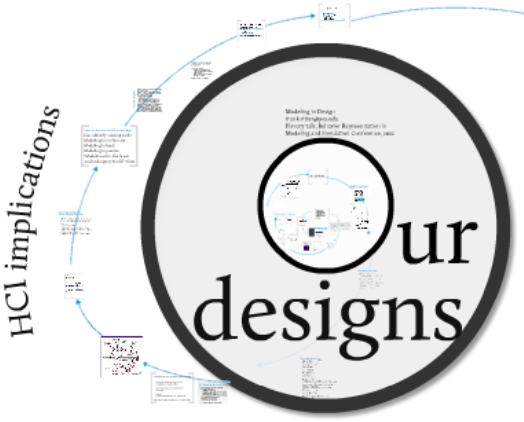

other's designs

models

models

models

models

References

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Modeling in Design

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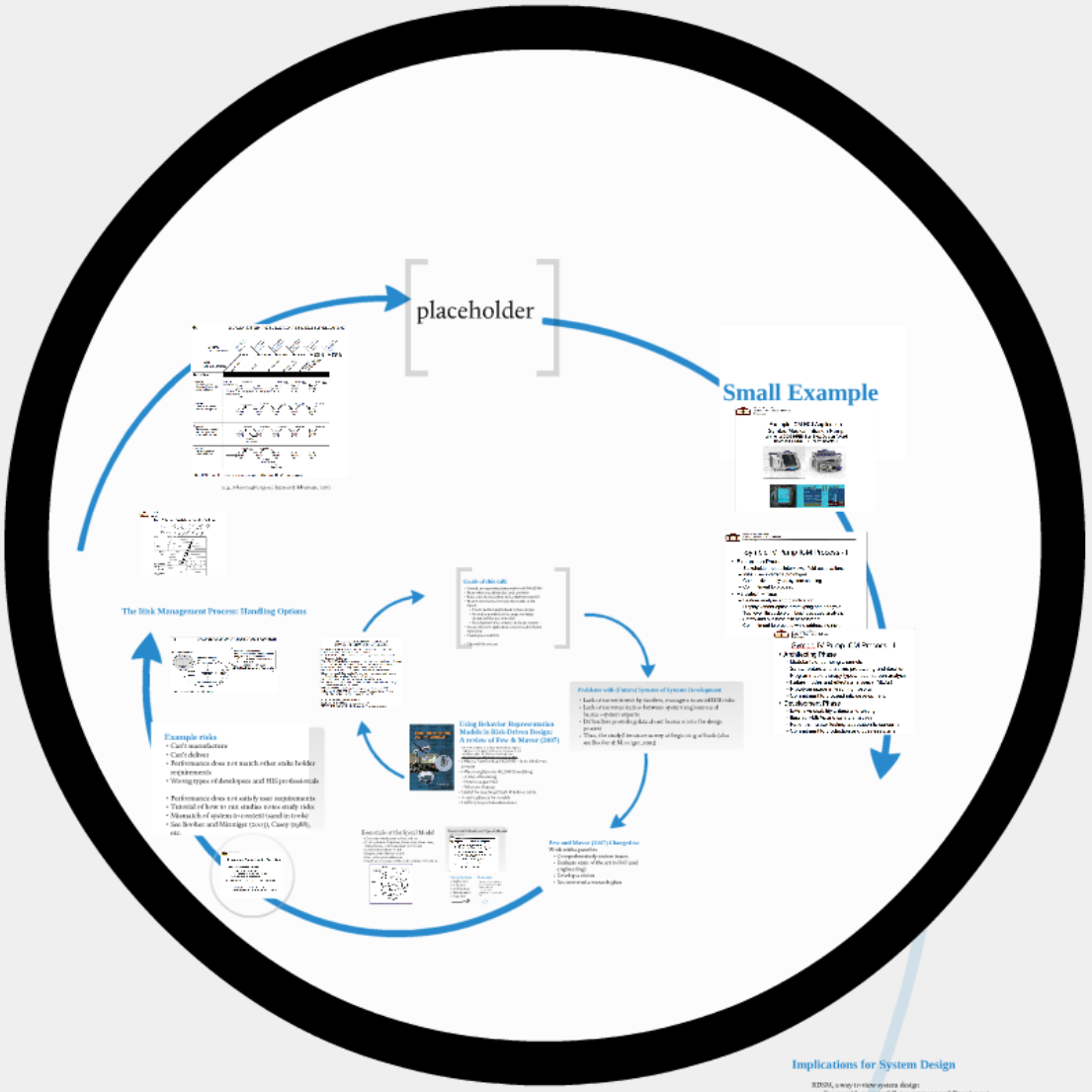
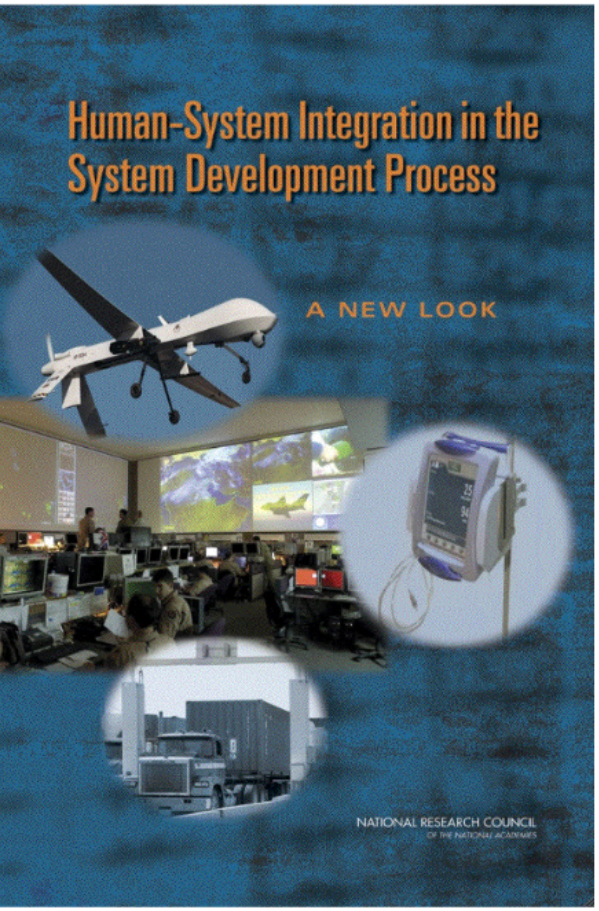
Plenary talk, Behavior Representation in Modeling and Simulation Conference, 2012





Using Behavior Representation Models in Risk-Driven Design: A review of Pew & Mavor (2007)

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- Offers a New look at HCI/HSI - It is risk-driven process
- Offers insights into HCI/HSI/modeling
  - A way of knowing
  - How to argue HCI
  - When to shut up
- Useful for teaching (Stark & Kokini, 2010)
- A new audience for models
- I will try to provide extensions

