System Description (SDSF)

Structuring Formalism

Abstract

A Structuring Formalism provides a way to organize and gain insights from AD Elements for a system-of-interest Architecture Description Framework (System-of-Interest ADF). This Structuring Formalism uses a two step approach aligned to the early life cycle processes found in ISO 15288:2015. These steps are to create:

- A System Description that captures the basic structure, behaviour and properties of a system-of-interest to establish a common language and understanding within the team.
- A System-of-Interest ADF that provides stakeholders with specific viewpoints and views of the system-of-interest based upon a whole system understanding of the system-of-interest.

The System Description is created using a SysDesc ADF that allows the System Description to be considered as an AD Element in the scope of the SysDesc ADF. This allows correspondences to be identified that promote re-use of AD Elements across a wider set of system-of-interests.

The concept of a System Description is used as the basis for this Structuring Formalism: System Description (SDSF). This document contains a description of the System Description (SDSF) that is used to gain insights about the AD Elements (including other System Descriptions) to structure the System-of-Interest ADF. This Structuring Formalism contains the following:

- A conceptual model of the Structuring Formalism: System Description (SDSF) used to organize and gain insight from the AD Elements for the System-of-Interest ADF.
- The various steps for creating and using System Descriptions when gaining insight and enhancing reuse of the AD Elements .
- The Structural Categories that allow sharing and reuse of AD Elements using correspondences.
- Various links to examples and results from using the two step approach.
- The types of benefits that can be achieved using the System Description as an AD Element.

PDF: Structuring Formalism: System Description (SDSF), Version 0.4, 07-February-2023

used to create System Descriptions and related System-of-Interest ADF:

Link to the System Description Architecture Description Framework

and the example Enterprise (SoS) Architecture Description Framework

Link to the Enterprise (SoS) Architecture Description Framework

Author and Version

Bruce McNaughton Version 0.4, 07-February-2023

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Re-Creating the Corporation, Russell Ackoff 18
The Compass Project, The Compass Club 18

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Revision History

V0.4 07-February-2023 restructure the abstract and introduction to provide a better context for the System Description (SDSF).

V0.3 27-January-2023 Add Conceptual Model of SDSF, add System Classification Framework and rework process to apply SDSF

V0.2 18-January-2023 included SBS into SD creation in Structuring Formalism.

V0.1 16-January-2023 Update references to CAFF, Add correspondence to SC.

V0.0 15-January-2023 Initial draft as full SD SF

Structuring Formalism: System Description (SDSF)

A Structuring Formalism provides a way to organize and gain insights from AD Elements for a system-of-interest Architecture Description Framework (System-of-Interest ADF). This Structuring Formalism uses a two step approach aligned to the early life cycle processes found in ISO 15288:2015. These steps are to create:

- A System Description that captures the basic structure, behaviour and properties of a system-of-interest to establish a common language and understanding within the team.
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The concept of a System Description is used as the basis for this Structuring Formalism: System Description (SDSF). This document contains a description of the System Description (SDSF) that is used to gain insights about the AD Elements (including other System Descriptions) to structure the System-of-Interest ADF. This Structuring Formalism contains the following:

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- The various steps for creating and using System Descriptions when gaining insight and enhancing reuse of the AD Elements .
- The Structural Categories that allow sharing and reuse of AD Elements using correspondences.
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PDF: Structuring Formalism: System Description (SDSF), Version 0.4, 07-February-2023

used to create System Descriptions and related System-of-Interest ADF:

Link to the System Description Architecture Description Framework

and the example Enterprise (SoS) Architecture Description Framework

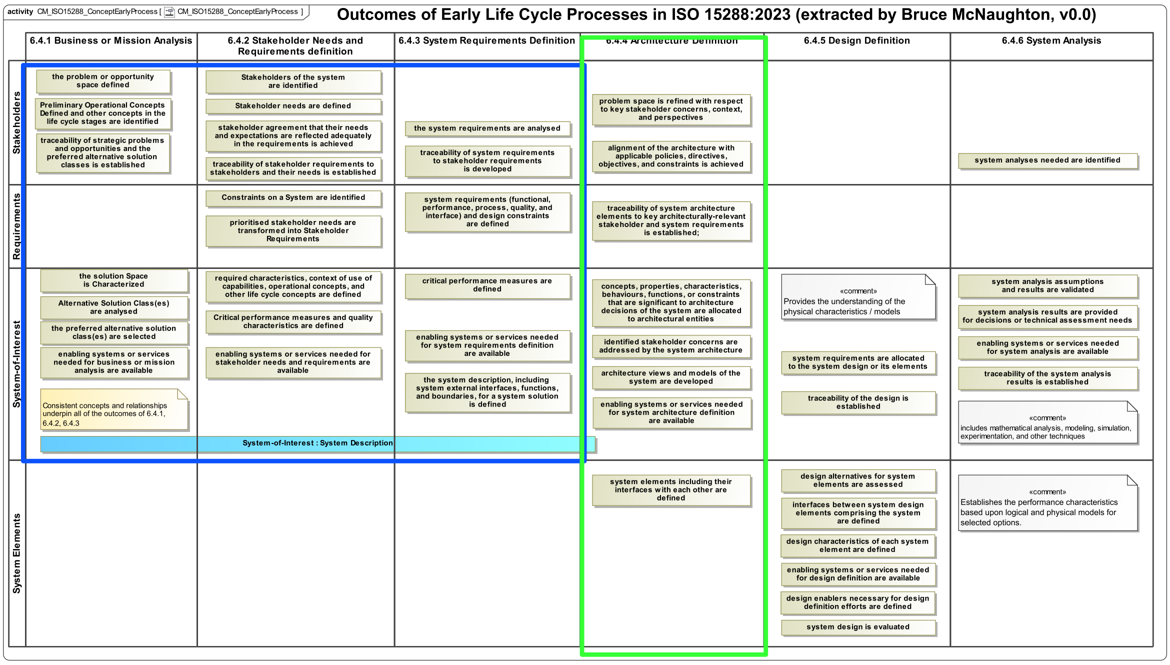
Link to the Enterprise (SoS) Architecture Description Framework

Context: Fit within the early ISO 15288:2015 life cycle processes

This System Description (SDSF) is used within the context of the life cycle of a system-of-interest identified in ISO 15288:2015. The early technical processes of the life cycle provide an opportunity to engage stakeholders about their concerns and needs for the system-of-interest. Establishing a common language and vision require conversations and co-creation of information. This can be seen as a two step process:

- Shaping the system-of-interest using a System Description (6.4.1, 6.4.2, 6.4.3) Blue Rectangle
- Creating the system-of-interest Architecture Description Framework based upon the system-of-interest System Description (6.4.4) Green Rectangle

The following picture shows the two areas where these conversations can occur:



activity CM_ISO15288_ConceptEarlyProcess [CM_ISO15288_ConceptEarlyProcess]

Outcomes of Early Life Cycle Processes in ISO 15288:2023 (extracted by Bruce McNaughton, v0.0)

	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	the problem or opportunity space defined Preliminary Operational Concepts Defined and other concepts in the life cycle stages are identified traceability of strategic problems and opportunities and the preferred alternative solution classes is established	Stakeholders of the system are identified Stakeholder needs are defined stakeholder agreement that their needs and expectations are reflected adequately in the requirements is achieved traceability of stakeholder requirements to stakeholders and their needs is established	the system requirements are analysed traceability of system requirements to stakeholder requirements is developed	problem space is refined with respect to key stakeholder concerns, context, and perspectives alignment of the architecture with applicable policies, directives, objectives, and constraints is achieved		system analyses needed are identified
Requirements		Constraints on a System are identified prioritised stakeholder needs are transformed into Stakeholder Requirements	system requirements (functional, performance, process, quality, and interface) and design constraints are defined	traceability of system architecture elements to key architecturally-relevant stakeholder and system requirements is established;		
System-of-Interest	the solution Space is Characterized Alternative Solution Class(es) are analysed the preferred alternative solution class(es) are selected enabling systems or services needed for business or mission analysis are available Consistent concepts and relationships underpin all of the outcomes of 6.4.1, 6.4.2, 6.4.3 System-of-Interest : System Description	required characteristics, context of use of capabilities, operational concepts, and other life cycle concepts are defined Critical performance measures and quality characteristics are defined enabling systems or services needed for stakeholder needs and requirements are available	critical performance measures are defined enabling systems or services needed for system requirements definition are available the system description, including system external interfaces, functions, and boundaries, for a system solution is defined	concepts, properties, characteristics, behaviours, functions, or constraints that are significant to architecture decisions of the system are allocated to architectural entities identified stakeholder concerns are addressed by the system architecture architecture views and models of the system are developed enabling systems or services needed for system architecture definition are available	«comment» Provides the understanding of the physical characteristics / models system requirements are allocated to the system design or its elements traceability of the design is established	system analysis assumptions and results are validated system analysis results are provided for decisions or technical assessment needs enabling systems or services needed for system analysis are available traceability of the system analysis results is established «comment» includes mathematical analysis, modeling, simulation, experimentation, and other techniques
System Elements				system elements including their interfaces with each other are defined	design alternatives for system elements are assessed interfaces between system design elements comprising the system are defined design characteristics of each system element are defined enabling systems or services needed for design definition are available design enablers necessary for design definition efforts are defined system design is evaluated	«comment» Establishes the performance characteristics based upon logical and physical models for selected options.

