Welcome to the INCOSE Enchantment Chapter Monthly Meeting

14 Jan, 2015 – 4:45-6:00 pm:

Modeling Conceptual Design

Jack Ring, INCOSE Fellow, Educe LLC, OntoPilot LLC, Kennen Technologies LLC

Abstract:

The session will focus on the Model-based Conceptual Design Working Group, particularly their 14 essays in the December 2014 INCOSE INSIGHT. Jack will present his essay regarding the fuzzy front end of conceptual design --- identifying and clarifying the real problem --- then facilitate a discussion and scoring of all 14 essays.

NOTE: This meeting will be recorded

A Few Words First

New INCOSE and Chapter web sites will go live in February, same addresses.

In February the Chapter Board will be planning the year.

A special focus this year on providing meetings, tutorials, and events that provide values you want – what would interest you?

Please respond to the survey that will be distributed shortly,
your input will guide the Chapter planning for the year.

Do you want to hear more about what working groups are doing … or not?

Do you want a CSEP preparation event?

What speakers or topics for meetings and tutorials?

Tours or social events?

What else?

Modeling Conceptual Design

Things to Think About

What does conceptual design mean to you?

What should conceptual design communicate – to who?

How should model-based conceptual design be depicted – for who?

Do you want to influence what this Working Group will establish?

Speaker Bio

Jack Ring is interested in promulgating system thinking, feeling and doing worldwide.

He is a Fellow, International Council on Systems Engineering and an active participant in several professional societies.

He serves on the Advisory Board of the University of Advancing Technologies, Phoenix, Arizona, and as Industrial Fellow at Stevens Institute of Technology, School of Systems and Enterprises.

Jack earned a B. A. in Physics from Emporia State U. and has continued self-directed study in innovation, knowledge exchange, choice making and leadership.

He has designed and operated more than 50 systems of various kinds and pioneered the application of aerospace telemetry to automobile racing.

Model-based Conceptual Design as described in INSIGHT, December, 2014

by
Jack Ring
for
INCOSE Enchantment Chapter
1/14/2015

You don't know Jack ?

- 1955 – Present.
- System Test & Evaluation (Atlas ICBM Radio Guidance System) → System Engineering (State-determined → Stochastic → Non-deterministic Systems).
- GE 20, Honeywell 10, Edelbrock 3, Ascent Logic 2, IBM OTP 1.
- More than 50 systems, most including humans as active components. Involved Newbies, Crossovers, Remedial cases, Geniuses and Mentors.
- Tutorials, Papers and Panels; INCOSE, INCOSE IL, ITEA, ICSEng, ISSS, IEEE SMC, IEEE SysCon, NIST.
- Co-chair, INCOSE WG's for
  - Intelligent Enterprises, 2002-2007
  - Motor Sports as learning environment, 2008 –
  - Autonomous Systems T&E, 2009 -
- Kennen Technologies LLC, OntoPilot LLC, Educe LLC.
- Pioneer, 1961, in race car telemetry.

Background

This session will focus on the MBCD Working Group report.

This initial product of the MBCDWG evidences several open issues. The impetus was application of MBSE to Acquisition phase of a system life cycle. However, the current version of MBSE may not be sufficient and many domains, e.g., healthcare, do not use an Acquisition phase to initiate a new system. Today's review and discussion will presume a broader viewpoint than an Acquisition phase by a military organization.

Agenda

I will describe the fuzzy front end of conceptual design then facilitate a discussion of the other 13 essays in the INCOSE INSIGHT, December 2014.

Because this session was advanced to January you may not have reviewed the December INSIGHT. We will hear any comments today and continue a dialog on the web.

A PUBLICATION OF THE INTERNATIONAL

What's Inside

What's Inside

Discovering the Real Problematic Situation: The First Aspect of Conceptual Design

My essay emphasized three points;

First, focus on the problem space and underlying problem system.

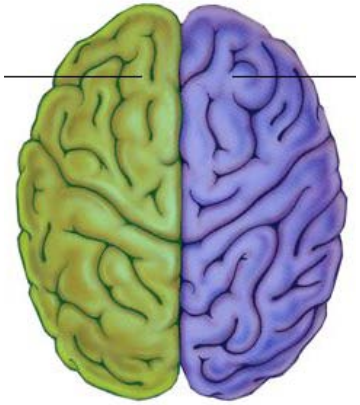
Second, foster, foment and facilitate stakeholder agreement regarding the goals and limits of at least two problem suppression therapies.