Acknowledgements

- Barry Boehm 
- Jeremy Lothian
- Dick Pew
- Anne Mavor
- Erika Poole
- ACS Lab
- guy on plane
- ONR N091-086/P10008, N00014-11-1-0275, N00014-06-1-0164, DTRA HDTRA1-09-1-0054
- The committee
- Army Res. Lab
- Rosson's grad HCI course

COMMITTEE ON HUMAN-SYSTEM DESIGN SUPPORT FOR CHANGING TECHNOLOGY

RICHARD W. PEW (*Chair*), BBN Technologies, Cambridge, MA
NIGEL BEVAN, University of York, London
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NANCY J. COOKE, Department of Psychology, Arizona State University
SHELLEY EVENSON, School of Design, Carnegie Mellon University
DAVID GRAEBER, Boeing Phantom Works, Seattle, WA
EDMOND W. ISRAELSKI, Abbott Laboratories, Abbott Park, IL
BRIAN M. KLEINER, Grado Department of Industrial and Systems Engineering, Virginia Polytechnic Institute
MICHAEL MULLER, IBM Research, Cambridge, MA
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THOMAS F. SANQUIST, Battelle Seattle Research Center, Pacific Northwest National Laboratory, Seattle, WA

ANNE S. MAVOR, *Study Director*
KRISTEN A. BUTLER, *Research Assistant*
MATTHEW D. McDONOUGH, *Senior Program Assistant*

Goals of this talk

- Provide an organizing framework for HSI/HCI/HF
- Show where modeling does and can fit in
- Note some free teaching and conjuring materials
- Show/Learn how to leverage the results of the report
  - Teach and be taught about system design
  - Provide you with tools to argue for better design and the use of models
  - by reducing risk to systems and your systems
- Discuss the new application of user models that it represents
- Proust-prose/old fish

- Play with Prezzi.com

Problems with (Future) Systems of Systems Development

- Lack of commitment by funders, managers to avoid HSI risks
- Lack of communication between system engineers and human-system experts
- Difficulties providing data about humans into the design process
- Thus, the study/literature survey at beginning of book (also see Booher & Minniger, 2003)

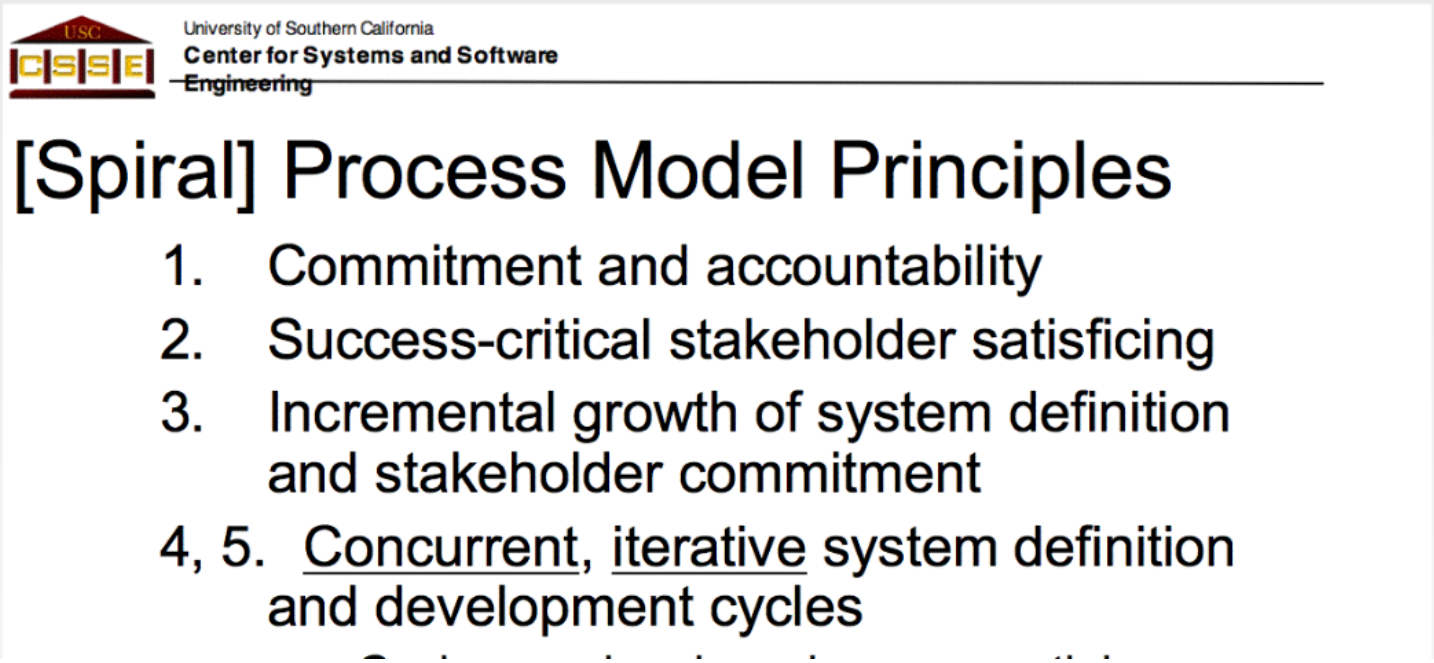
Pew and Mavor (2007) Charged to:

Work with a panel to

- Comprehensively review issues
- Evaluate state of the art in HSI (and engineering)
- Develop a vision
- Recommend a research plan

Starts with Boehm's Spiral Model

Boehm & Hansen (2001)



[Spiral] Process Model Principles

1. Commitment and accountability
2. Success-critical stakeholder satisficing
3. Incremental growth of system definition and stakeholder commitment
4, 5. Concurrent, iterative system definition and development cycles
    - Cycles can be viewed as sequential concurrently-performed phases or spiral growth of system definition
6. Risk-based activity levels and anchor point commitment milestones

