Using the CAFF to create an Architecture Framework for the Enterprise as a SoS

Bruce McNaughton

Programme Manager / System Architect

Topics

★ **My Journey – Why?**

★ **Learning along the way (FAF to CAFF)**

★ **The System Description (ODV, VRV)**

★ **The Enterprise as a SoS (ODV, VRV)**

★ **Learning from using the CAFF**

★ **Questions.**

Start of My Journey

★ **2010**
  → Met Will Hopper, Author of 'The Puritan Gift'
  → The book includes 25 Management Principles

★ **Management Principle 1:**

  All successful organizations, however simple, consist of systems within a system.

★ **Questions…**
  → What is the system?
  → What are the systems within the system?
  → Do managers actually see their organizations this way?

★ **My Approach.. Use / Adopt / Adapt - not re-invent**

My Journey

★ **Modelling (University to 2010)**
  → from the Start.. Control Theory with a focus on Electrical Engineering
  → Westinghouse (robotics and adaptive control in manufacturing R&D)
  → Digital Equipment Corporation (Special Systems, SSAD, Models in Life cycles)
  → Management (Programme / Project / Line), Life cycles and Business Change
  → Systems thinking.. Fifth Discipline Peter Senge

★ **Management Models (2010 to Now)**
  → Management Systems / Practice ISO 9001 (people, process and technology)
  → Systems Thinking / Theory: Ackoff, Checkland, Churchman, LVB, etc.

★ **Architecture (model based) (2011 to Now)**
  → Architecture Frameworks (TOGAF, DoDAF, TEAF, etc)
  → **ISO 42010:2011 Architecture Description**

★ **INCOSE (2015 to Now)**
  → **The FAF for the Enterprise and Management System**
  → **ISO 15288:2015: System Hierarchy (Figure 2)**
  → **Root Definition to System Description**
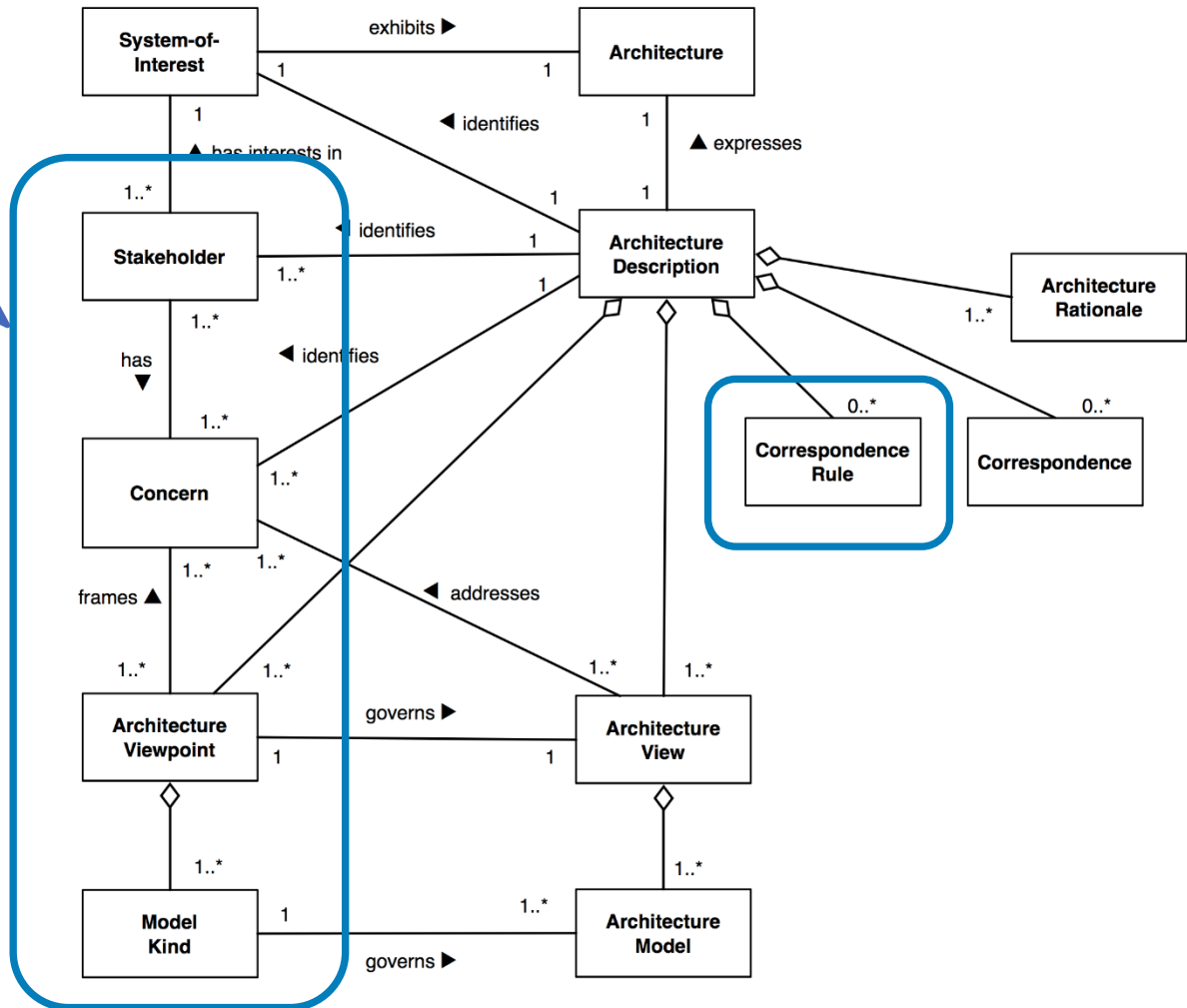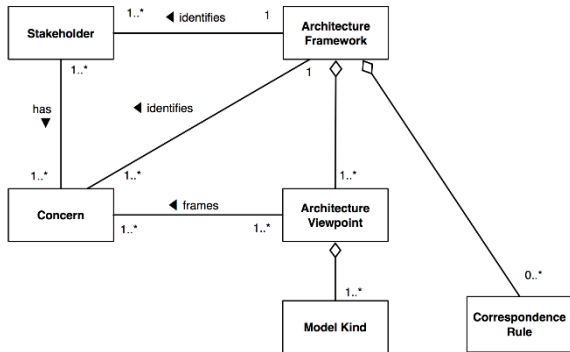 → **System of Systems and the CAFF for the Enterprise as a System of Systems.**

★ **Modelling Living Systems**
  → Cell, Organism, Person, Social System, Ecosystem, Earth

ISO 42010:2011

An **architecture framework (AF)** establishes a common practice for creating, interpreting, analyzing and using architecture descriptions within a particular domain of application or stakeholder community.
e.g. for a class of systems
(And with help from an author Rich Hilliard)

An **architecture description** (AD) is an artifact that expresses an Architecture for a system-of-interest.