Shaping the system-of-interest (Blue Rectangle)

The first three processes (6.4.1, 6.4.2, and 6.4.3) build an understanding of the system-of-interest through identifying stakeholders and their needs and concerns, identifying stakeholder and system requirements and understanding the language (Ontology) and structure, behavior and system properties (capabilities) of the system-of-interest. The system-of-interest row (third row from the top) co-creates an understanding of the whole system through the creation of a System Description. The system engineering role or the system architect role is generally working to build this understanding across the team. One of the outcomes from the process 6.4.3 System Requirements Definition is a System Description. This step is similar to the process "Architecture Conceptualization" in ISO 42020:2019. The System Description is created using the SysDesc ADF as an Architecture Description.

Also during this period, insights can be gained through the identification and reuse of other system descriptions. This reuse is captured through correspondences across the various AD Elements, including other System Descriptions.

Creating the system-of-interest Architecture Description Framework (Green Rectangle)

The System-of-Interest ADF provides viewpoints and views that address the full set of stakeholders and their concerns based upon the system description created in 6.4.3. The System Description provides a strong foundation for the creation of the additional AD elements needed for the System-of-Interest ADF. This step is very similar to the "Architecture Elaboration" process in ISO 42020:2019.

The insights gained from the System Description through identification of correspondences provides a way of reusing AD Elements across other Architecture Description Frameworks, such as viewpoints, model kinds, ADLs, etc.

This System Description (SDSF) Document

The Structuring Formalism consists of three key parts:

- The conceptual model of the System Description (SDSF)
- The approach to creating a SoI ADF based on the System Description (SDSF)
- The System Classification Framework for identification and use of existing systems and system descriptions.

Each of these parts are described in this System Description (SDSF).

Conceptual Model: System Description (SDSF)

ISO 42010:2022 identifies the following new concepts:

- Structuring Formalism
- Structural Categories
- Aspects

This System Description (SDSF) Structuring Formalism is building on these concepts to provide more flexibility in identifying and developing system architecture descriptions and promote reuse of Architecture Description Elements across a full range of system-of-interest types.

Structuring Formalism

The purpose of a Structuring Formalism is:

- "to provide ways of representing relationships among various elements of the architecture and enhancing opportunities for analysis of interactions among those elements."

The Structuring Formalism focuses on the structural categories (SCs) and key relationships among those SCs.

1. SCs are drawn from the types of AD Elements (ADEs) specified by the framework.
2. Relationships can be represented using Correspondences to relate those elements.

Structural Categories

Structural Categories are equated to "dimensions" of a framework. An ADF defines structural categories used in the structuring formalism. These categories result from correspondence methods that group AD elements into meaningful configurations for presentation, analysis, and management of the AD for the system-of-interest.