commitment milestones

Life cycle phases

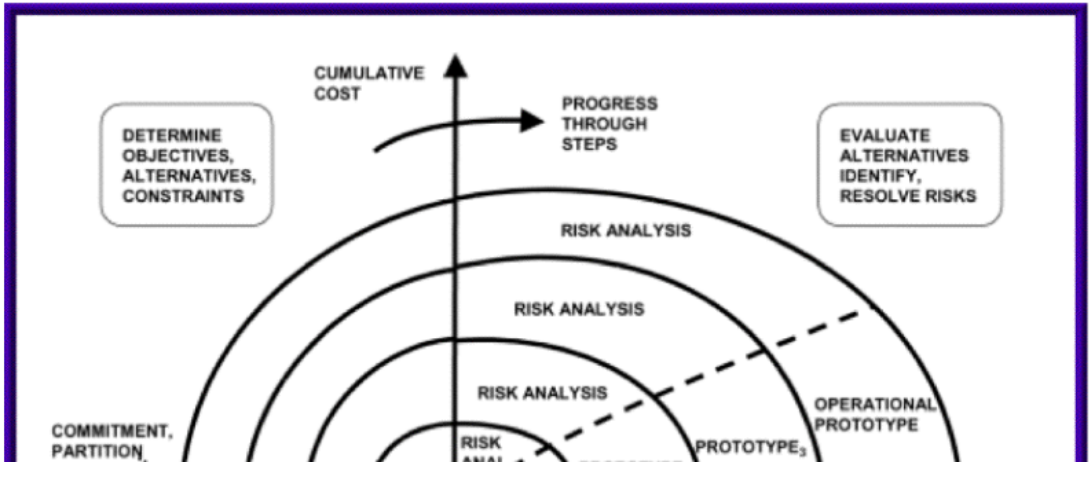
- Exploration
- Valuation
- Architecting
- Development
- Operation

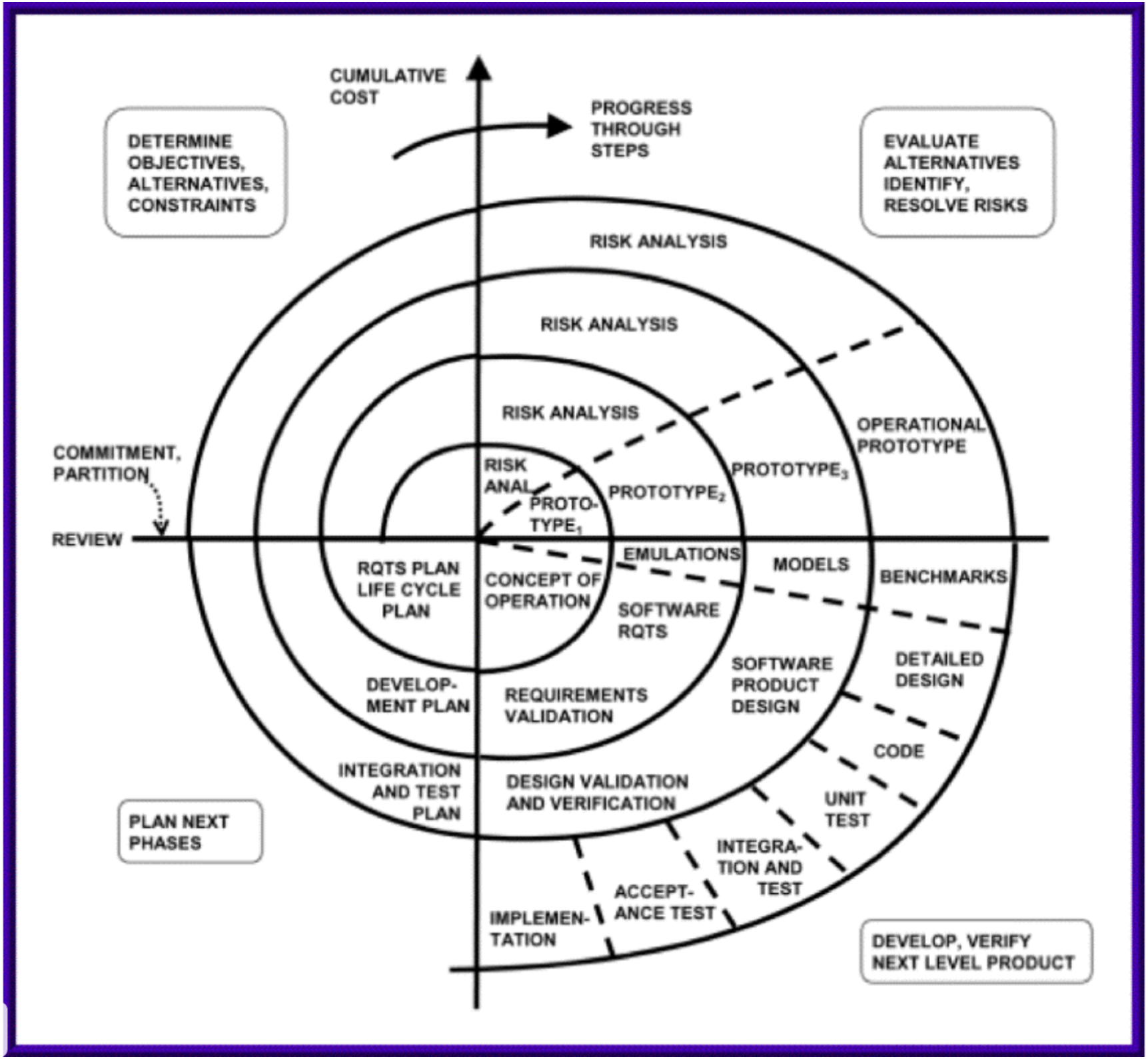
Phase steps

- Evaluate alternatives with risk analysis & prototype
- Develop/verify
- Plan/architect
- Review [with stakeholders]
- Cost

Essentials of the Spiral Model

- Concurrent development of key artifacts
- Each cycle does Objectives, Constraints, Alternatives, Risks, Review, and Commitment to Proceed
- Level of effort driven by risk
- Degree of detail driven by risk
- Use anchor point milestones
- Emphasis on system and life cycle activities and artifacts




CUMULATIVE COST
PROGRESS THROUGH STEPS
DETERMINE OBJECTIVES, ALTERNATIVES, CONSTRAINTS
EVALUATE ALTERNATIVES IDENTIFY, RESOLVE RISKS
RISK ANALYSIS
RISK ANALYSIS
RISK ANALYSIS
COMMITMENT, PARTITION
REVIEW
RISK ANAL
PROTO-TYPE1
PROTOTYPE2
PROTOTYPE3
OPERATIONAL PROTOTYPE
EMULATIONS
MODELS
BENCHMARKS
RQTS PLAN LIFE CYCLE PLAN
CONCEPT OF OPERATION
SOFTWARE RQTS
DEVELOP-MENT PLAN
REQUIREMENTS VALIDATION
SOFTWARE PRODUCT DESIGN
DETAILED DESIGN
CODE
INTEGRATION AND TEST PLAN
DESIGN VALIDATION AND VERIFICATION
UNIT TEST
INTEGRA-TION AND TEST
ACCEPT-ANCE TEST
IMPLEMEN-TATION
PLAN NEXT PHASES
DEVELOP, VERIFY NEXT LEVEL PRODUCT

Incremental Commitment in Gambling

- Total Commitment: Roulette
  - Put your chips on a number
    - E.g., a value of a key performance parameter
  - Wait and see if you win or lose
- Incremental Commitment: Poker, Blackjack
  - Put some chips in
  - See your cards, some of others' cards
  - Decide whether, how much to commit to proceed

Example risks

- Can't manufacture
- Can't deliver
- Performance does not match other stake holder requirements
- Wrong types of developers and HIS professionals

- Performance does not satisfy user requirements
- Tutorial of how to run studies notes study risks
- Mismatch of system to context (sand in tools)
- See Booher and Minniger (2003), Casey (1988), etc.

