Architecting the Enterprise:
Is INCOSE up to the Challenge?

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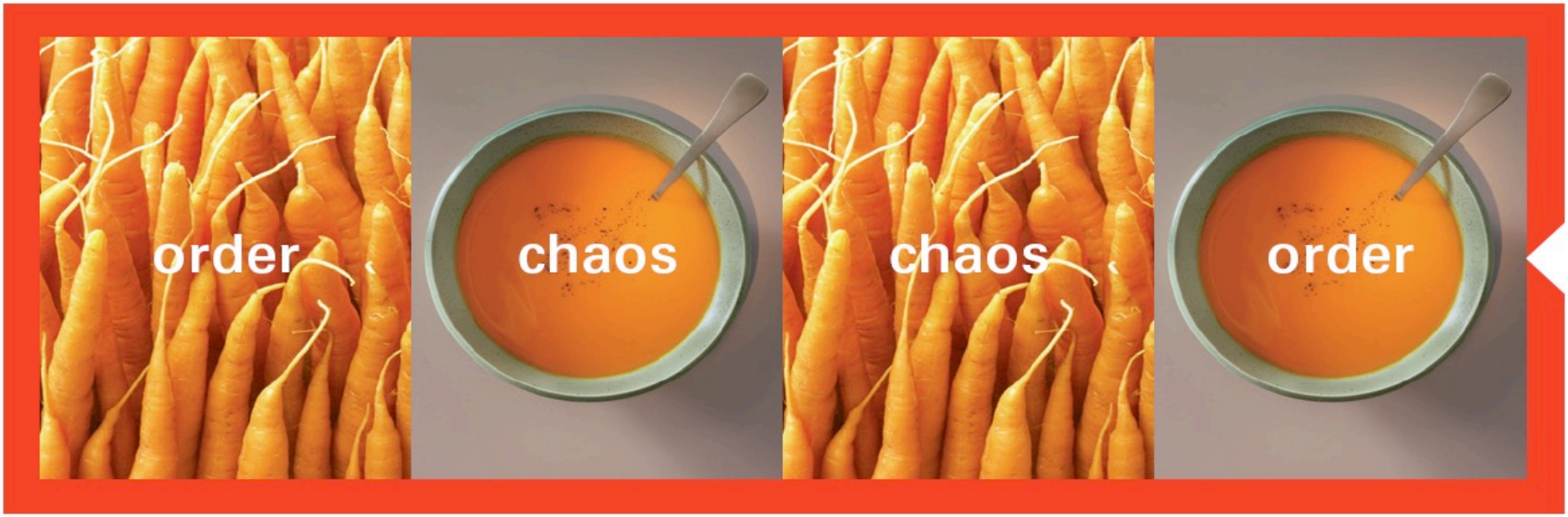
Professional Background:
Systems; *System of Systems, Enterprise*

- Royal Academy Chair of Systems Engineering
- 15 years at MIT Lincoln Laboratory
- Academic and professional affiliations
  - INCOSE: Chair, Architecture Working Group
  - *IEEE: System of Systems (SoS)*
  - OMG: Chair, Maths Formalism SIG/Model Transforms
- Defence and aerospace experience
  - *Director of Architecture for 1st - 3rd USN Chief Engineer*
  - *Aegis Systems Engineer for Ballistic Missile Defence*
  - F/A-18 Operational Test and Evaluation
  - BAE Systems, Lockheed Skunkworks, Northrop

OMG: Object Management Group SIG: Special Interest Group
INCOSE: International Council on Sys Eng USN: U.S. Navy

Viewpoints

Differences can occur in science and engineering.



- Chaos theory or carrot soup?
  - Is order in the soup or the carrots?
  - You never know what will be on the menu*.
- Technically, a *viewpoint* on a system is a technique for abstraction**

*Adapted from HSBC; http://www.yourpointofview.com

**This definition in the MDA Guide V1.0.1 is based on IEEE 1471.

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Using System Viewpoints of *Enterprise*

- INCOSE/IEEE definition [1]:

  A *system* is a combination of interacting elements organised to achieve one or more stated purposes.

- System Viewpoints:
  - *Closed*: the system is fully observable and understandable using the reductionism of the traditional scientific method
  - *Open*: the system is only partially observable and must be understood through its environment which is not completely knowable

A closed viewpoint on System is inadequate for Enterprise; you never know what will be on the 'Enterprise' menu!

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System Architecture Viewpoints

- There are over 140 definitions of '*architecture'.*
- INCOSE definition [1]:

  The fundamental and unifying system structure expressed in terms of system elements, interfaces, processes, constraints, and behaviours.

- ISO/IEC WD4 42010 (current draft):

  The fundamental conception of a system in its environment embodied in elements, their relationships to each other and to the environment, and principles guiding system design and evolution.

A closed viewpoint on Architecture is inadequate for Enterprise.

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Defence Systems Engineering (1 of 2)

- Paradigm shift to system of systems (SoS) and network enablement for military capability [2].
  - Assemblage of SoS for military capability
  - Capability through operation and interoperation
- Defence Lines of Development (Enterprise Level)
  - TEPIDOIL in the UK MOD
  - DOTMLPF in the US DoD
- But legacy focus on equipment, logistics, training

The Defence viewpoint on System has shifted to SoS and to Enterprise for the development of Military Capability.

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Defence Systems Engineering (2 of 2)

- Defence system of systems (SoS) and network enablement are intimately intertwined [3].
  - Information and cognition are central for emergent behaviour and military capability [4]
  - Technical and organisational C^2 interoperation [5]
- Defence SoS must be understood through the
  - Integration of capabilities in a mission context
  - Capabilities achieved by interoperation

The 'design and build' viewpoint on System is inadequate for Defence SoS and therefore for Enterprise.

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Are There New Paradigms for Architecting?

- Enterprise Architecture Frameworks (AF)
  - Zachman Enterprise AF
  - The Open Group AF (TOGAF)
  - Others
- OMG Model Driven Architecture (MDA)
  - Separates business and application logic from underlying platform technology
- MDA concepts for Systems Engineering [6]

Summary of Panel Position:
Architecting the Enterprise

- An Enterprise is a System but legacy systems paradigm is inadequate to architect the enterprise
- **Inadequacies**
  paradigm is inadequate to architect the enterprise

  Inadequacies of current paradigm:
  -
- Taking closed viewpoint of System and Architecture

  Using a ‘design and build’ approach for Capabilities,

Although the legacy paradigm for System is inadequate for Architecting the Enterprise, new paradigms are within reach.

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QUESTIONS?

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[5] Owens, W.A. February 1996. *The emerging U.S. system-of-systems*, Washington, DC: The National Defense University, Institute of National Security Studies, Number 63

[6] Dickerson, C.E. October 2009. *A Review of Model-Based Methods*

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