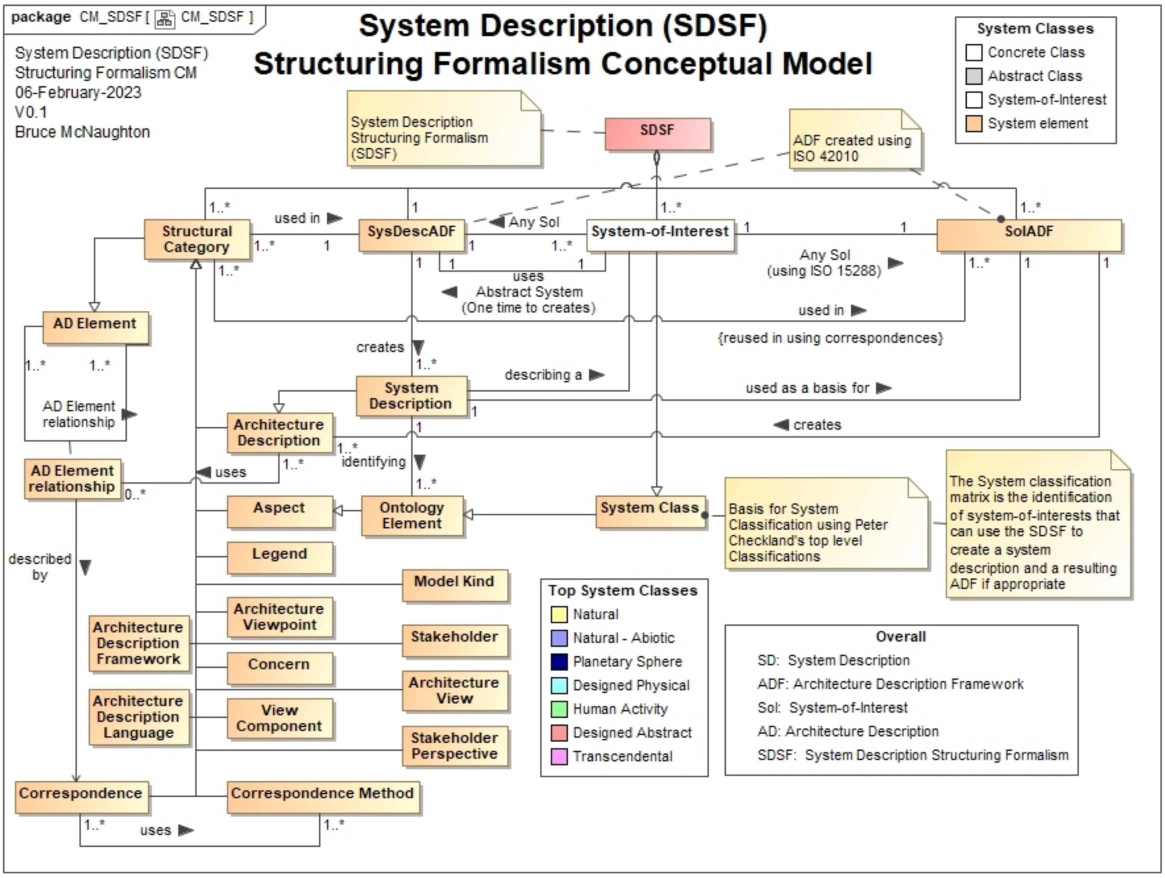
Aspect

3.9 part of an entity's character or nature (from ISO 42010:2022)

NOTE: in this structuring formalism, an entity is a system-of-interest or system to align with ISO 15288:2015 system concepts.

System Description (SDSF) Conceptual Model

The System Description (SDSF) conceptual model is shown in the following diagram:



In this System Description (SDSF), the SysDesc ADF creates a System Description that includes a number of AD Elements that can be used in correspondences across a set of System Descriptions for associated system-of-interests. These are:

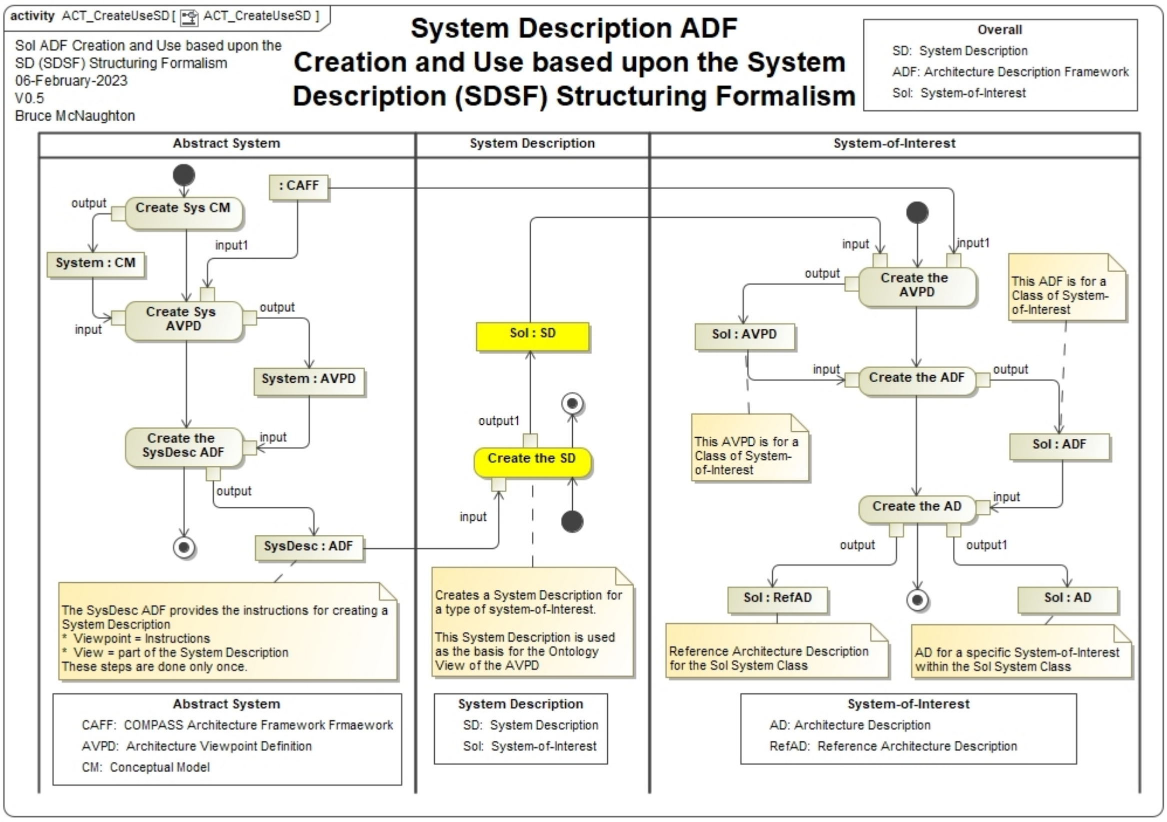
- System Description is a type of Architecture Description
- Ontology Elements (system-of-interest concepts) are a type of Aspect