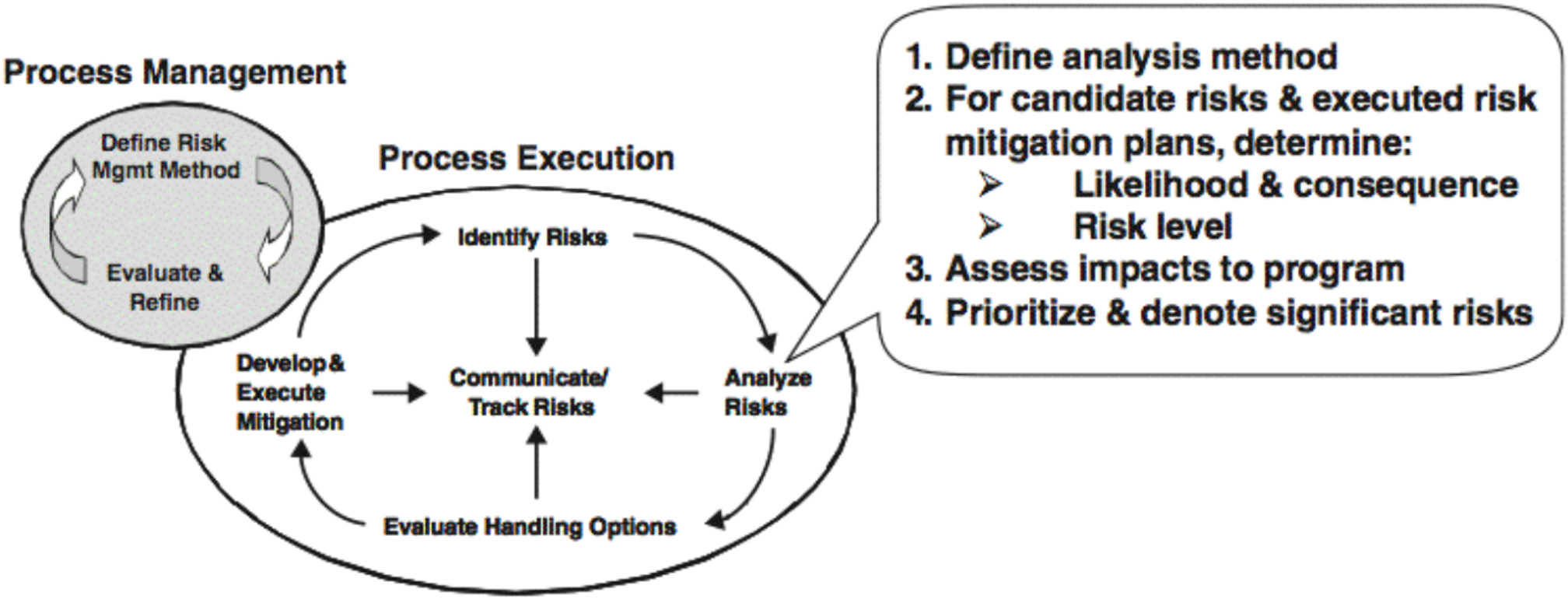
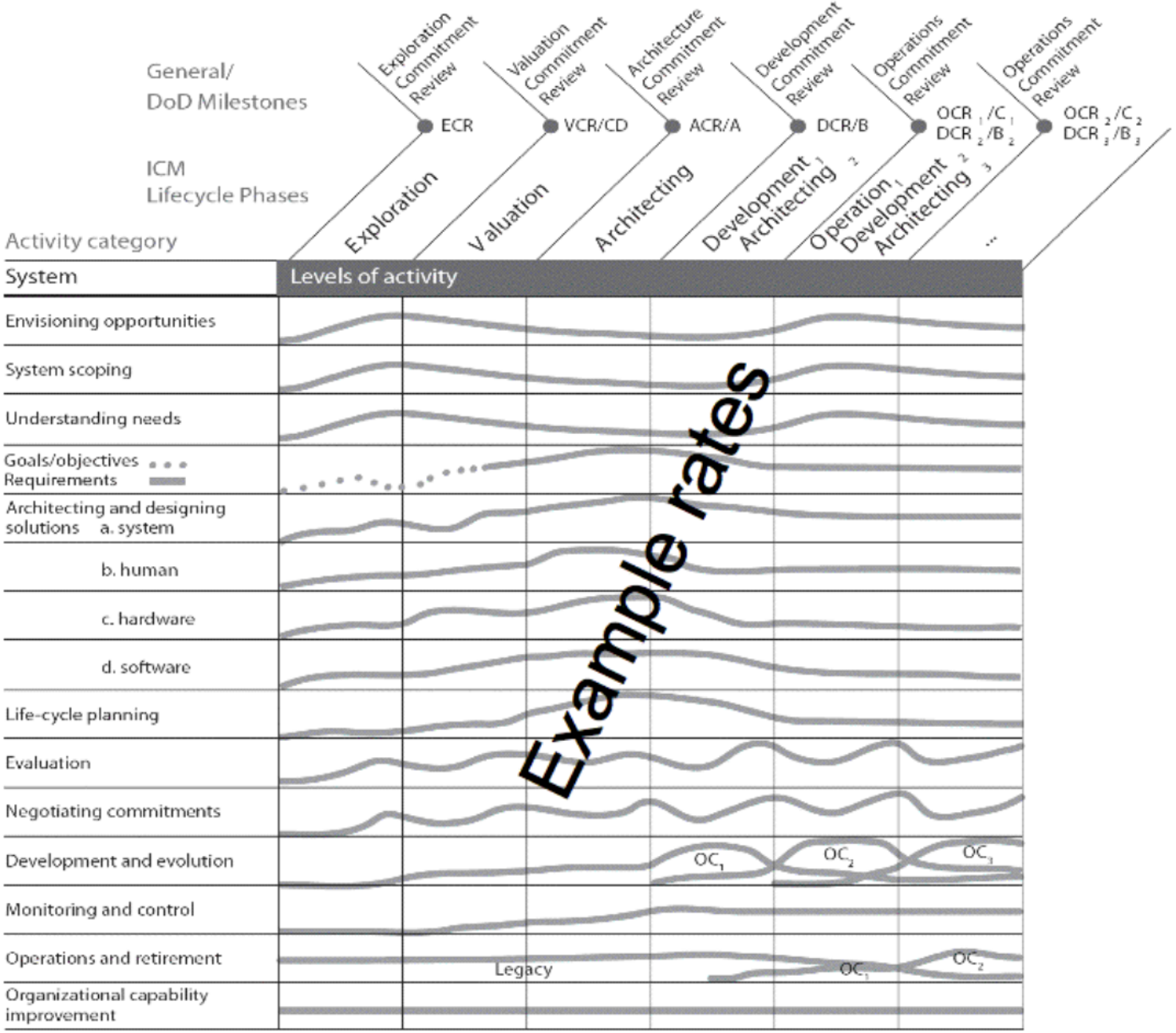


FIGURE 4-3 Steps in risk analysis.

