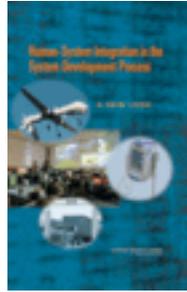# Part III: The Future: Scenarios, Conclusions, and Recommendations
[of HSI Methods in System Development]
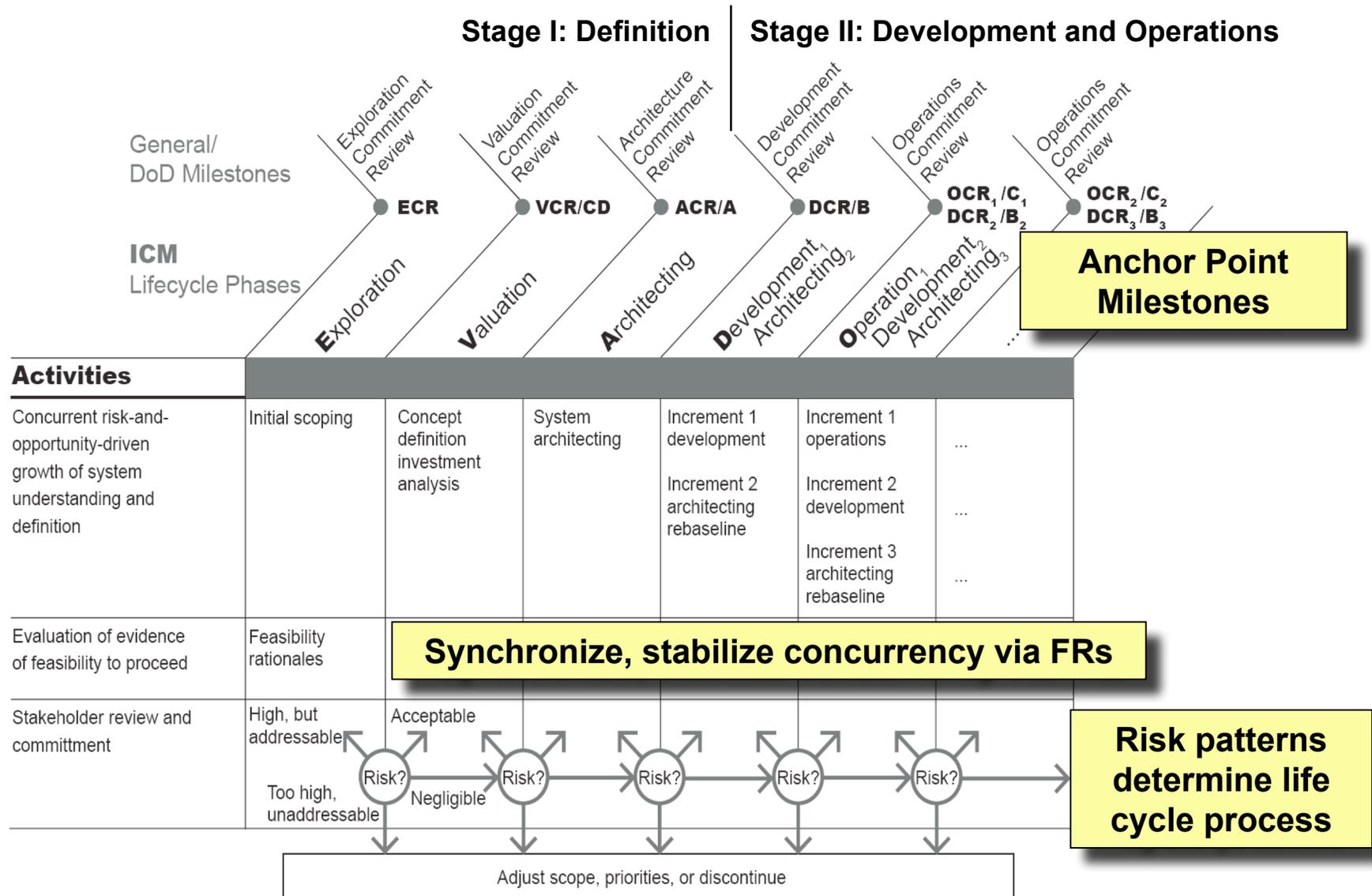
Frank E. Ritter

26 feb 08

Glossary

- IMPRINT a tool for performance prediction
- IPT Integrated product teams
- SA situation(al) awareness
- SoS system of systems (e.g., phone system, Internet)

Review of So Far

- Essential aspects
  - Stakeholder satisficing
  - Incremental commitment (and development)
  - Concurrent development of subsystems
  - Iterative
  - Risk-driven
    - Methodologies for reducing HSI risk
- Provided future scenarios
  - Integrated methodology
  - HSI as a discipline
  - Knowledge-based planning
  - Greater user participation

The Incremental Commitment Life Cycle Process: Overview

Stage I: Definition | **Stage II: Development and Operations**

General/DoD Milestones

Exploration Commitment Review — ECR
Valuation Commitment Review — VCR/CD
Architecture Commitment Review — ACR/A
Development Commitment Review — DCR/B
Operations Commitment Review — OCR_1/C_1, DCR_2/B_2
Operations Commitment Review — OCR_2/C_2, DCR_3/B_3

ICM Lifecycle Phases

Exploration
Valuation
Architecting
Development$_1$ Architecting$_2$
Operation$_1$ Development$_2$ Architecting$_3$
...

