Three Papers

• Meta-systems Engineering (INCOSE2000)

• Anti-terror Meta-systems Engineering

• Vajra Logic and Mathematical Meta-models for Meta-systems Engineering
Précis

• Basic purpose of this talk is to persuade the practitioners of the Systems Engineering discipline to look beyond Systems Theory as the source of schemas for understanding phenomena and designing artifacts

• In the current discipline, three schemas are emphasized

• This should be expanded ultimately to at least ten different schemas

• But here we will focus on a consideration of at least one more schema – the meta-system

• This schema has profound implications for the transformation of the this discipline into Meta-systems Engineering.
The same schema of a “system” is projected at various levels in a hierarchy. This implies that the “system” schema is all we need to understand things and states of affairs.
Formal Structural System

System Schema -- description
- wholes and parts
- universal algebra
- systemism

Form Schema -- proof
- geometry
- logic
- formalism

Pattern Schema -- explanation
- reductionism
  (atomic theory in relation to chemistry)
- structuralism

Current science emphasizes three basic schemas
Schemas
example ontological hierarchy

Pluriverse
Kosmos
World
Domain
Meta-system
System
Form
Pattern
Monad
Facet

‘Domain World Meta-system’?

Formal Structural System
Emergent Hierarchies

Ontic Emergent Hierarchy
- gaia?
- social
- organism
- organ
- multi-cell
- cell
- macro-molecule
- molecule
- atom
- particle
- quark
- string?

Ontological Emergent Hierarchy
- pluriverse
- kosmos
- world
- domain
- meta-system
- system
- form
- pattern
- monad
- facet
Dual Schemas

<table>
<thead>
<tr>
<th>System</th>
<th>Meta-system</th>
</tr>
</thead>
<tbody>
<tr>
<td>description</td>
<td>indication</td>
</tr>
<tr>
<td>Gestalt</td>
<td>Proto-gestalt</td>
</tr>
<tr>
<td>Turing Machine</td>
<td>Universal Turing Machine</td>
</tr>
<tr>
<td>Restricted Economy</td>
<td>General Economy</td>
</tr>
<tr>
<td>Application</td>
<td>“Operating System”</td>
</tr>
</tbody>
</table>
Meta-systems exist between system hierarchy levels.
Types of Meta-systems
no good general words unlike other schemas
‘Meta’ meanings

Above

logical type
Meta-levels

Beyond

sequence
complement
Meta-system

Change

succession
emergent event
Meta-system transition

Meta-system transition

Meta-system

supervenience

pure

non-L

process

hyper

wild
## Kinds of Being

<table>
<thead>
<tr>
<th>Type of Being</th>
<th>no hand</th>
<th>nonattachment</th>
<th>indeterminate</th>
<th>model theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultra Being</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild Being</td>
<td>out-of-hand</td>
<td>encompass</td>
<td>propensity</td>
<td>category</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>chaotic</td>
<td>theory</td>
</tr>
<tr>
<td>Hyper Being</td>
<td>in-hand</td>
<td>bear</td>
<td>possibility</td>
<td>group theory</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>fuzzy</td>
<td></td>
</tr>
<tr>
<td>Process Being</td>
<td>ready-to-hand</td>
<td>grasp</td>
<td>probability</td>
<td>algebra</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>stochastic</td>
<td></td>
</tr>
<tr>
<td>Pure Being</td>
<td>present-at-hand</td>
<td>point</td>
<td>determinant</td>
<td>geometry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>continuous</td>
<td></td>
</tr>
<tr>
<td>being, entity,</td>
<td></td>
<td></td>
<td></td>
<td>arithmetic</td>
</tr>
<tr>
<td>thing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Emergent Event

Emergent event must traverse all four kinds of Being to be genuine.

Outside worldview

novum

Existence

Ultra Being | Wild Being | Hyper Being | Process Being | Pure Being

Inside worldview

eventity

new ontology
episteme change
paradigm shift
new theory
new facts
new givens
# System Schema

<table>
<thead>
<tr>
<th>ontic</th>
<th>layers of worldview</th>
<th>ontology</th>
</tr>
</thead>
<tbody>
<tr>
<td>specimen</td>
<td>exception</td>
<td>System</td>
</tr>
<tr>
<td></td>
<td>property</td>
<td>schema</td>
</tr>
<tr>
<td></td>
<td>condition</td>
<td></td>
</tr>
<tr>
<td>speech</td>
<td>pun</td>
<td>language</td>
</tr>
<tr>
<td></td>
<td>phoneme</td>
<td>example</td>
</tr>
<tr>
<td></td>
<td>grammar</td>
<td></td>
</tr>
<tr>
<td>play</td>
<td>case</td>
<td>game</td>
</tr>
<tr>
<td></td>
<td>piece</td>
<td>example</td>
</tr>
<tr>
<td></td>
<td>rule</td>
<td></td>
</tr>
<tr>
<td>Thing-in-itself existent ‘magma’</td>
<td>contrary</td>
<td>Projection</td>
</tr>
<tr>
<td></td>
<td>filter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>norm</td>
<td></td>
</tr>
<tr>
<td>ultra</td>
<td>wild</td>
<td>pure</td>
</tr>
<tr>
<td></td>
<td>hyper</td>
<td></td>
</tr>
<tr>
<td></td>
<td>process</td>
<td></td>
</tr>
</tbody>
</table>