Third, convey results with a Concept of Operations story.

- Clarifies necessary, sufficient and efficient Effects (including Operational Availability) and MOE's.
- Nominates preferred Capabilities.
- Estimates probable limits (dynamic and integrity).

critically reviewed for viability and for Do No Harm.

Three stages of a system

Conceptual	→ Model	→ Operational
Tacit	Expressed in languages	Expressed in technologies
	Modeling Mathematical Graphical Textual Simulation Emulation etc.	Thermodynamics Informatics Biomatics Teleonomics Social Dynamics Economics Ecologics etc.
Content <-> Behavior		

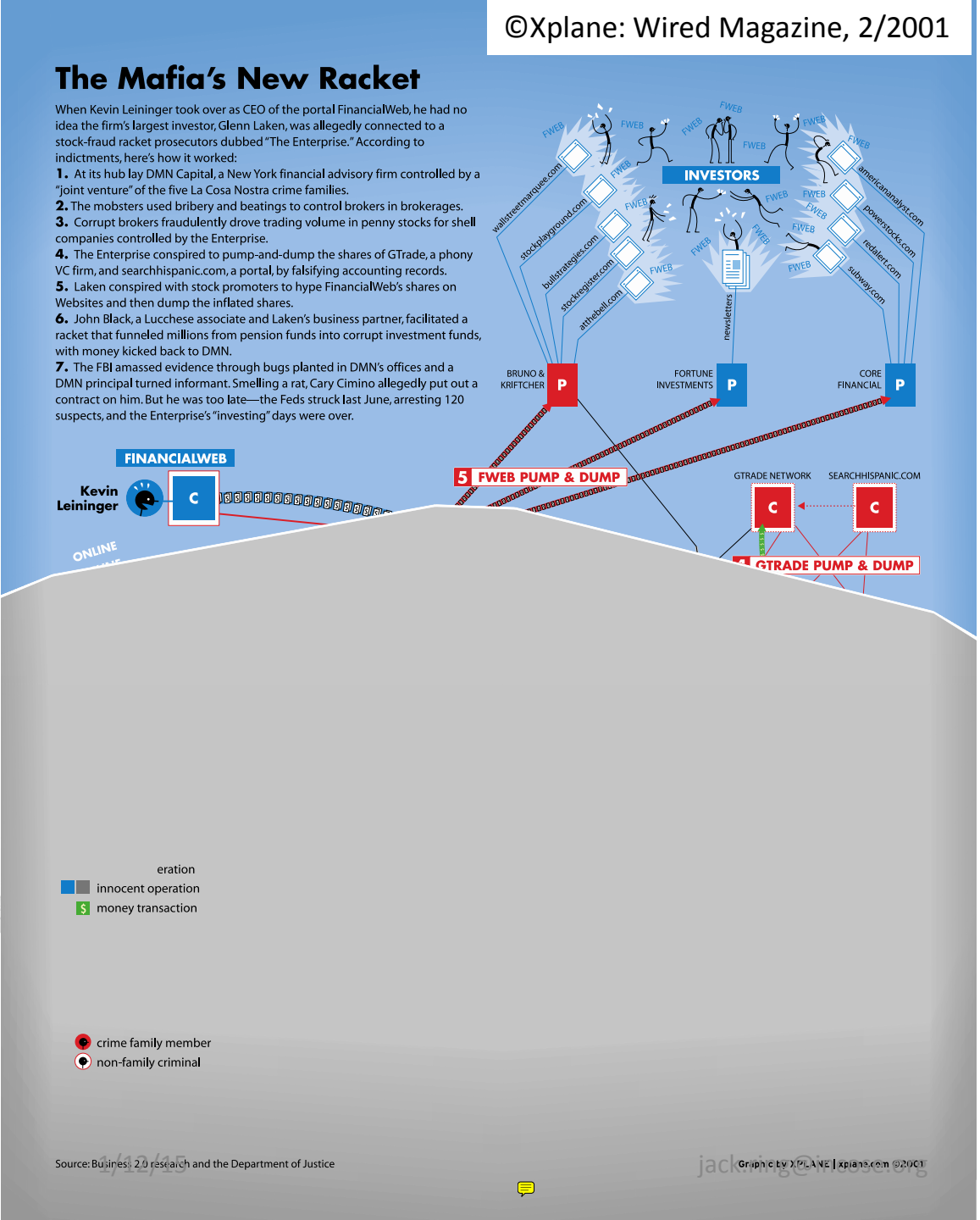
quality assurance

Reflection + Feels right | Dialog + Simulation | MOE's

Aspects of the Challenge

To excel at Model-based Conceptual Design ---

1) What must you know?
2) Why must you know?
3) When must you know?
4) Where must you know?
5) Who must know?
6) How can you know, for sure?