This provides flexibility for reusing many types of AD Elements across many types of system-of-interests.

The **System Class** Ontology element provides a way to identify and type systems within a System Classification Framework. This allows for integration across types of systems and within system types.

Apply and Use: System Description (SDSF)

The application of the SDSF is based upon the creation and use of a System Description. This process is shown in the following diagram:


activity ACT_CreateUseSD [ACT_CreateUseSD]
SoI ADF Creation and Use based upon the SD (SDSF) Structuring Formalism
06-February-2023
V0.5
Bruce McNaughton
System Description ADF
Creation and Use based upon the System Description (SDSF) Structuring Formalism
Overall
SD: System Description
ADF: Architecture Description Framework
SoI: System-of-Interest
Abstract System
System Description
System-of-Interest
: CAFF
output
Create Sys CM
System : CM
input1
input
Create Sys AVPD
output
System : AVPD
Create the SysDesc ADF
input
output
SysDesc : ADF
The SysDesc ADF provides the instructions for creating a System Description
* Viewpoint = Instructions
* View = part of the System Description
These steps are done only once.
Abstract System
CAFF: COMPASS Architecture Framework Frmaework
AVPD: Architecture Viewpoint Definition
CM: Conceptual Model
SoI : SD
output1
Create the SD
input
Creates a System Description for a type of system-of-interest.
This System Description is used as the basis for the Ontology View of the AVPD
System Description
SD: System Description
SoI: System-of-Interest
input
input1
output
Create the AVPD
This ADF is for a Class of System-of-Interest
SoI : AVPD
input
Create the ADF
output
This AVPD is for a Class of System-of-Interest
SoI : ADF
Create the AD
input
output
output1
SoI : RefAD
SoI : AD
Reference Architecture Description for the SoI System Class
AD for a specific System-of-Interest within the SoI System Class
System-of-Interest
AD: Architecture Description
RefAD: Reference Architecture Description

This diagram shows three distinct areas of use for the System Description SDSF.

- The creation of a System Description Architecture Description Framework (One Time)
- The creation of a System Description for a system-of-interest.
- The creation of an Architecture Description Framework to create Architecture Descriptions for the system-of-interest.

PDF: Structuring Formalism: System Description (SDSF), Version 0.4, 07-February-2023

Correspondences

Correspondences can also be created or used to establish relationships across the various Architecture Description Elements. The SysDesc ADF Correspondence Section provides the primary source for finding existing correspondences and correspondence methods. The existing correspondences should be checked and if appropriate correspondences are found, these should be used before creating new correspondences and correspondence methods. These correspondences can also be used to connect across the systems within a System Breakdown Structure and across System Breakdown Structures in other systems (or related system descriptions).

Link to the SysDesc ADF Correspondences

Create the SysDesc ADF (One Time)

To create the System Description Architecture Description Framework, the system-of-interest is the System (Abstract System) Conceptual Model as an agreed named Thing. The stakeholders will be the members of the early processes in ISO 15288:2015 including System Engineers, System Architects, Team leaders (System Elements), System Dynamics modellers, etc. The concerns relate to seeing a whole system-of-interest from a number of viewpoints / views. This whole system view establishes the following:

- Consistent naming of aspects of the system (ontology elements).
- Consistent understanding of the system name / class and purpose.
- Consistent understanding of the environment and boundaries of the System (Abstract)

- Consistent understanding of the system properties, system structure (pattern of organization) and system behavior (structural changes).