Enterprise as a System of Systems

FAF
(Framework for Architecture Frameworks)

✴ **The FAF**

➔ Is a process to design an Architecture Framework

➔ Is an Architecture Framework (based upon 42010:2008)

✴ **Result of using the FAF**

➔ An Architecture Framework Definition (my name)

➔ Identifies the Ontology for a system-of-interest or class of systems.

➔ Identifies the AF Viewpoints based upon Stakeholder Concerns and the ontology

➔ The viewpoints can only use concepts from the Ontology.

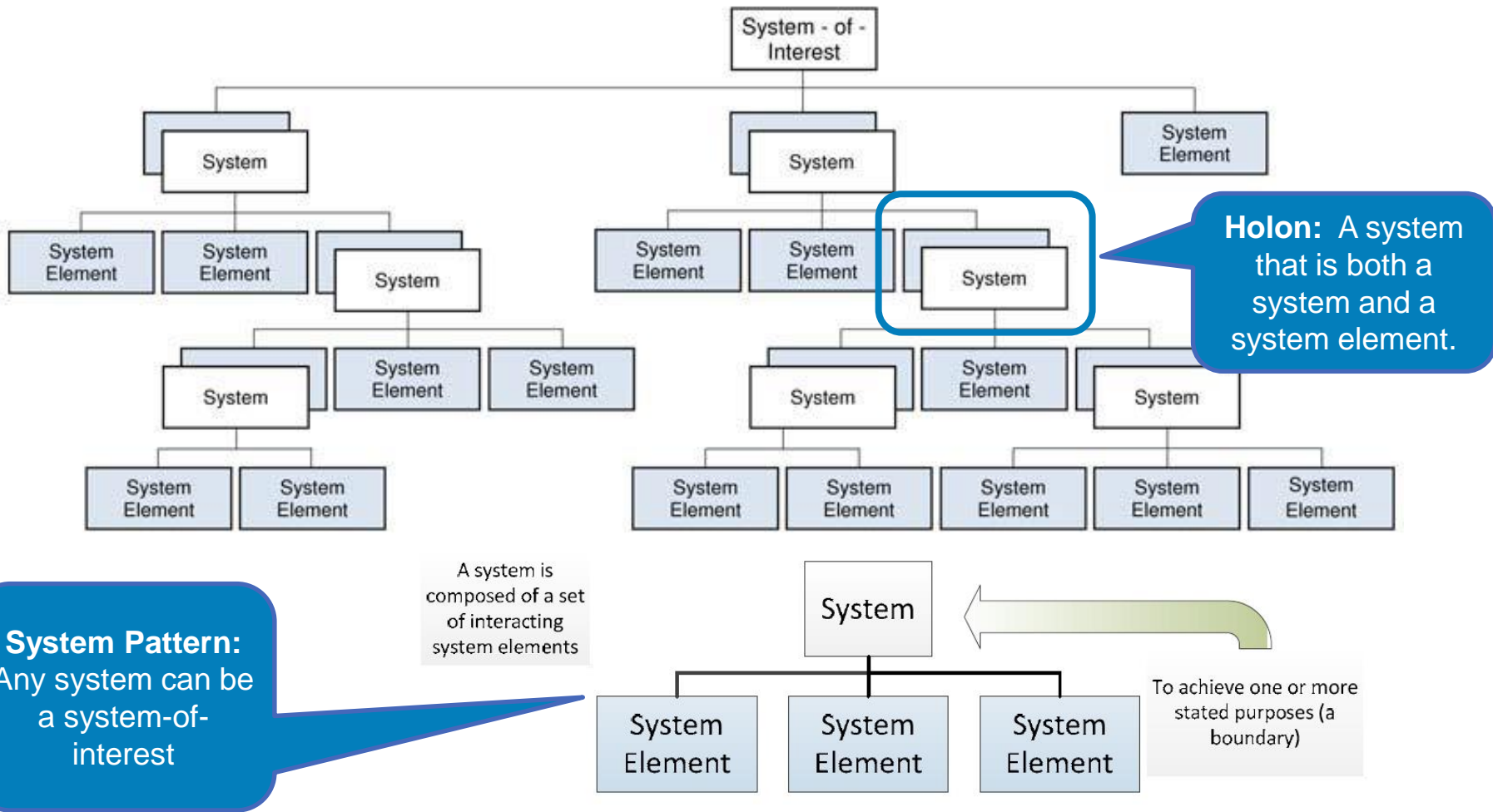# ISO 15288:2015 Hierarchy
Figure 2 System-of-Interest Structure

Holon: A system that is both a system and a system element.

System Pattern: Any system can be a system-of-interest

A system is composed of a set of interacting system elements

To achieve one or more stated purposes (a boundary)

Figure 1 — System and system element relationship

Enterprise as a System of Systems

Root Definition to System Description

✴ Why a System Description?

→ To document each system identified on the system-of-interest hierarchy in a consistent way.

✴ Root Definition from SSM (Peter Checkland)

→ Describes a Human Activity Systems using CATWOE

→ A consistent way to understand people and process.

✴ System Description for any System

→ Created a system conceptual model (Ontology)

→ Used the Root Definition as a model for system description

→ Many attempts to get the headings correct

System of Systems and the CAFF

★ **Focus on the Enterprise not the Organisation.**

➔ **Michael Porter: .. Value System consisting of Value Chains.** (e.g. a network of organizations delivering value). (also relates to Lean Thinking and supply chains).

