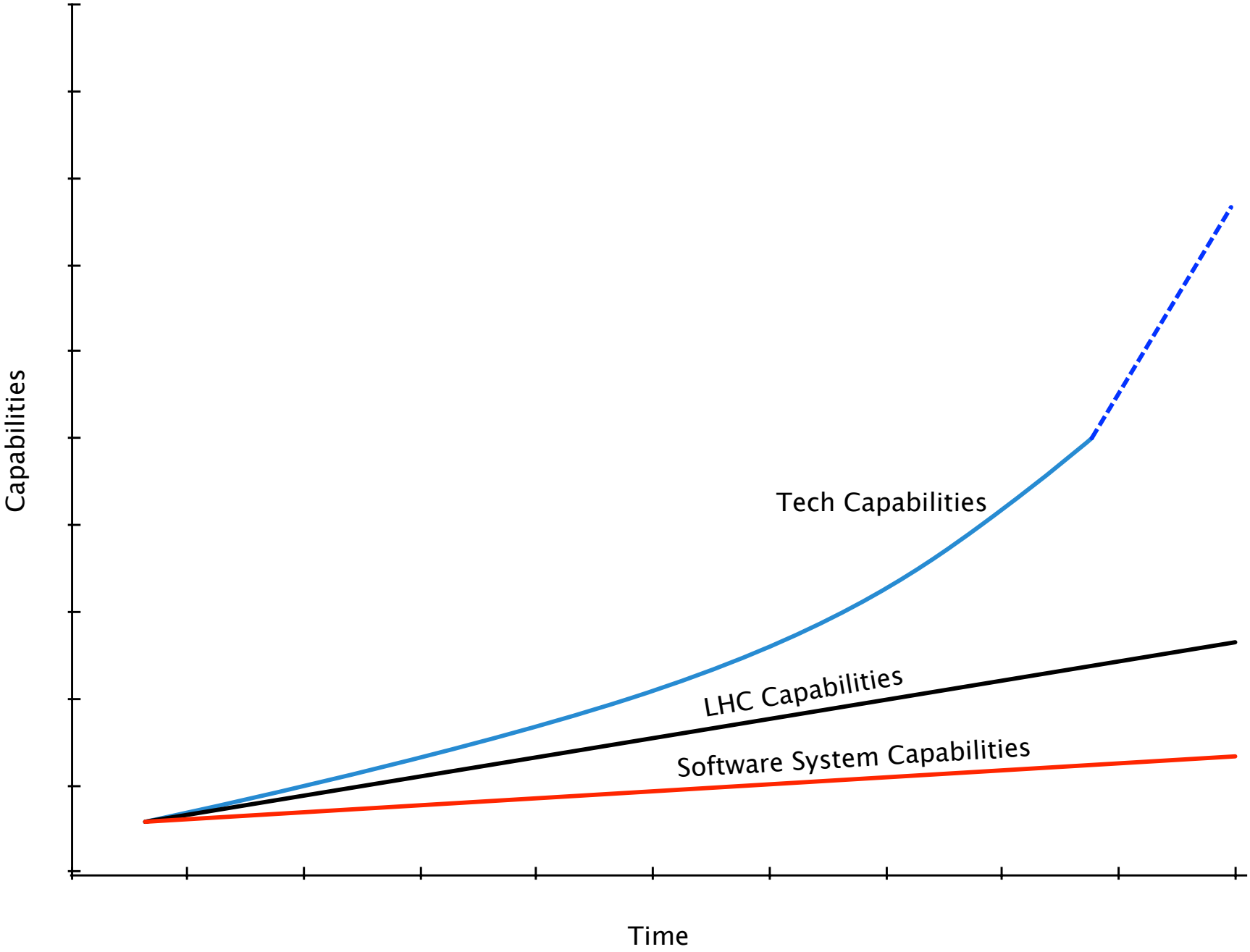

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Fundamental Constraint

- When system go-live happens in 10 years, you WILL be running on outdated software and hardware
  - Tech cycle is always faster than system dev. cycle (exceptions: FB, Twitter, Amazon)
  - What percentage of software is ‘owned’ vs outsourced
- Many organizations refuse to believe this! (we are not all FB)

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Future-Proofing Approaches

- Modularize for evolution.
  - *Tradeoff: integration risk.*
- Modularize for release.
  - *Tradeoff: duplication*
- Abstract for architecture and for release.
  - *Tradeoff: leaky abstractions*
- Defer decisions until Last Responsible Moment. Iterate and Prototype ‘Just-in-time’.
  - *Tradeoff: schedule impact, duplicated work*
- Evaluate architecture approach regularly with business goal scenarios.
  - *Tradeoff: cost, process buy-in.*

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