ICM HSI Levels of Activity for Complex Systems



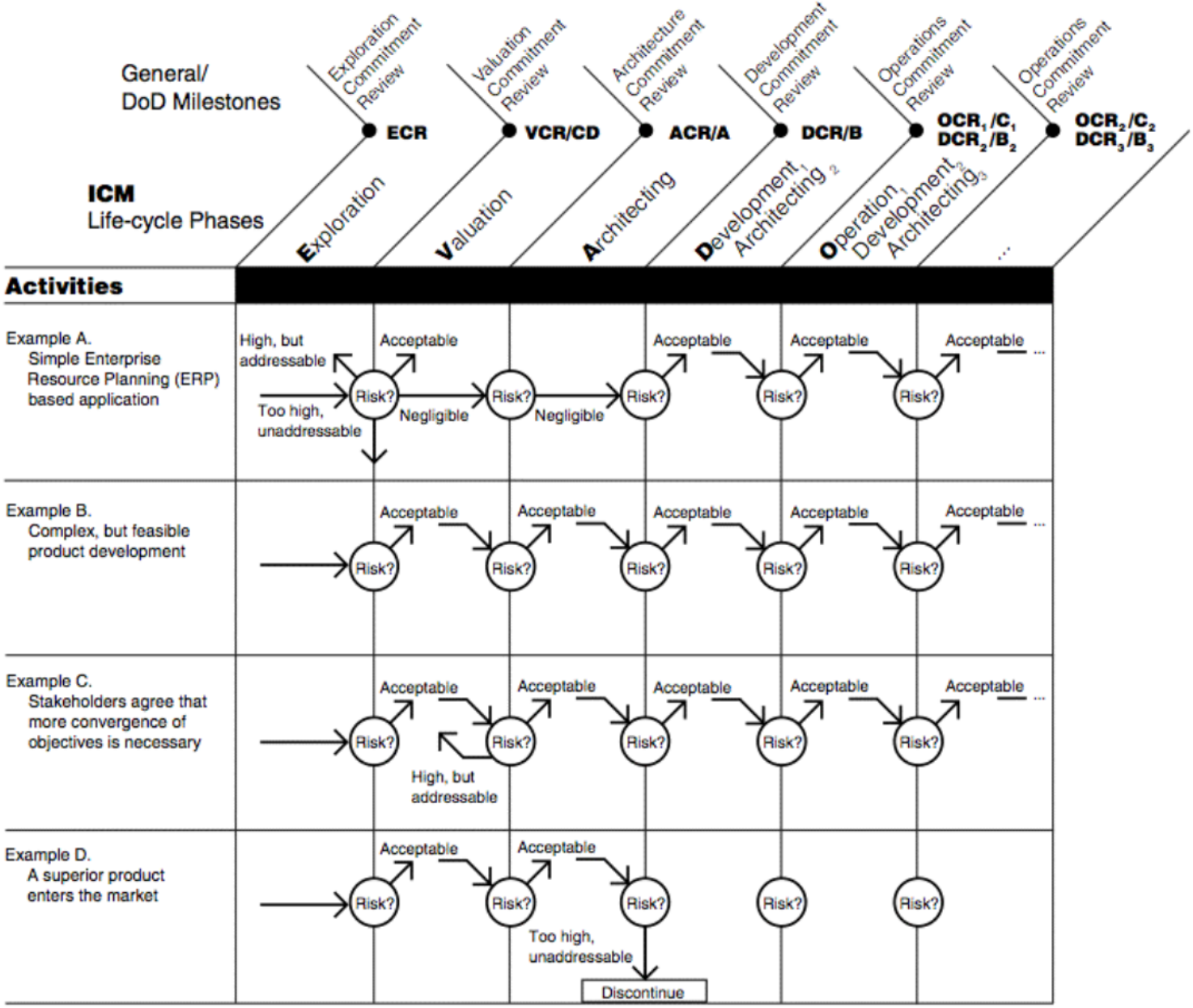
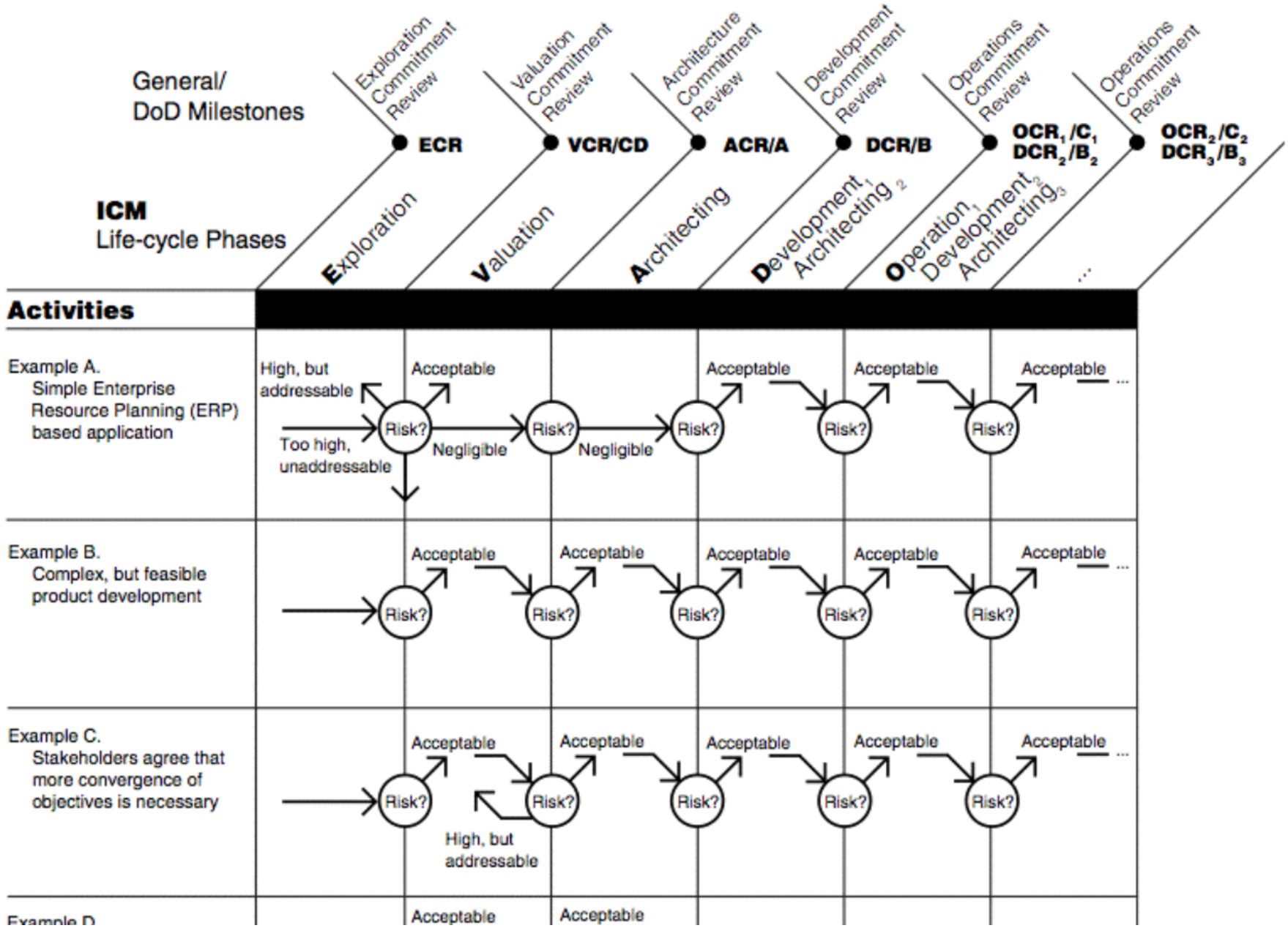