➔ **ISO 15704:2000: Enterprise:** one or more organisations sharing a definite mission, goals, and objectives to offer an output such as a product or service

★ **System of Systems**

➔ **ISO 15288:2015 Appendix G**

◆ Managerial and operational independence of constituent systems

◆ Four types of SoS

➔ **The COMPASS** (Comprehensive Modelling for Advanced Systems of Systems) **Project** developed the CAFF.

★ **The CAFF**

➔ CAFF = COMPASS Architecture Framework Framework

➔ Basically the FAF in a Systems of Systems Context.
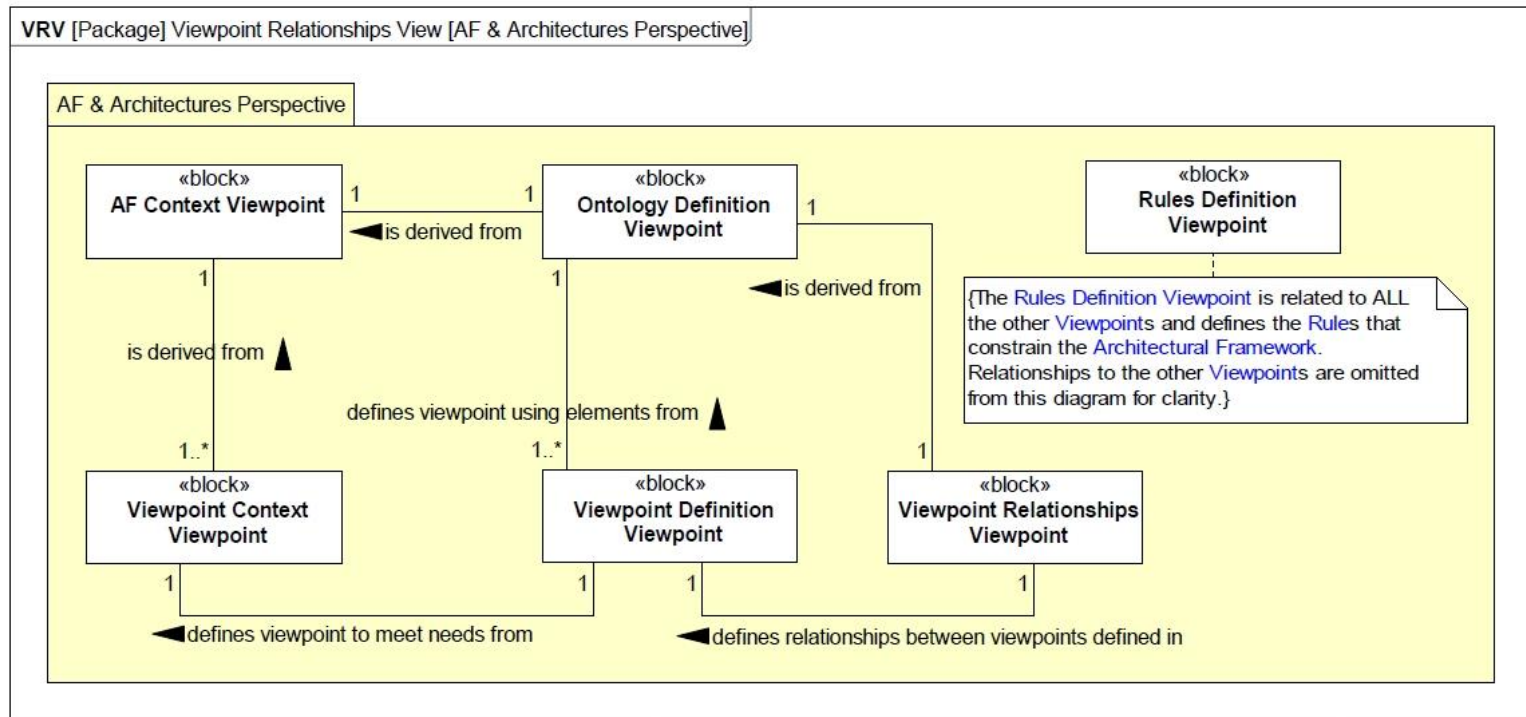
CAFF Viewpoints

Figure 4 - Viewpoint Relationships View Showing Viewpoints and Perspectives that make up the AF Framework

Figure 4 shows the various Viewpoints that make up the CAFF, the relationships between them and the Perspectives to which the Viewpoints belong.

The CAFF is a *meta*-Architectural Framework: an Architectural Framework for defining Architectural Frameworks. It is made up of six Viewpoints:

System Description

★ **System-of-Interest: Abstract System (in UML sense).**

  → **ISO 15288:2015: system** combination of interacting elements organized to achieve one or more stated purposes

  → **INCOSE**: *A* **system** *is an arrangement of parts or elements that together exhibit behavior or meaning that the individual constituents do not.*

  → Other definitions: Russell Ackoff, Hillary Sillitto, ISO 9000:2015.

★ **Architecture Description**

  → The Architecture Framework is the process (viewpoints) to create an Architecture Description (collection of views)