Anchor Point Milestones

Activities						
Concurrent risk-and-opportunity-driven growth of system understanding and definition	Initial scoping	Concept definition investment analysis	System architecting	Increment 1 development Increment 2 architecting rebaseline	Increment 1 operations Increment 2 development Increment 3 architecting rebaseline	... ...
Evaluation of evidence of feasibility to proceed	Feasibility rationales					
Stakeholder review and commitment	High, but addressable / Too high, unaddressable	Acceptable / Negligible				

Synchronize, stabilize concurrency via FRs

Risk? → Risk? → Risk? → Risk? → Risk? →

Risk patterns determine life cycle process

Adjust scope, priorities, or discontinue

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Conclusions

- Include HSI definition and risk assessment at beginning of system design (Booher & Minniger give big examples)
- Integrate across HSI domains
  - HF, manpower, personnel, training, system safety and health, habitability, and survivability
- Adopt a risk- and opportunity-driven approach
  - Ignore low risks, accept large opportunities
  - Tailor methods to time and budget (and risk)
- Include HSI professional on most IPT subteams
- Ensure communication between stakeholders
  - Shared reps readily assimilated into process
  - Shared reps in common terms
- Design to accommodate change
  - Can't capture all up front
  - SoS require new approaches to uncover interdependencies

Research and Policy Recommendations
(all are for US DoD and government and private organizations)

- Realising the integration of human systems and systems engineering
- Methods for defining opportunities and context of use
- Methods for defining requirements and design
- Methods for evaluation

- These should proceed concurrently (!)

Realising the integration of human systems and systems engineering

- Institutionalise the success factors
  - **R**: Refine / coordinate definition and process adoption
  - **R**: Revise system acquisition policies
  - **R**: Put HSI on par with other requirements
  - **R**: Define ways to verify and validate HSI requirements
  - **R**: Add HSI to business offers
  - **R**: Explore Web 2.0 for configuration control
  - **R**: Explore how to provide openness and security

- Traceability and Requirements (Maintenance across design phases)
  - **R**: Adapt or adopt methods / tools to capture/traceability of HSI design objectives, e.g., develop shared reps, define acceptance criteria

Realising the integration of human systems and systems engineering

- Shared Representations
  R: Identify characteristics that communicate across domains, e.g., study some good ones, e.g., create a tool

- System of Systems
  R: Develop a test-bed
  R: Identify ways to adopt methods to SoS design tasks
  R: Test methods in test-bed
  R: Feed back methods to system developers

  R: Study mental models of SoS
  R: Envisioning methods and models
  R: Methods and tools for reconciling incompatibilities
  R: and for resilient systems

Realising the integration of human systems and systems engineering

- Sizing the HSI effort
  R: Develop, experimentally apply, evaluate, refine:
  - Bottom-up methods
  - Top-down
  - Unit-cost
  - Expert consensus
  - Parametric methods
  - Risk-based models

- Knowledge-based planning aids
  R: Develop framework
  R: Develop method for selecting method
  R: Develop tool for selecting best methods

Realising the integration of human systems and systems engineering

- Developing HSI as a discipline
  - **R**: Define HSI expertise
  - **R**: Define proficiency (benchmark and pilot programs)
  - **R**: Define rational for choosing methods
  - **R**: Grow internationally, e.g., teaching materials, conferences, journal
- Foster synergy between research and practice
  - **R**: Develop method and tools to support this, e.g., design patterns, publication outlets

Methods for Defining Opportunities and Context of Use

- Tools to support capture and dissemination
  R: Create a suite of tools to build corpus of work domain and context of use knowledge

- User participation in systems engineering
  R: Study how logs are currently used
  R: Tool to help analyse logs
  R: Study how to let users manage their information
  R: Study how to let users pass in their needs, concerns, solutions with shared representations
  R: Architectures to support user configuration
  R: Study Spimes and geospatial web: changes in work, users' mental models, future uses
  R: Refine data analysis methods, e.g., explore types of data, apply data mining, derive data structure standards
  R: Research technologies to protect privacy and security

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Methods for Defining Requirements and Design

- **Human-System model development**
  R: Study how models are developed
  R: Invent a high-level language to make like Excel
     (Nichols & Ritter, Cohen, Ritter +14)
  R: Explore computer learning to help models
  R: Expand existing models to include: Multitasking, impact of interruptions, SA, behavioral moderators, cultural, social processes, emotions
  R: Require HSI models to be validated
  R: Understand what good enough means
  R: Study how to use models as shared representations

Methods for Defining Requirements and Design

- Prototype training and organizational design
  𝗥: Review and explore prototyping organizations for use in HSI development
  𝗥: Review and explore prototyping training systems for use in HSI development

Methods for Evaluation

- Improve the use of usability objectives
  ℞: Develop better ways to investigate, set, and use them as acceptance criteria

- Maximise the cost-effectiveness of usability evaluation
  ℞: Generalise Nielson's sample size formula
  ℞: Understand how to choose methods
  ℞: Understand discount methods by casual users
  ℞: Understand how generate more objective measures, and how to do so easily

Methods for Evaluation

- **Identify and Assess HSI Risks**
  R: Develop a robust HSI taxonomy
  R: Extend fault trees to help with boundary cases

- Improve the communication of risk
  R: Demonstrate the value of improved understanding of risk
  R: Survey other areas for good practice
  R: Study risk understanding in this area
  R: Support interdisciplinary investigations into communication, representation, and negotiation of risks

- HSI contributions to System Adaptability and Resilience
  R: Understand factors that contribute to resilience
  R: Understand the role of people in resilience systems
  R: Understand how to design resilient systems