FIGURE 2-2 Different risks create different ICM processes.


General/
DoD Milestones
Exploration Commitment Review
Valuation Commitment Review
Architecture Commitment Review
Development Commitment Review
Operations Commitment Review
Operations Commitment Review
ECR
VCR/CD
ACR/A
DCR/B
OCR1/C1
DCR2/B2
OCR2/C2
DCR3/B3
ICM
Life-cycle Phases
Exploration
Valuation
Architecting
Development1
Architecting2
Operation1
Development2
Architecting3
Activities
Example A.
Simple Enterprise Resource Planning (ERP) based application
High, but addressable
Too high, unaddressable
Risk?
Negligible
Acceptable
Example B.
Complex, but feasible product development
Example C.
Stakeholders agree that more convergence of objectives is necessary
High, but addressable
Example D

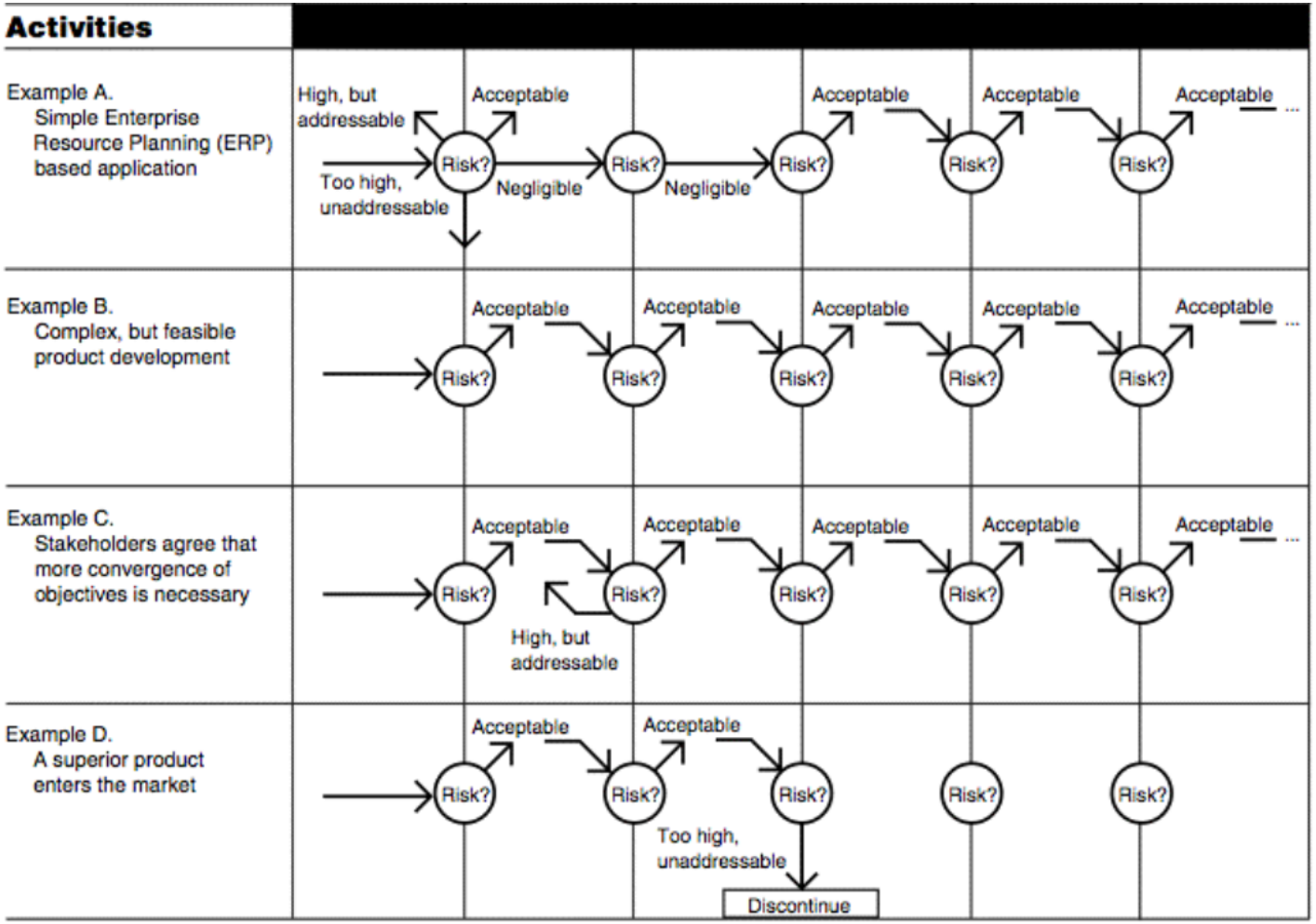


FIGURE 2-2 Different risks create different ICM processes.