  → Set of Views for a System-of-Interest that addresses stakeholder concerns.
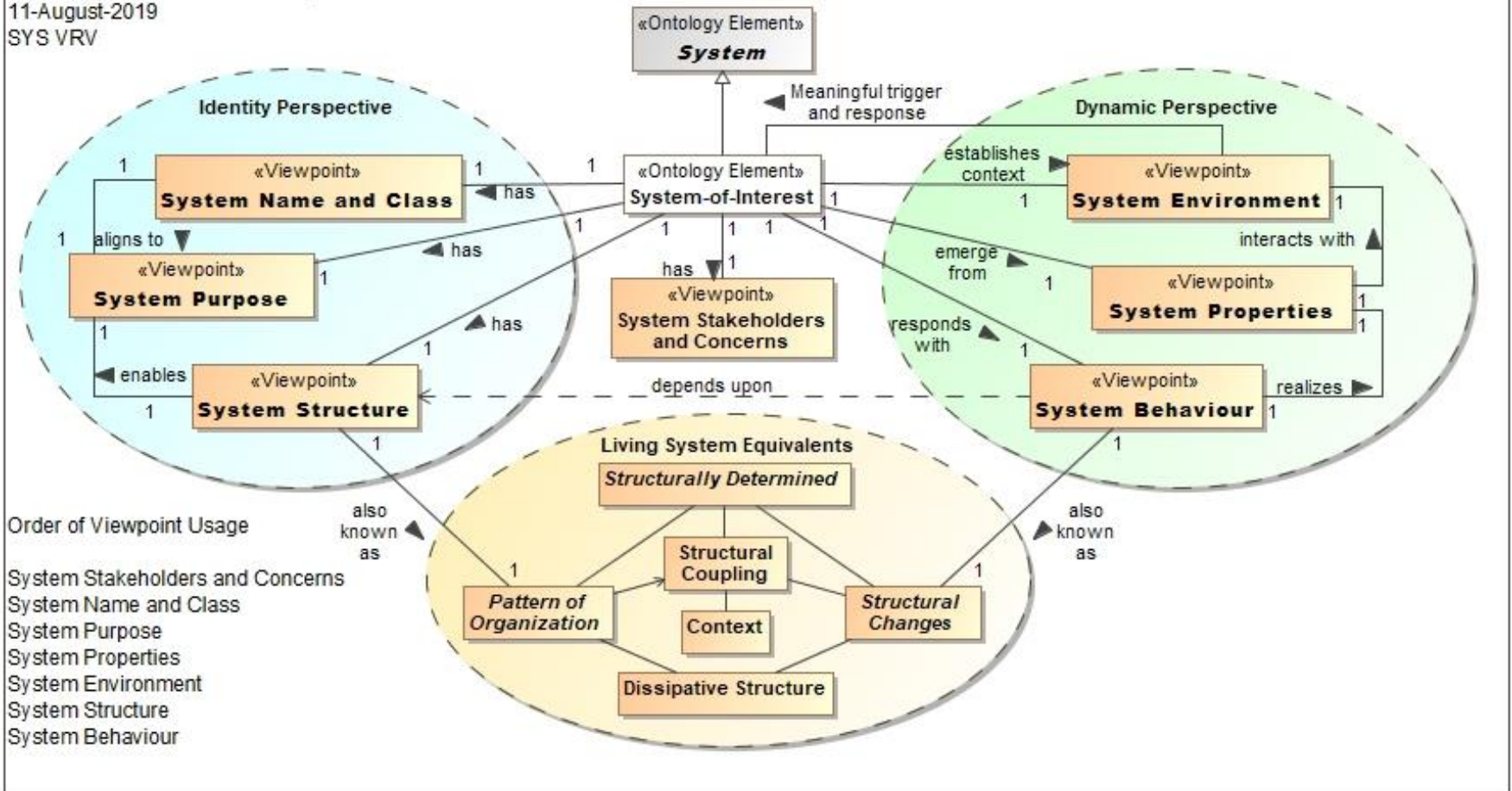
★ **System Description**

  → A description of each of the perspectives of a system-of-interest according to the ontology / concepts for a abstract system.

  → There are stakeholders that have concerns about the system-of-interest

  → This enabled me to create a design of a Architecture Framework using the CAFF (FAF) for a System-of-Interest.

  → The result of using the System Architecture Framework is a System Description.

Abstract System ODV

System VRV

View: Viewpoint Relationships
System-of-Interest situated in its environment

Enterprise as a System of Systems

★ **System-of-Interest: Enterprise as a System of Systems**

  ➔ **ISO 15704:2000: Enterprise:** one or more organisations sharing a definite mission, goals, and objectives to offer an output such as a product or service
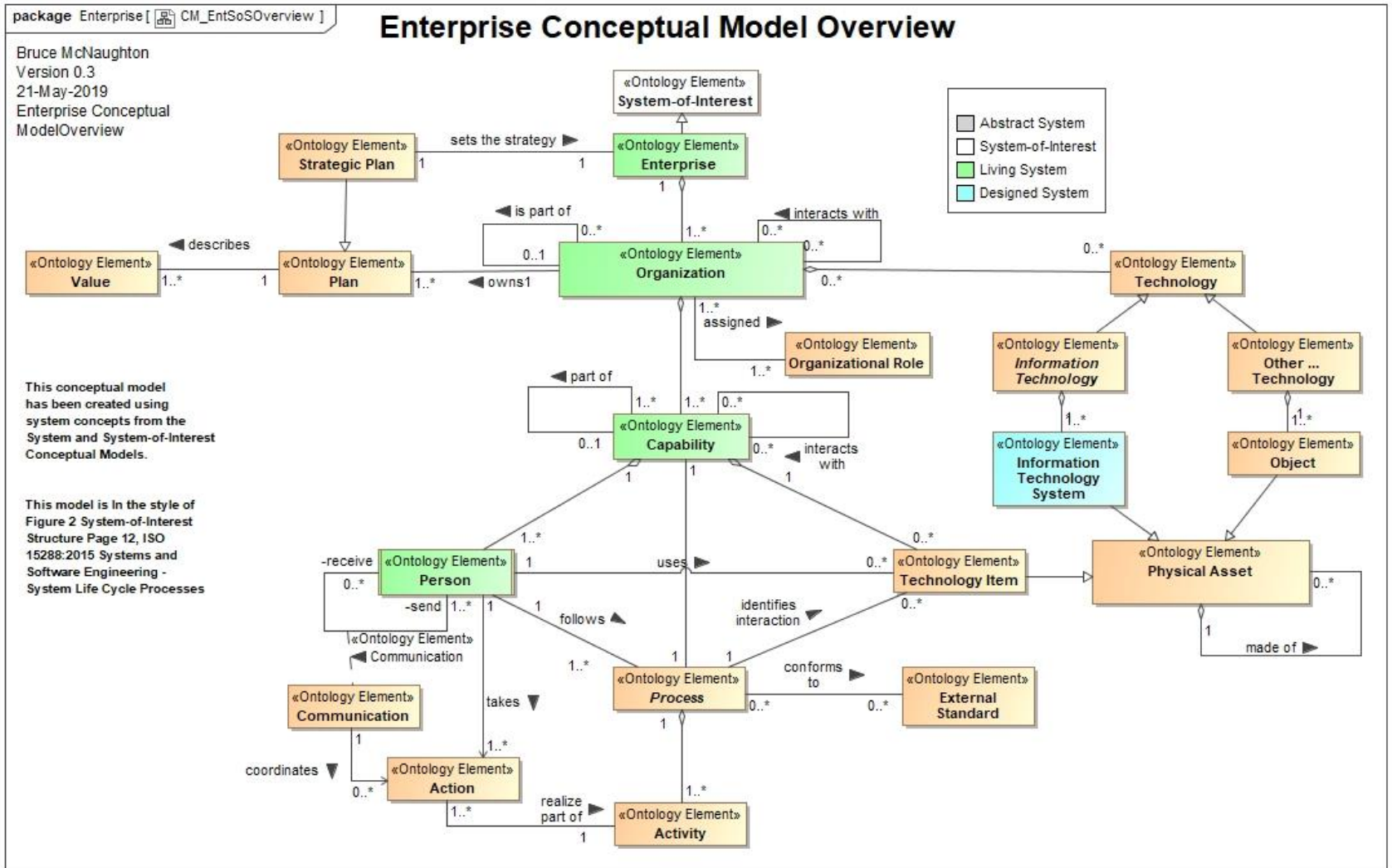
★ **Using the CAFF**