- **System**: A fundamental concept in the schema, representing the core structure of the system.
- **Schema**: A representation of a system's properties and behaviors, often used in cognitive and behavioral sciences.
- **Projection**: A theoretical construct that describes the relationship between different layers of the worldview.
- **Ontology**: The study of the nature of being, existence, and reality, often used in philosophy and metaphysics.
<table>
<thead>
<tr>
<th>ontic</th>
<th>layers of worldview</th>
<th>ontology</th>
</tr>
</thead>
<tbody>
<tr>
<td>locus</td>
<td>catastrophe</td>
<td>Meta-system</td>
</tr>
<tr>
<td>replication</td>
<td>low ratings</td>
<td>media</td>
</tr>
<tr>
<td>node</td>
<td>hot/soc</td>
<td>network</td>
</tr>
<tr>
<td>organism</td>
<td>extinction</td>
<td>environment</td>
</tr>
<tr>
<td>potential</td>
<td>oscillation</td>
<td>field</td>
</tr>
<tr>
<td>transaction</td>
<td>crash</td>
<td>market</td>
</tr>
<tr>
<td>thing-in-itself</td>
<td>contrary</td>
<td>Projection</td>
</tr>
<tr>
<td>ultra</td>
<td>wild</td>
<td>pure</td>
</tr>
</tbody>
</table>

- **Meta-system schema**

- **ontic** column includes concepts like 'locus', 'replication', 'node', 'organism', 'potential', 'transaction', and 'thing-in-itself'.

- **layers of worldview** column includes concepts like 'catastrophe', 'distribution', 'source/sink', 'food, water, air', 'generator', 'production', 'filter', 'norm', 'hyper', 'process', and 'contrary'.

- **ontology** column includes 'Meta-system', 'media', 'network', 'environment', 'field', 'market', and 'Projection'.
# Aspects of Meta-system

<table>
<thead>
<tr>
<th>Boundary</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>horizon</td>
<td>object template outside spacetime</td>
</tr>
<tr>
<td>Origin</td>
<td>Arena</td>
</tr>
<tr>
<td>Entry point in spacetime</td>
<td>Media for interplay between system and anti-system</td>
</tr>
<tr>
<td>gatekeeper</td>
<td></td>
</tr>
</tbody>
</table>
Geometry Example

*Ordered positive dimensionality*

dimension $n = $ arena
dimension $n+1 = $ boundary

*Unordered negative dimensionality*

$\varnothing$ odd zero

source object template

origin instance

$x$ destination

$w$ reference

$z$
## Highway example

<table>
<thead>
<tr>
<th>Boundary</th>
<th>Source</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sides of road</td>
<td>entry from streets</td>
<td>System = automobile</td>
</tr>
<tr>
<td><strong>Origin and destination</strong></td>
<td>Arena lanes</td>
<td>Meta-system = highways</td>
</tr>
<tr>
<td>on ramp and off ramp</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Overpass structure at cloverleaf grade separation of U.S. 101 and Mission Valley highways in San Diego*
## Bifurcation

<table>
<thead>
<tr>
<th>Boundary</th>
<th>Source</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin</td>
<td>Arena</td>
<td>positive</td>
<td>negative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>feedback</td>
<td>dimensional</td>
</tr>
<tr>
<td></td>
<td></td>
<td>miracle / blackhole</td>
<td>ramification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>singularity catastrophe</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>positive dimensional ramification</td>
</tr>
</tbody>
</table>
Highway example

Clover-leaf
- crossing without stopping
- Non-stop driving on Freeways
### Highway example