The steps to create an Architecture Description Framework for a system-of-interest are as follows:

- Identify the system-of-interest
- Create the work product Architecture Viewpoint Definition (AVPD) for the system-of-interest to define the viewpoints.
    - Identify the context: Stakeholders and Purpose
    - Create the Ontology Definition View using one of the following:
        - The Conceptual Model of the system-of-interest created for the system-of-interest (See Abstract System CM)
        - or use elements from or reference the System Description for the System-of-interest as the basis for the Ontology Definition View.
    - The Viewpoint Relationships View: All of the Viewpoints
    - Each Viewpoint definition
    - Correspondences
    - Rationale
- Create all of the other AD elements for the Architecture Description Framework
- Create an Architecture Description to test the SoI ADF

System-of-Interest

The system-of-interest for the System ADF is an Abstract System.

Architecture Viewpoint Definition (AVPD)

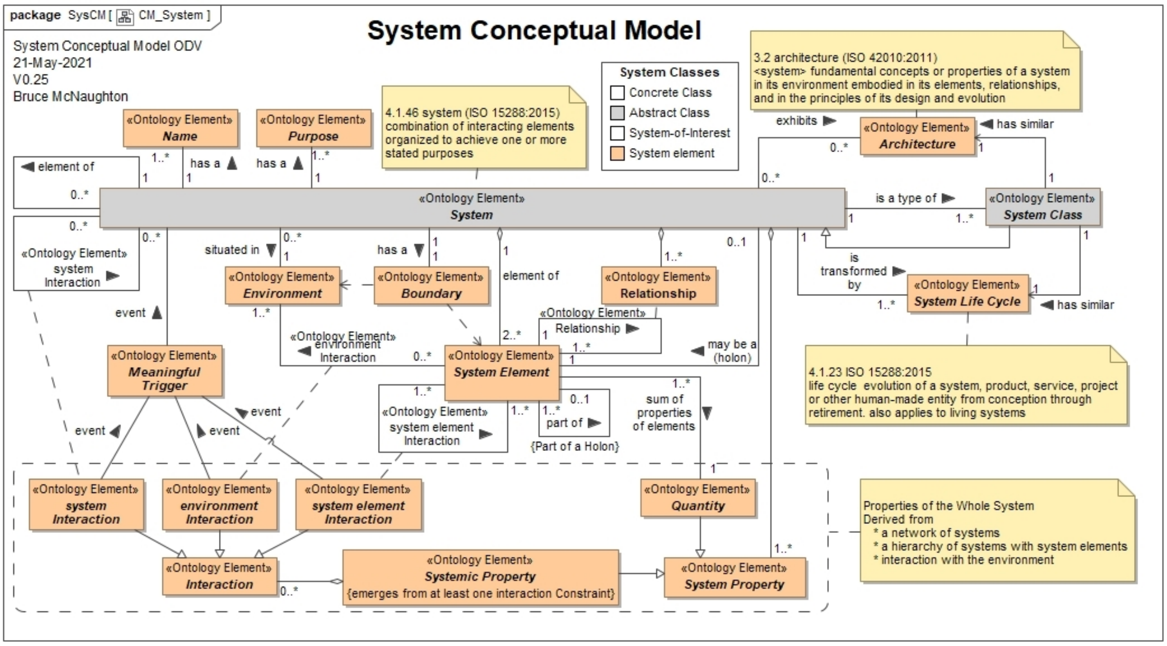
The steps are clear in the CAFF to create the System (Abstract) AVPD work product. The work product is available within the SysDesc ADF.

Link to the System (Abstract) Architecture Viewpoint Definition

See guidance is available to use the CAFF to create the System (Abstract) AVPD.

Link to System (Abstract) AVPD PDF

The conceptual model for the abstract system is shown below is a key part of the Ontology Definition View (ODV) for the SysDesc ADF:


package SysCM [CM_System]
System Conceptual Model
System Conceptual Model ODV
21-May-2021
V0.25
Bruce McNaughton
System Classes
Concrete Class
Abstract Class
System-of-Interest
System element
«Ontology Element» Name
«Ontology Element» Purpose
«Ontology Element» System
«Ontology Element» Architecture
«Ontology Element» System Class
«Ontology Element» System Life Cycle
«Ontology Element» Environment
«Ontology Element» Boundary
«Ontology Element» Relationship
«Ontology Element» System Element
«Ontology Element» Meaningful Trigger
«Ontology Element» system Interaction
«Ontology Element» environment Interaction
«Ontology Element» system element Interaction
«Ontology Element» Relationship
«Ontology Element» Quantity
«Ontology Element» Interaction
«Ontology Element» Systemic Property {emerges from at least one interaction Constraint}
«Ontology Element» System Property
element of
has a
has a
exhibits
has similar
is a type of
is transformed by
has similar
situated in
has a
element of
may be a (holon)
sum of properties of elements
part of
{Part of a Holon}
event
event
event
event
1..*
1
0..*
0..1
2..*