  ➔ Created an Enterprise (SoS) Architecture Framework Definition

  ➔ Including Stakeholders and Concerns
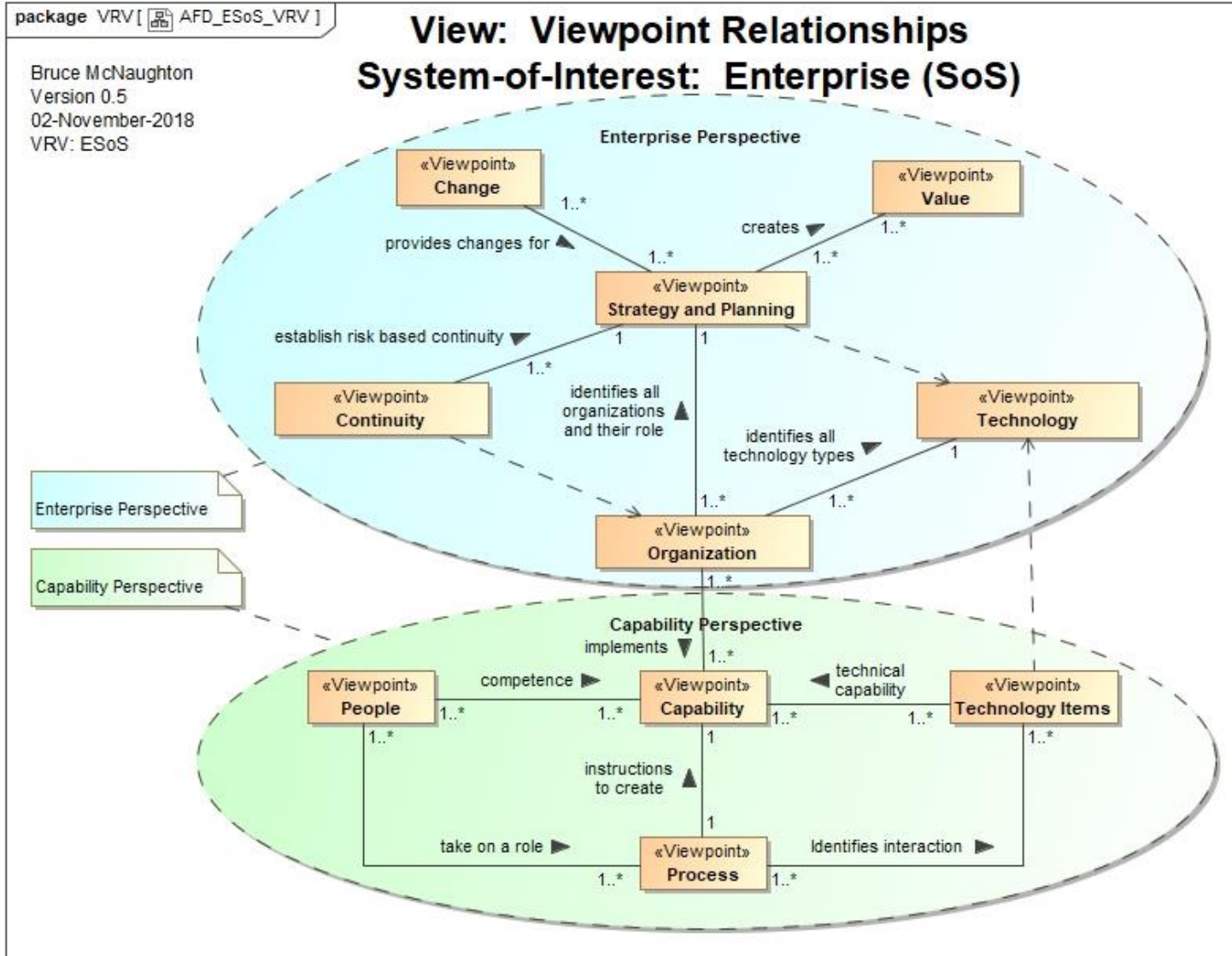
  ➔ Design of the Viewpoints

★ **Created an Architecture Framework using AFD**

  ➔ Created architecture framework using ISO 42010:2011 based upon the viewpoints identified in the AFD.

  ➔ Created Viewpoints and Model kinds (prototype).

Enterprise as a SoS ODV

Enterprise Conceptual Model Overview

Enterprise as a SoS VRV

CAFF Learning

★ **Clear identification of System-of-Interest**
  ➜ At any level of the hierarchy
  ➜ Described in a consistent way.

★ **Ontology (Conceptual Model)**
  ➜ Absolutely critical for the system-of-interest domain
  ➜ Discipline of only using concepts in AF from ODV.
  ➜ Tested through Stakeholders and their concerns.