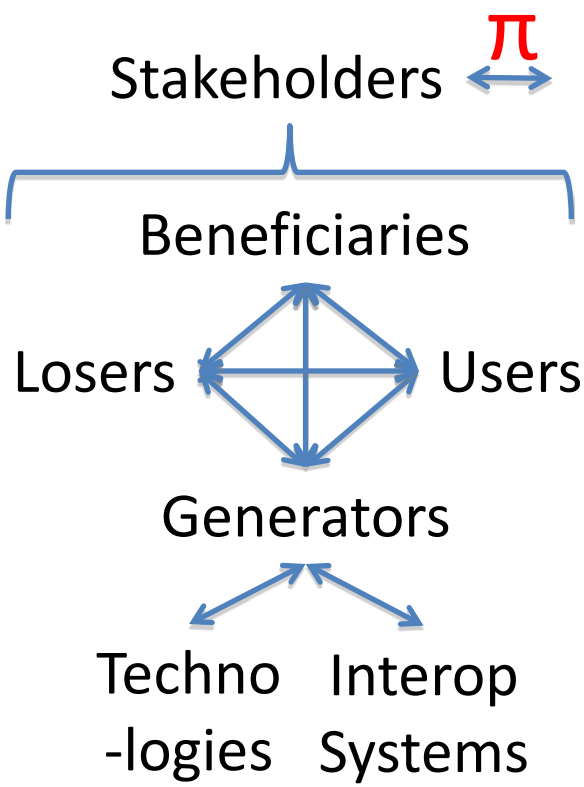
What must you know: The Problem

As Is (see graphic)
May become, grow
May become, morph

State-determined
Ergodic
Non-deterministic

Stakeholder Perspective
- Significance
- Urgency
- Intent
- Concerns

Why must you know: To Conceive π



Problem
System

	E	V	A
High			
Medium			
Low			

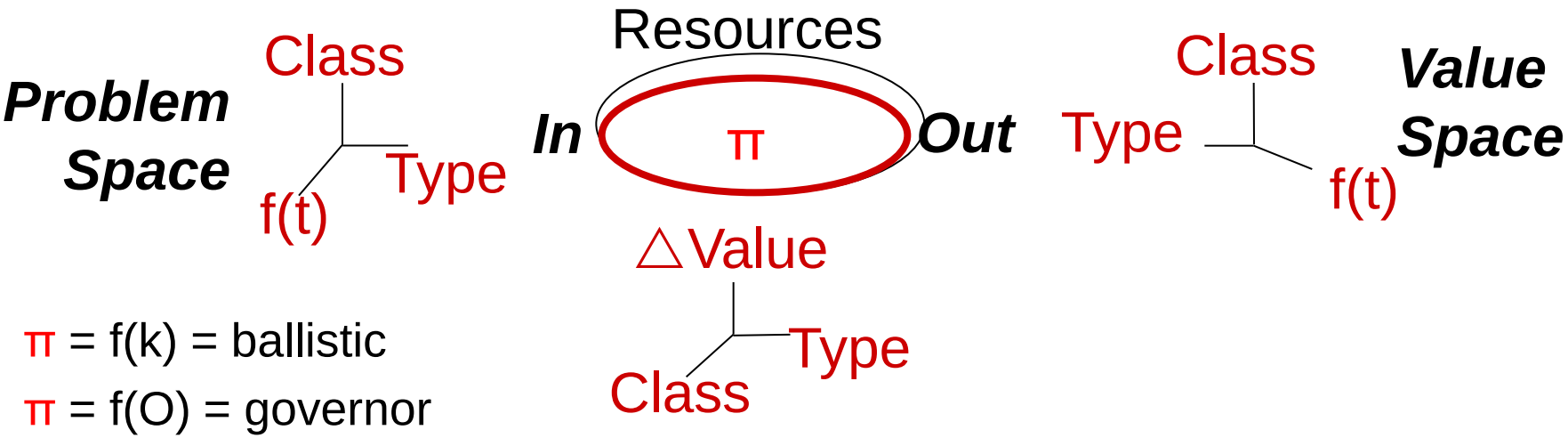
E = Extent
V = Variety
A = Ambiguity

= SE 3.0
= SE2.0
= TSE

π

Q = Quality (Effects, OpAvail)
P = Parsimony
B = Beauty

Example π Categories



π = f(k) = ballistic
π = f(O) = governor
π = f(I) = compensator
π = f(π) = self-test, auto repair
π = f(Sit, O) = homeostatic
π = f(Sit1, O) = homeorhetic
π = f(Val) = goal-seeking
π = f(Pr) = self-organizing
π = f(Pr, Val) = autopoietic
π = f(all) = autocatalytic

Pr	= Problem Space
Val	= Value Space
S	= Stimulus
R	= Response
Sit	= Situation
π	= System Transfer Function

Why must you know: Else

- Unintended Consequences
- Schedule slips
- Overruns
- SoS ➔

When must you know?
Cycle Time, stages 1 – 7, Is critical.

1
Stakeholders

2
Effects, Capabilities, MOE's

Problematic Situation(i)

Engagement Ready

7
Effects OpAvail

N
Y
F4P?

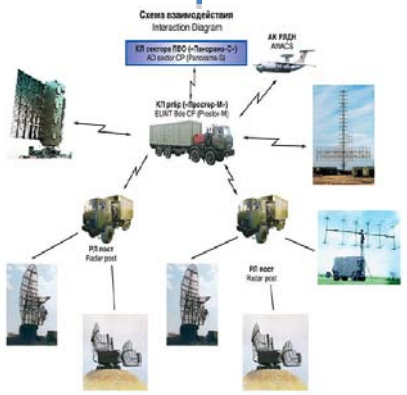
3
Operational System Engineering

Application Knowledge Base

4
Inventory of Components

5
System Realization & Resilience

6



Where must you know?

- As close to the action as possible, persistently.
- Then when system usage starts: POSIWID

It is **not** about Requirements Management

Who must know

creative tension)

The Stakeholders*

vs.

The Fuzzy Front End team*

vs.

The Problematic Situation Representative(s).

*Both Accountable for subsequent surprises.

c.f., Fuzzball Eaters Society in Friends In High Places, William Livingston III

How can you know?

Prepare the Concept of Operations, ConOps.

- ✓ A prescriptive model, or two, of intended usage.
- ✓ Clearly communicates intended and unacceptable Effects on problem system.
- ✓ States Top Ten Measures of Effectiveness.