(e.g., when to give up see Baumer & Silberman, 2011)

placeholder

Small Example

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Center for Systems and Software Engineering

Example ICM HCI Application:
Symbiq Medical Infusion Pump
Winner of 2006 HFES Best New Design Award
Described in NRC HSI Report, Chapter 5

University of Southern California
Center for Systems and Software Engineering

Symbiq IV Pump ICM Process - I

- Exploration Phase
  - Stakeholder needs interviews, field observations
  - Initial user interface prototypes
  - Competitive analysis, system scoping
  - Commitment to proceed
- Valuation Phase
  - Feature analysis and prioritization
  - Display vendor option prototyping and analysis
  - Top-level life cycle plan, business case analysis
  - Safety and business risk assessment
  - Commitment to proceed while addressing risks

University of Southern California
Center for Systems and Software Engineering

Symbiq IV Pump ICM Process - II

- Architecting Phase
  - Modularity of pumping channels
  - Safety feature and alarms prototyping and iteration
  - Programmable therapy types, touchscreen analysis
  - Failure modes and effects analyses (FMEAs)
  - Prototype usage in teaching hospital
  - Commitment to proceed into development
- Development Phase
  - Extensive usability criteria and testing
  - Iterated FMEAs and safety analyses
  - Patient-simulator testing; adaptation to concerns
  - Commitment to production and business plans

Problems with (Future) Systems of Systems Development

- Lack of commitment by funders, managers to avoid HSI risks
- Lack of communication between system engineers and human-system experts
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Implications for System Design

RDSM, a way to view system design

- Comparable to waterfall (see www.waterfall2006.com)
- and other approaches in book
- gives a language for HCI and modeling (risk=monkies)

Risks related to humans (users) are often ignored by system engineers

- People naturally work on risks, so theory is not just normative but descriptive
- Risks related to hardware are ignored by HF professionals
- Can/could/should bring in experts to advise
- If no HCI risks, then nothing needed from HCI
- See further recommendations in book

Can be applied to our model development

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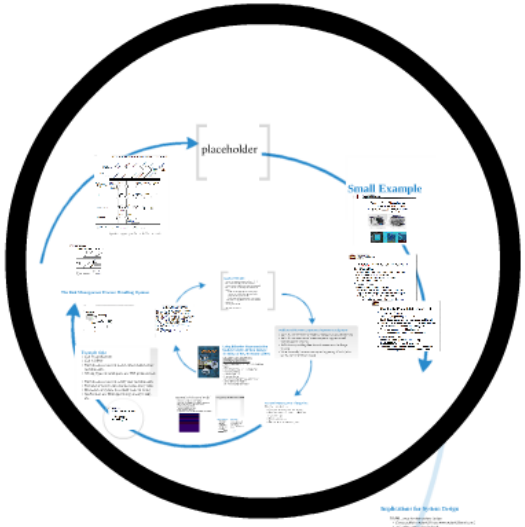
Plenary talk, Behavior Representation in Modeling and Simulation Conference, 2012

Our designs



What does this mean for HCI and modeling?
Can identify missing tools
Modeling is in this mix
Modeling is fussy
Modeling is precise
"Models are for the brass and mahogany world"-Goss

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- Erika Poole
- ACS Lab
- gray on plane
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- Army Res. Lab
- Rossum's grad HCI course

Prezi

HCI implications

our designs

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- DYRA, HDTRA1-06-1-0054,
- The committee
- Army Res. Lab
- Russian's good HCI course

HCI—Methods for Reducing HSI Risks

RDSM can be used to describe HCI methods

Three major periods of use

- Defining the context of use
- Defining the requirements and design solutions
- Evaluating designs (early, late)

  (Classification to period is somewhat arbitrary)

All HCI methods fit back into spiral

All methods used to reduce risks

We have bags of these methods!

Not exhaustive, illustrative lists to follow

Example techniques for each stage to reduce system risk

- Define opportunities and context of use:
  scenarios, personas, task analysis
- Define requirements and design solutions:
  TA, models
- Evaluate:
  VPA, behavior loggers (e.g., RUI), full models

Shared representations are passed between these stages

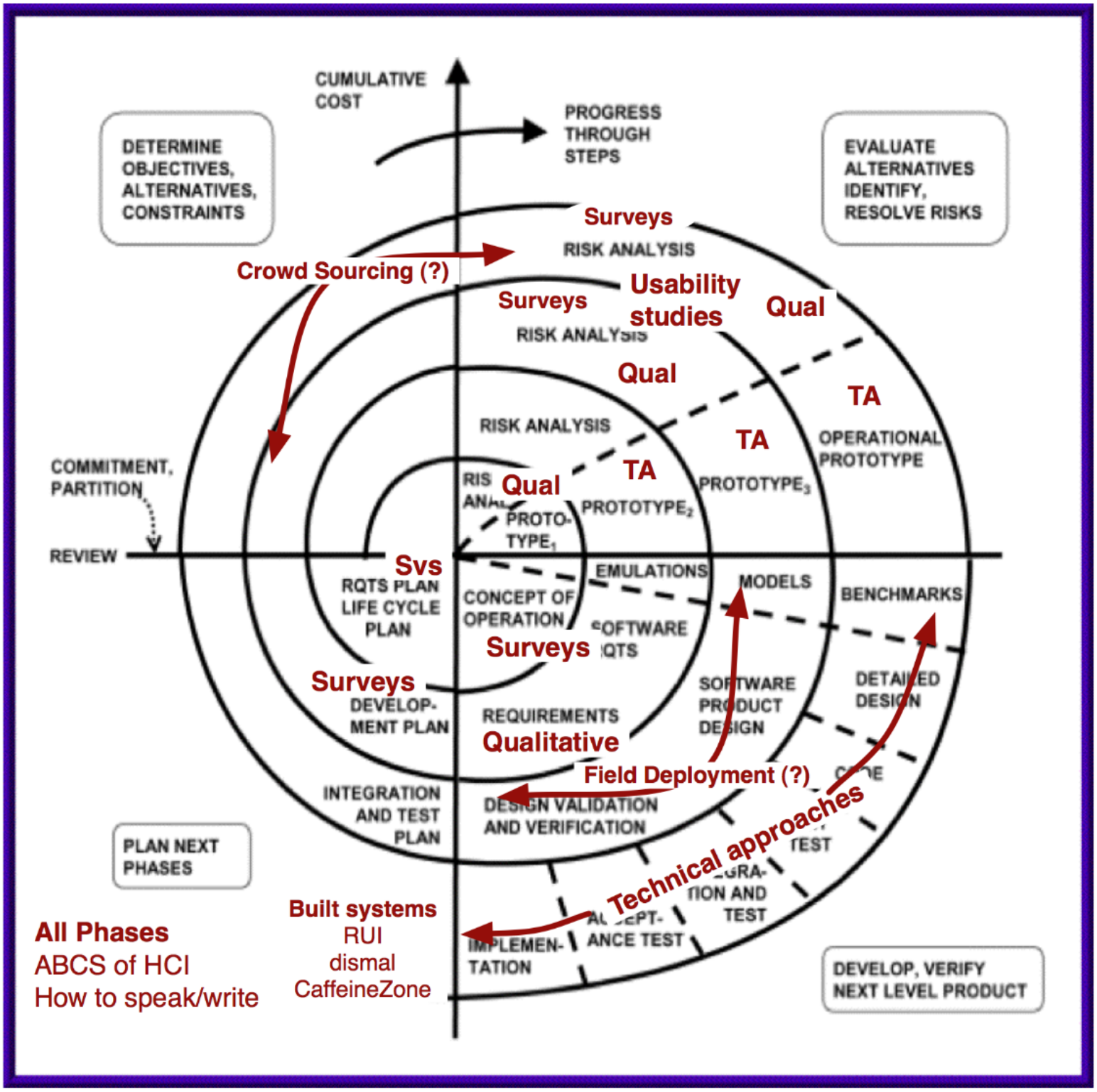
CUMULATIVE COST
PROGRESS THROUGH STEPS
DETERMINE OBJECTIVES, ALTERNATIVES, CONSTRAINTS
EVALUATE ALTERNATIVES IDENTIFY, RESOLVE RISKS
Surveys
RISK ANALYSIS
Crowd Sourcing (?)
Usability studies
Qual
Surveys
RISK ANALYSIS
Qual
TA
RISK ANALYSIS
TA
OPERATIONAL PROTOTYPE
COMMITMENT, PARTITION
Qual
TA
PROTOTYPE3
PROTOTYPE2
PROTO-TYPE1
REVIEW
Svs
RQTS PLAN LIFE CYCLE PLAN
EMULATIONS
MODELS
BENCHMARKS
CONCEPT OF OPERATION
SOFTWARE RQTS
Surveys
Surveys
DEVELOP-MENT PLAN
REQUIREMENTS
Qualitative
SOFTWARE PRODUCT DESIGN
DETAILED DESIGN
Field Deployment (?)
INTEGRATION AND TEST PLAN
DESIGN VALIDATION AND VERIFICATION
TEST
Technical approaches
PLAN NEXT PHASES
Built systems
RUI
dismal
CaffeineZone
All Phases
ABCS of HCI
How to speak/write
IMPLEMEN-TATION
ANCE TEST
TION AND TEST
DEVELOP, VERIFY NEXT LEVEL PRODUCT