★ **System Descriptions**
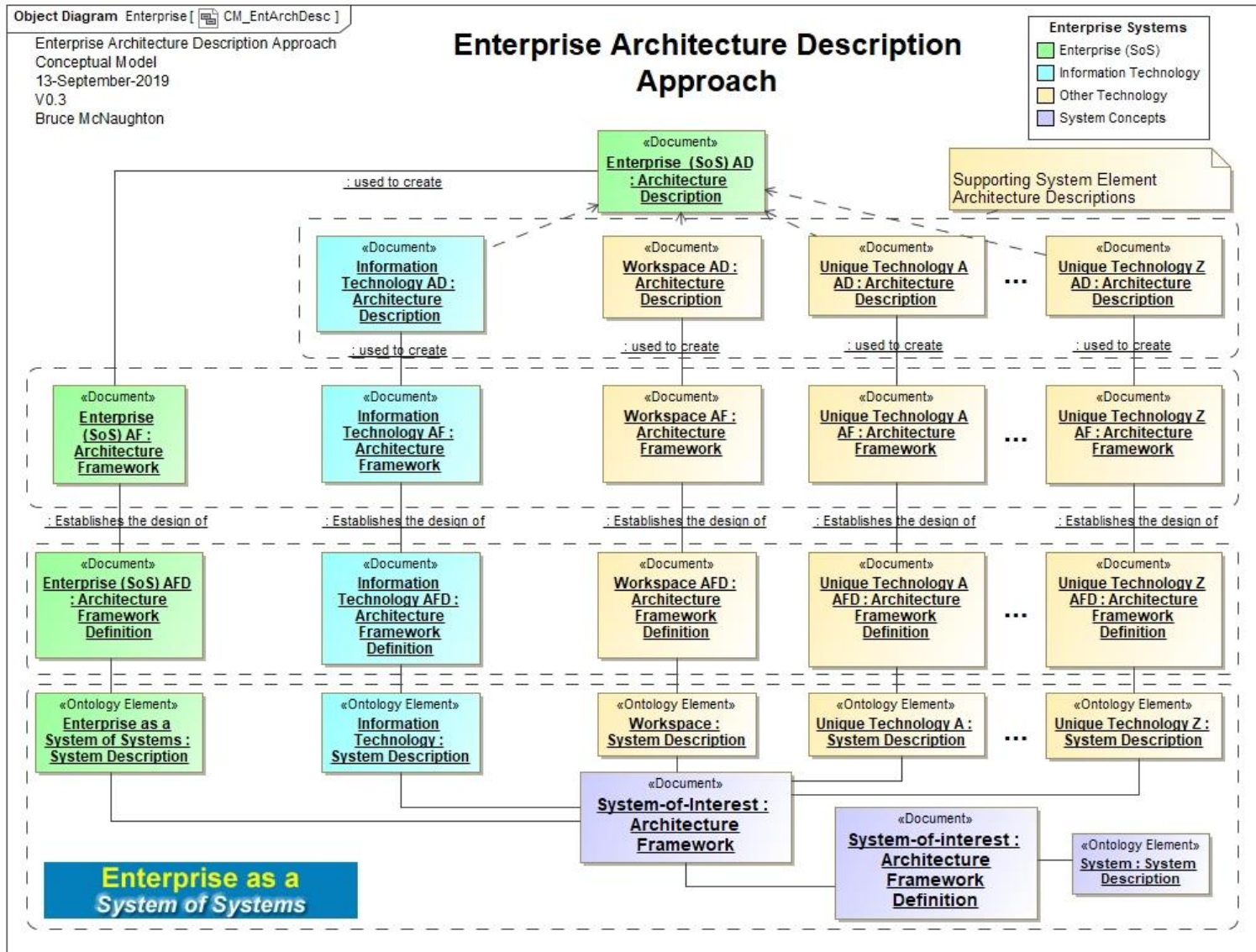 ➜ **Key to establishing the Ontology for a System-of-Interest**

★ **Viewpoint Identification**
  ➜ Based upon stakeholders and their concerns.
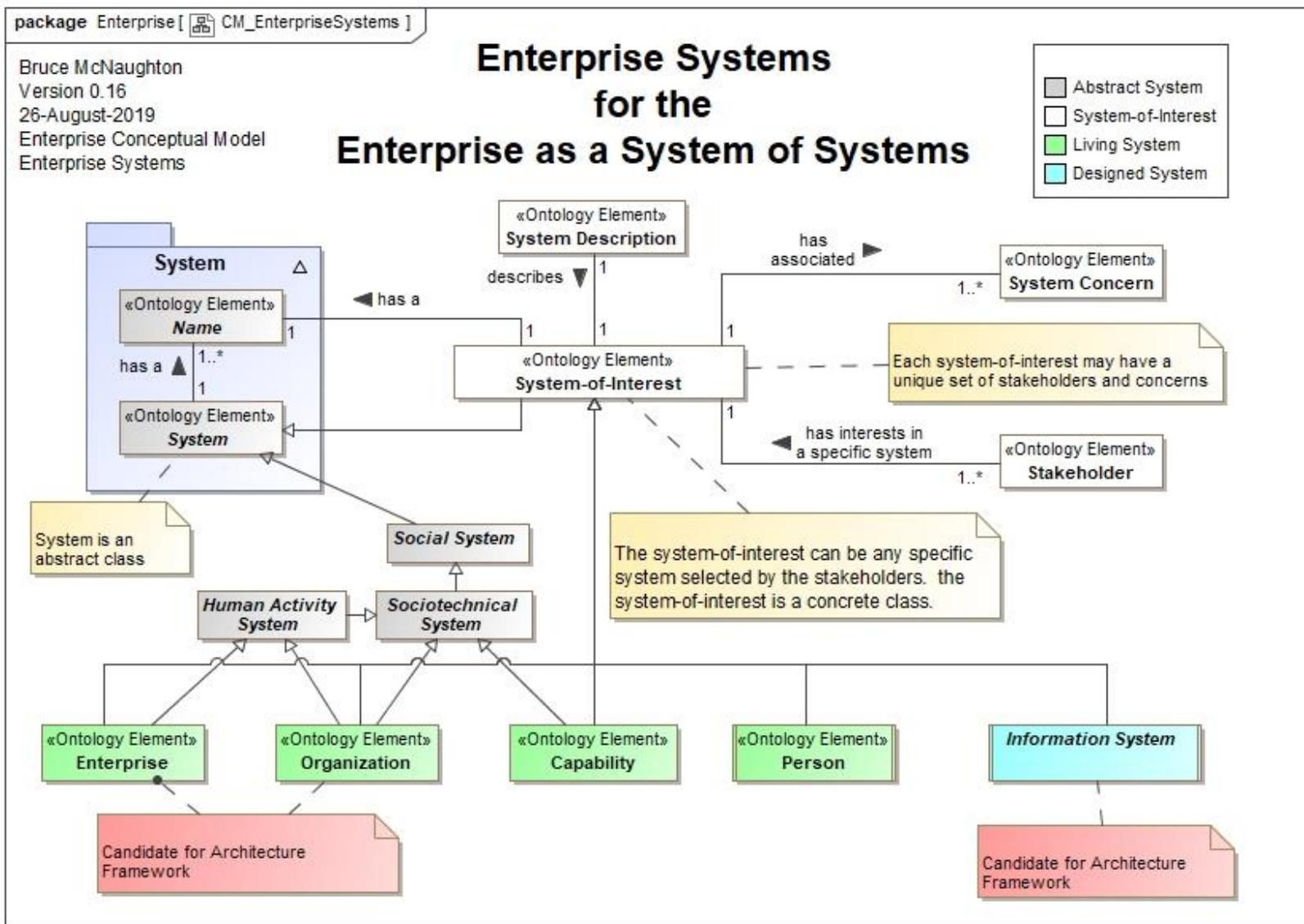
★ **Multiple Architecture Frameworks**
  ➜ Uncouple system-of-interest ontology domains.
  ➜ Easy to design and build an architecture framework using the CAFF
  ➜ Architecture Frameworks (as a process) promote reuse, consistent architecture descriptions and product line development