- ✓ States Standard of Acceptance (multiple if various modalities and usage domains).
- ✓ Anticipates trajectory of emergent characteristics and properties.
- ✓ Source of T&E scenarios.
- ➢ Not to be confused with Operations Concept (the owner's/operator's manual).

ConOps Checklist

A. States top ten intended effects on the problematic situation, particularly the problem system.

B. States standards of acceptance for the intervention system (multiple versions if various modalities and usage domains).

C. Fully addresses the human aspects of the stakeholders, the system modeling effort, and the envisioned suppression system.

D. Clarifies the kinds of therapies the stakeholders are willing to undergo.

E. Describes the rewards that will accrue to the system and the stakeholders as triggered by the intervention. Units of reward may include monetary, information, goals, trust, and loyalty.

F. Precludes getting lost in detail, avoids premature feasibility (mis)judgments, and avoids the insertion of preconceived design concepts.

G. Does not presume or bias the content and structure of the eventual intervention system.

H. Is formally accepted by the downstream systems engineering and realization staff (performing incoming inspection and integrity assessment).

How Can You Know For Sure?

Complex Situation ← ≈7 languages X 100's of dependencies

+

Naïve Designers ← Arrogance[1,2,3,4] > (Knowledge + Standard of Care)

↓

Cognitive Overload

↓

Underconceptualization

Suppress Arrogance + Ensure Second Opinion

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1) ≠ checking your work. 7-4=3+4=7

2) T&E as a Dependent Variable

3) LVC Simulation

4) ≠ confirming Dynamic & Integrity Limits

Beware 1: When Stakeholders Become the Problem

"Beware CHANGE ---
There is nothing as difficult to handle, more dubious in outcome or more dangerous to organise.

It creates enemies of all those content with the status quo,

and can only muster lukewarm support from those who would benefit from the change."