TABLE 6-4 Examples of Uses of Event Data Analysis

Question	Type of Event Data
What does the operator do from moment to moment? What options are not used? What options precede the request for help? What action sequences occur often enough to be automated or assisted?	Keystrokes, mouse movements, click streams.
What are the service demands made on a shared resource (like a server or a database)? What are critical dates or times of day? How can server/database traffic be anticipated or smoothed?	Hits on a web site. Database accesses. Server traffic. (While conventional server logs provide a very low-level view of these demands, instrumentation can provide a work-oriented account of server demands.)
What are the current issues that the organization is grappling with? What is the organization's current intellectual capital?	User-initiated social-software events and data, like tag creation and tag modification, blog entries, wiki entries, and current searches.
What are people thinking and planning as they work? What confuses them?	Think-aloud reports. Verbal reports. Paired-user testing.
What is the communication network in the organization? Who communicates with whom?	Communications events (email, chat, meeting attendance).
What is the context of critical events? How often do critical events occur and what events preceded and follow them?	Stream of video events (e.g., in an emergency room or air traffic control center). One or more recordings of shared radio frequencies among emergency responders.
How do people use the work space? What communication patterns or traffic patterns occur? How can the space be used more effectively or efficiently?	Movement in an office space.

Shared Representations as Part of Design Process - Uses

- All HCI results are shared representations
- Transfer knowledge between stages and designers
- Examined critically
- Reduce working memory load in design
- Make explicit what is explicit and implicit
- Produce new connections
- Collaboratively produce new knowledge

What does this mean for HCI and modeling?

Can identify missing tools

Modeling is in this mix

Modeling is fussy

Modeling is precise

"Models are for the brass and mahogany world"-Goss

Further Insights

- Many "HCI" projects are not in a small box, but cut across boxes/phases
- Many HCI results are constraints on things in the boxes, or ways to view the boxes, or ways to share results across boxes
- Can look for missing methods
  - light weight ACT-R/Soar!
- Why start with KLM to look at built systems?
  - we used to be given system only at end
- Can choose method based on risk if you care about risk, or project if you care about method! (most here care about method, ie models)
  - Many future users are not modelers (sigh)
- Some HCI/modeling work ignores implications for design, and ends up being narrow, undefined wrt to design process, and further from designers

Suggestion 1: A shared methodology

Broad use of Shared representations (I.E. MODELS)

Shared representations

- from personas to running models
- Gantt charts synchronized to system
- Scripted modules
- Software from design to code with model-based testing

Include Model-based evaluation

4. Greater User Participation

- Context of use methods can be expensive
- Approaches to capturing user input (and creating mods)
  - Combine lists with maps (mash-ups)
  - RSS feeds and associated tools
  - Social bookmarks
  - Blogs and associated multimedia
  - Wikis
- Systems Engineering for User Participation in these approaches
  - Building tools and systems to support users in this process
  - Design for end user customization
  - Support issue tracking and resolution

Book Conclusions

- Include HSI early, understand how to do it
- Tailor methods to risk and resources
- Ensure communication of shared representations (models of various things)
- Design to accommodate change
- Encourages projects
  - To develop process
  - to implement HSI as a field
  - to improve models (ease to create, ease to understand, quality), shared representations, data analysis
  - to improve usability objectives

Ritter's Conclusions and Final Insights

- Usability and explainability will help us a reach a new market, that of designers of systems and systems of systems

- Models are currently a small formal part of most design processes
  - We are too detailed for many design processes
  - We need models that are understandable
  - We need models that are easy to use by other designers
  - We need models that develop iteratively
    - Herbal
    - CoJACK

- Lessons from models also come on the NEXT system
  - We need models that are understandable
  - We need models that are easy to learn from
  - We need more success stories
    - e.g., Booher & Minniger, 2003
    - prizes
- We need to keep the big picture in mind

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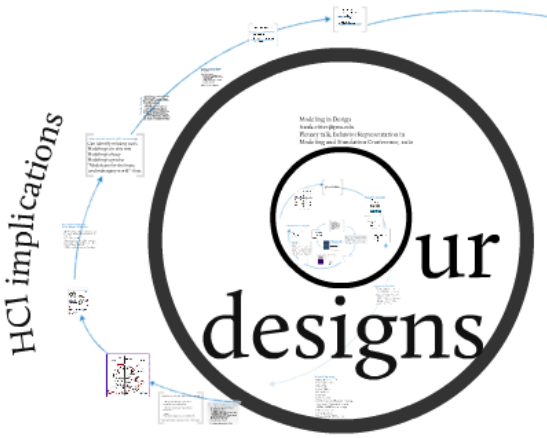

other's designs

models

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