Enterprise Architecture Frameworks

Identifying Architecture Frameworks.

Use of the CAFF / System Description
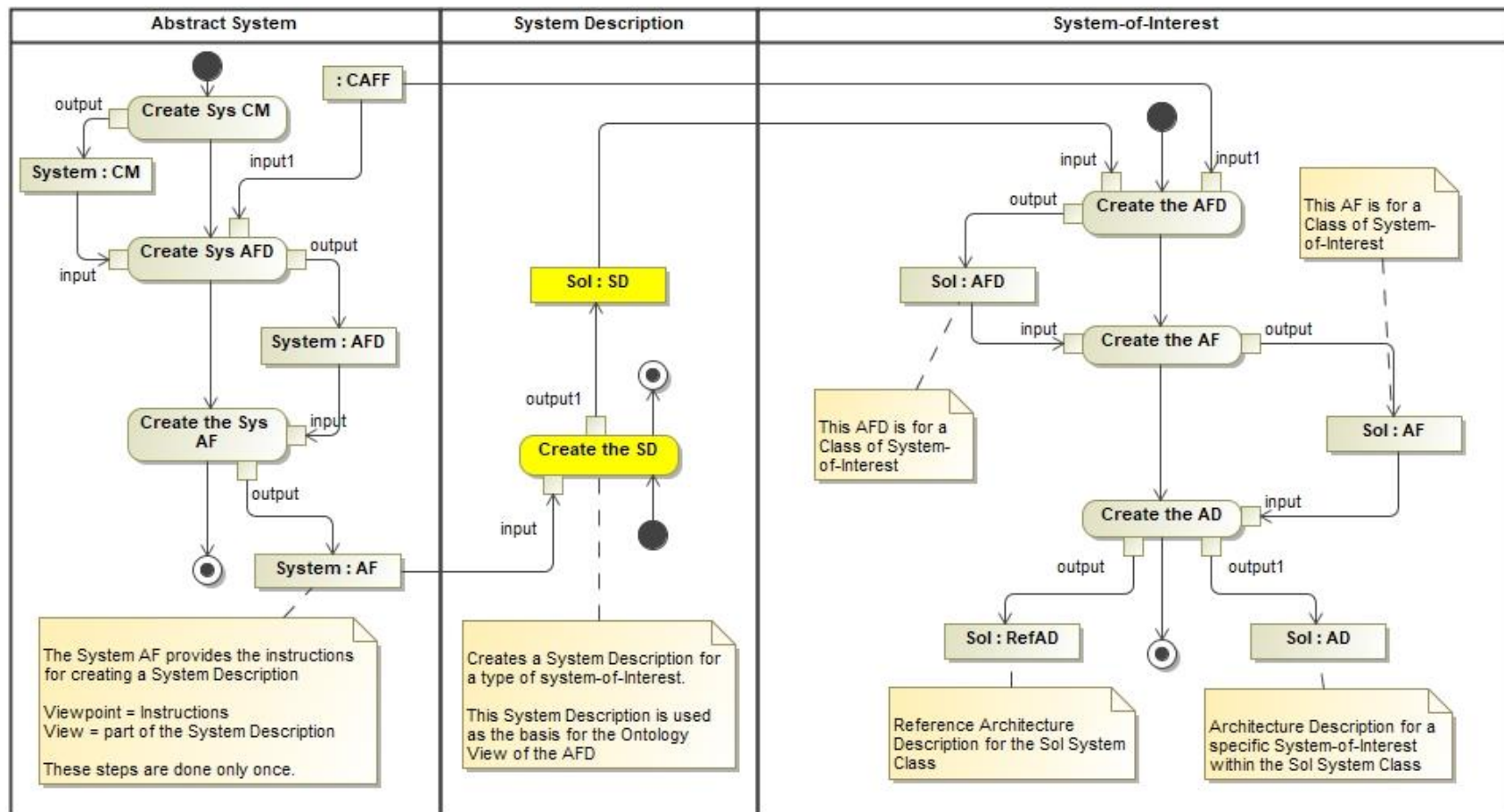
Conclusion

★ **People**

- → **This work is best done in workshops with real people co-creating the models.**

- → **We need more examples of good Architecture Frameworks focused on a well defined system-of-interest used in a life cycle.**

- → **I understand Management Principle 1**

★ **Approach / Process**

- → **System Descriptions for a system-of-interest are very important to establish a coherent system understanding.**

- → **The ODV and VRV capture the essence of the system-of-interest.**

- → **ISO 42010:2011 is great – if you use the CAFF as the process to design the Architecture Framework.**

Questions..