Niccolo Machiavelli 1513

Forewarn Stakeholders and Honor your Standard of Care

Beware 2: When Systems People become the problem

When the Situation Complexity Index, SCI, gets high enough the systems project people become the primary problem. They experience cognitive dissonance then underconceptualize the problematic situation.

Fortunately, this malfunction mode is rather easy to detect. It appears when the systems people abandon efforts to prepare and convey a model of the problematic situation turning instead to writing requirements and envisioning the intervention system.

Beware 3: Re-use

Key Take-aways

- The Fuzzy Front End involves:
  - Preparing a descriptive model of the Problem System.
  - Preparing the ConOps showing a) what Effects, when, must be wrought on the Problem system and b) the acceptable Capabilities to do so, including Do No Harm.
- Your value add will be determined by your willingness to abide by a Standard of Care, e.g., Do No Harm, while facilitating mutual understanding between the Stakeholders and those in the Problem System.
- Then, and only then, can your project confidently proceed to design the Problem Suppression System.

Key Issues w/r Current SE Recipes

- Clarifies that ‘system shall’ statements are design hypotheses, not requirements.
- Effects and MOE’s must include the When and While aspects of problem suppression. Operational Availability. Basis for Resiliency.

INSIGHT (17.4) Essays

11. Discovering the Real Problematic Situation: The First Aspect of Conceptual Design

A descriptive model that clarifies the problematic situation must reflect specifically the entire problem.

16. Exploring Model-Based Concept Design – Ideas and Offerings

…it behoves the systems engineering research community to articulate the underpinning theory and establish the veracity of the MBCD and MBSE propositions within the discipline of systems engineering first before broadening the application beyond the engineering realm.

20. Managing Complexity in Model-Based Conceptual Design

Designers must strive for an optimum balance between performance and complexity and identify the designs that lie on the performance-complexity Pareto frontier.

INSIGHT (17.4) Essays, con't.

23. Return on Investment Using Model-Based Concept Design

Concept definition involves analyzing the value proposition from multiple stakeholders, and assessing considerations such as organizational relationships, technical readiness, socio-political considerations, environmental, and legislative requirements to define a problem space that provides the best overall value to the stakeholders and enterprise.

26. Problem Framing: How Can Model-Based Methods Help Systems Engineers Solve The Right Problem?

MBSE tools and techniques have the potential to be applied much earlier in the systems engineering process at the problem-framing stage.

29. A Structure for Model-Based Concept Design.

This MBCD ontology proposes structures for modeling concepts and has placed emphasis on the need to generate critical information needed by decision makers to progress concepts into realizable systems.

INSIGHT (17.4) Essays, con't.

33. Application of MBCD to Creativity and Innovation.

    In innovative conceptual design, there are two tasks in which MBCD plays a fundamental role, namely communication and conceptual implementation.

35. Model-Based Stakeholder Needs and Requirements

    The key to applying model-based methods and techniques to stakeholder needs analysis is the recognition that the problem addressed by a solution system occurs because the stakeholders seek to operate differently and receive some future benefit.

37. Overview of Value-Driven Design Research: Methods, Applications, and Relevance for Conceptual Design

INSIGHT (17.4) Essays, con't.

40. MBSE-Supported System Acquisition

    The purpose of the research project was to investigate the MBSE practices needed to integrate MBSE models across the contractual boundary.

43. Model-Based Techniques Applied to Emergency Services Capability Design

    Taking a capability approach to managing, acquiring, and organising resources such as people, assets, and processes, has become an accepted concept in defence departments around the world.

46. A Model-Based Study of Concept Development for Hospital Wayfinding to Improve Operating Efficiency

    Even simplified models of human behaviour in the context of MBCD have limitations and present challenging problems.

INSIGHT (17.4) Essays, con't.

49. Model-Based Conceptual Design in the Mining Industry

A powerful modelling tool is a necessity, and such a tool is only viable based on a widely accepted modelling language, such as SysML.

51. The Future for Model-Based Conceptual Design and INCOSE's Working Group

The MBCD WG needs to be a catalyst in realising the vision for MBCD and leading the identification of opportunities to meet the challenges.

Questions?

Continuing the dialog ---

https://www.linkedin.com/groups?home=&gid=6930690&trk=my_groups-tile-grp

Thank you!

Please

The link for the online survey for today's meeting is
https://www.surveymonkey.com/s/Enchant_01_14_15

https://www.surveymonkey.com/s/Enchant_01_14_15