3.2 architecture (ISO 42010:2011)
<system> fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution

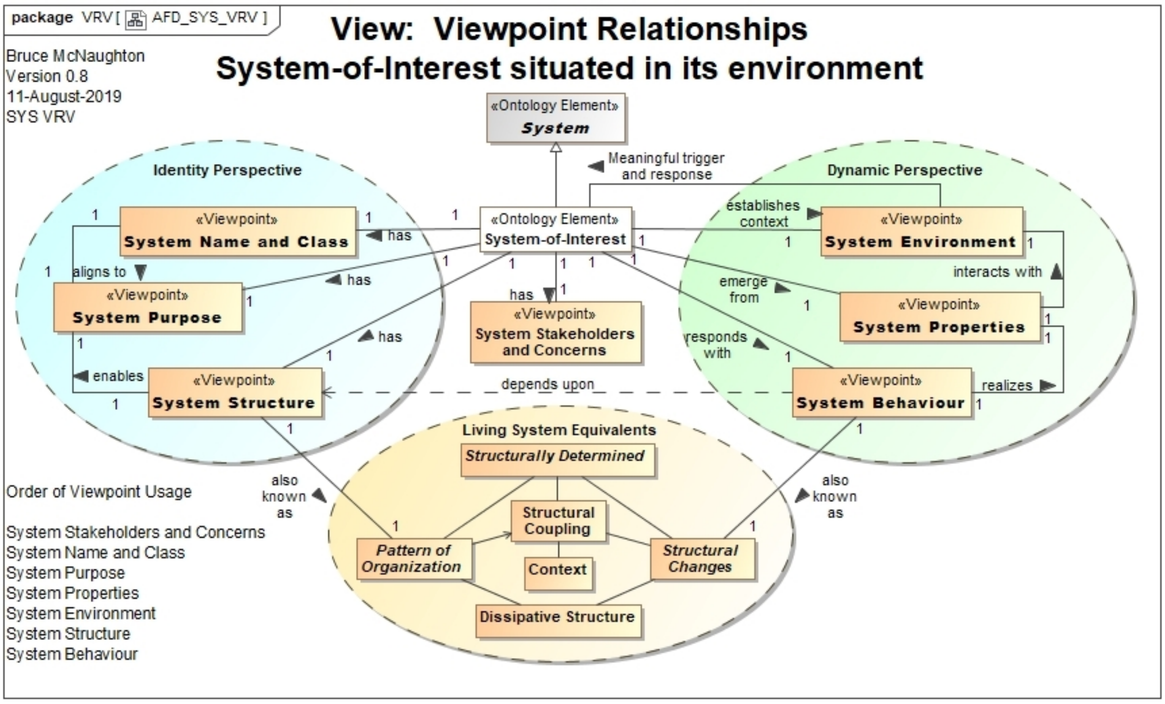
4.1.46 system (ISO 15288:2015)
combination of interacting elements organized to achieve one or more stated purposes

4.1.23 ISO 15288:2015
life cycle evolution of a system, product, service, project or other human-made entity from conception through retirement. also applies to living systems

Properties of the Whole System
Derived from
* a network of systems
* a hierarchy of systems with system elements
* interaction with the environment

The actual ODV uses 3 Conceptual Models (Abstract System, System Properties, System-of-Interest).

The resulting viewpoints are derived from the various conceptual models. For example, the following identifies the key viewpoints in the Viewpoint Relationship View:



The viewpoints and model kinds were then developed to create the SysDesc ADF according to ISO 42010:2022.

The final step is to produce a system [architecture] description for the Abstract System using the SysDesc ADF. The following are links to the work products that have been created.

Please see the following Links for the System Description: *System (Abstract)*.