* **People**
  - → Value from this process?
  - → Perception of work involved?
  - → How to engage stakeholders?
  - → Or just too much information..

* **Approach / Process**
  - → Architecture Framework?
  - → FAF and CAFF?
  - → Ontology? Conceptual Models?

* **System-of-Interest**
  - → System Description for System-of-Interest
  - → Enterprise
  - → Living Systems
  - → Other: Airline or F1

Thank you.

✦ **Content**

➔ Very happy to share further

✦ **Contact Information**

➔ bruce.mcnaughton@change-aide.com

✦ Websites to see the prototype

➔ http://eaasos.info

➔ http://sysaf.eaasos.info

➔ http://entsosaf.eaasos.info
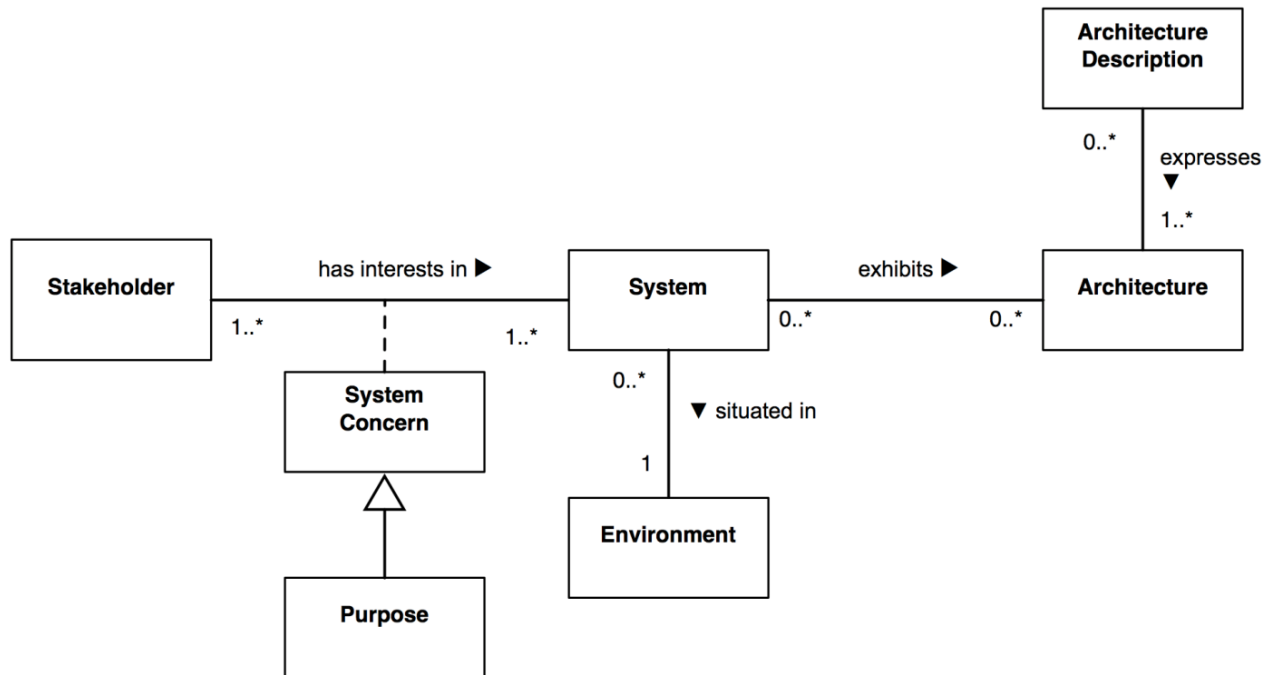
Enterprise as a System of Systems

ISO 42010 Architecture Description

★ **Architecture**

➔ *"fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution".*

➔ *For a system of interest to you, the Standard provides guidance for documenting an architecture for that system.*

15288:2015 Early Process Outcomes

activity CM_ISO15288_ConceptEarlyProcess [CM_ISO15288_ConceptEarlyProcess]

	6.4.1 Business or Mission Analysis	6.4.2 Stakeholder Needs and Requirements definition	6.4.3 System Requirements Definition	6.4.4 Architecture Definition	6.4.5 Design Definition	6.4.6 System Analysis
Stakeholders	Problem or opportunity space defined; Preliminary Operational Concepts Defined	Stakeholders Identified; Stakeholders Needs Defined; Needs prioritized and down-selected; Context of Use Defined; Scenarios Defined and Operational Concepts Refined		Additional stakeholders and concerns identified.		System analyses needed are identified
Requirements		Constraints on the System Defined; Stakeholder Requirements Defined	System Requirements and Rationale Defined	Key requirements aligned to design characteristics		
System-of-Interest	Solution Space Characterized; Alternative Solution Classes Defined	Initial definition of the Boundaries and Structure of the system; Critical Performance Measures Defined; Purpose and System Objectives; Initial non-functional capabilities; Required Capabilities	Critical Performance Measures Refined; Implementation Constraints Defined; Initial System Description, including Context, Interfaces, Boundaries, Properties for the Solution defined.	Architectural viewpoints developed; System context, boundaries, external interfaces defined; System views and Models developed; Key aspects significant to key system architecture decisions allocated to architectural entities; Architectural candidates assessed; architectural basis for processes throughout life cycle is achieved	System requirements are allocated to system elements.	System analysis assumptions and results are validated; System analysis results are provided for decisions.
System Elements				System elements and Interfaces identified; Alignment of architecture with requirements and design characteristics achieved.	Architecture governance approach realized; Architecture traceability maintained; Design Characteristics of each system element are defined; Design enablers necessary for design definition are selected or defined; Interfaces between system elements are defined or refined.; Design alternatives for system elements are assessed (NDI - COTS, or New or modified); Design artifacts are developed	

Operational Concepts, Requirements, Stakeholders, System-of-interest and System Elements developed in parallel in the life cycle.