<table>
<thead>
<tr>
<th>Miracle / Blackhole</th>
<th>Negative Ramification</th>
</tr>
</thead>
<tbody>
<tr>
<td>efficient and effective transport / endless energy use</td>
<td>entry from streets</td>
</tr>
<tr>
<td>increased safety / environmental impact</td>
<td>showroom – gas station</td>
</tr>
<tr>
<td>brings business / proliferation of highways</td>
<td>factory - refinery</td>
</tr>
<tr>
<td>tourism / homogenization of landscape</td>
<td>raw materials - oil wells</td>
</tr>
<tr>
<td>suburbs / urban sprawl</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Singularity / Catastrophe</th>
<th>Positive Ramification</th>
</tr>
</thead>
<tbody>
<tr>
<td>lane divider</td>
<td>connection between different types of transport</td>
</tr>
<tr>
<td>road divider</td>
<td>air/car/truck/sea etc</td>
</tr>
<tr>
<td>no oil</td>
<td>connection between different parts of the economy</td>
</tr>
<tr>
<td>car breakdowns</td>
<td></td>
</tr>
<tr>
<td>accidents</td>
<td></td>
</tr>
</tbody>
</table>
MATRIX

H. Minkowski (1864-1909)
G.F.B. Riemann (1826-1866)

space

time

curved space

future

present

past

somewhere / nowhere

SOURCE

causality

position

ORIGIN

absolute time

absolute space

ARENA

w

y

z

x

t
Foreground

System

(Product)

Process

(Routine Work)

Gestalt

Flow

perception

reference

conception
Background

Meta-system

Meta-process

(proto-routine work)

CMMI

Multiple PAs

Proto-gestalt

(F)

(conception)

(production environment)

 Proto-flow

horizon

streams within river

<<duals>>
### Count verses Non-count approaches

<table>
<thead>
<tr>
<th>SET things</th>
<th>MASS stuff</th>
</tr>
</thead>
<tbody>
<tr>
<td>essence</td>
<td>group action</td>
</tr>
<tr>
<td>collection of difference</td>
<td>fusion of identity</td>
</tr>
<tr>
<td>unity</td>
<td>totality</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syllogistic logic</th>
<th>Pervasion logic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded middle</td>
<td>Included middle</td>
</tr>
<tr>
<td>Boolean logic</td>
<td>Brownian Laws of Form</td>
</tr>
<tr>
<td>Attribute =&gt; Particular</td>
<td>Mass =&gt; Instance</td>
</tr>
<tr>
<td>Universal</td>
<td>Boundary</td>
</tr>
</tbody>
</table>
Strange Logics

- Mass Pervasion Logic (India, China)
- Laws of Form (Brown, Bricken)
- Diamond Logic (Hellerstein)
- Vajra Logic (includes all aspects of Being)
- Matrix Logic (Stern)
Model Theory

Universal Algebra + Logic

categories
schemas

Hyperc-plex complex algebras System Holonomies Meta-system

syntax

Semantics

Set Standard Logic

Mass Deviant Logics

Supplied by model theory by adding Real aspect of Being
Aspects of Being and Fundamental Properties

Real

Identity

coherence

verification

consistency

clarity (well-formed)

validation

verification

completeness

Presence

True
Model Theory

- Syntax
- Consistency
- Completeness
- Clarity

- Semantics
- Validation = Model
- Coherence = Theory
- Verification = Speculation

Note: addition of reality generates meaning!
Meta-model Theory

Universal algebra + Representations Interpretations + Logical Syntax + Meaningful Semantics

Hyper-Complex Algebras + Schemas + Deviant Logics + Rational Grammar
## Meta-model Theory

<table>
<thead>
<tr>
<th>Algebra</th>
<th>System</th>
<th>Logic</th>
<th>Grammar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real algebra</td>
<td>System</td>
<td>Boolean Logic</td>
<td>Normal Grammar</td>
</tr>
<tr>
<td>Complex algebra</td>
<td>Dissipative Special System (Prigogine)</td>
<td>Boundary Logic (Briklin, Brown)</td>
<td>Models</td>
</tr>
<tr>
<td>Quaternion algebra</td>
<td>Autopoietic Special System (Varela &amp; Maturana)</td>
<td>Diamond Logic (Hellerstein)</td>
<td>Theories</td>
</tr>
<tr>
<td>Octonion algebra</td>
<td>Reflexive Special System (O’Malley, Sandywell)</td>
<td>Vajra Logic</td>
<td>Speculations</td>
</tr>
<tr>
<td>Sedenion algebra</td>
<td>Meta-System (Bataile, Plotnitsky)</td>
<td>Matrix Logic (Stern)</td>
<td>Discourse</td>
</tr>
</tbody>
</table>
Anti-terror Meta-systems Engineering

- Need to look at meta-systems not just systems
- Need to use Deviant Logics not just standard logic
- Terrorists exemplify reasoning by deviant logics not just bad motives
- We need to preempt them by using deviant logics ourselves first
- Deviant logics are useful for finding unintended side effects within the meta-system

- Meta-systems need to be explicitly designed along with other expansive schemas like domains and worlds