- PDF: System Description: System (Abstract), Version 0.30, 27-December-2023 (working draft)
- Link to the System Description Architecture Description Framework
- Link to the System (Abstract) Architecture Viewpoint Definition
- PDF: Structuring Formalism: System Description (SDSF), Version 0.4, 07-February-2023
- Website: sysdesc.info: System

The System Description includes the following sections representing views of the system-of-interest:

- System Name and Class
- System Purpose
- System Properties
- System Stakeholders and their concerns
- System Environment (Context)
- System Structure (Pattern of Organization)
- System Behavior (Structural Changes)
- Correspondences
- Decisions and Rationale
- References

The following links help create a System Description

- Link to the System Description Template
- Link to the System Description Validation Template

The following are links to the COMPASS Project and the CAFF:

- Link to D21.5b Compass Architectural Framework Framework (Local): CAFF Viewpoint Definitions

Correspondences

The SysDesc ADF is the primary Architecture Description Framework applicable to the System Description. This SysDesc ADF includes a set of correspondence methods that are available to use when creating a System Description. The latest set of correspondence methods can be seen at the link below:

Link to the SysDesc ADF Correspondences

Create a System Description for a System-of-Interest

Create a System Description for any system-of-interest

Once the SysDesc ADF is available, a System Description can be created for any system-of-interest using the SysDesc ADF. This System Description provides coherent and consistent views of the system which can then be used to:

- build a shared understanding of the system-of-interest across the set of stakeholders
- establish a common language for describing the system-of-interest
- classify the system-of-interest in a wider classification framework based upon a base classifier of the system-of-interest
- identify areas from other system descriptions that can be reused or refined to achieve consistency across a wider set of systems
- use in the creation of an Architecture Description Framework for this class of systems

The following are the steps to create a System Description:

NOTE: The **viewpoint** provides the instructions for creating a **view**. These tend to be linked directly from the header in the template.

- Identify the **system-of-interest** for the System Description
- Create or use a **template** with the headers pointing back to the viewpoints in the SysDesc ADF.
- Identify the **stakeholders and their concerns** View
- Identify the **name and class** View for the system-of-interest
- Identify the **purpose** of the system-of-interest
- Identify the **environment (Context)** View for the system-of-interest
- The next three views and two sections may be created throughout the entire process incrementally:
    - The **System Properties** View
    - The **Structure (Pattern of Organization)** View
        - Generally in the form of a System Breakdown Structure (e.g. Figure 2 ISO 15288:2015) (see below)
    - The **Behavior (Structural Changes)** View
    - **Correspondences**
    - **Decision and Rationale**
    - Note: Templates for Correspondence, Correspondence Method, Decision and Rationale may need to be created or already exist ready for use.

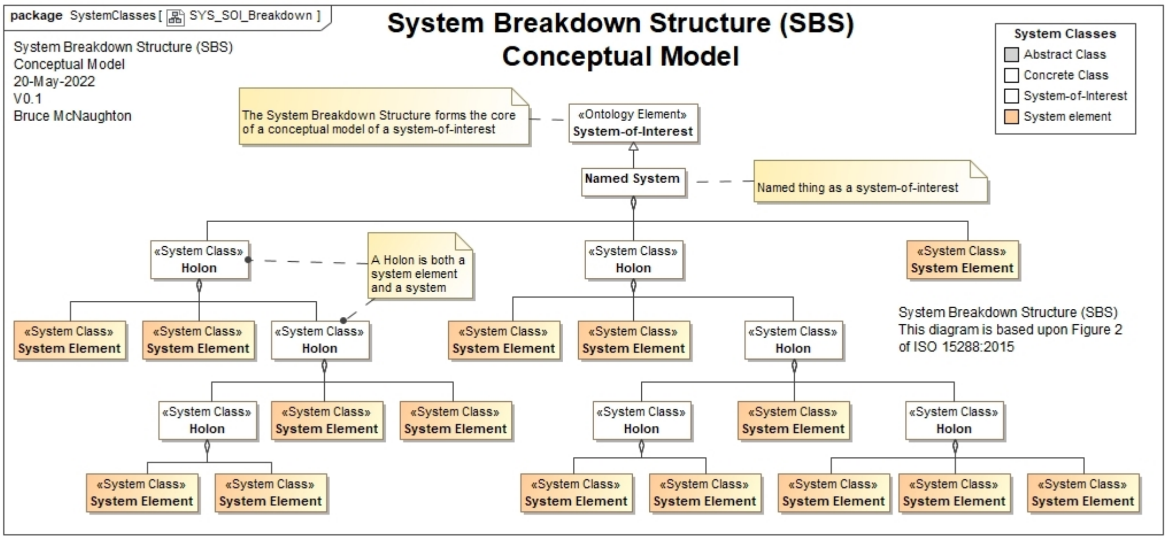
One way to create this System Description is to get the stakeholders together using workshops to talk about the interests and concerns the stakeholders have in the area of the view and begin to structure the information in the view. The views may start as rough bullets or even rough models and then can be refined as more is learned. The more conversations the team has the better. Each conversation is creating a learning alignment around the contents of the system description.

NOTE: Some existing system descriptions may be important as both an example and learning opportunity and for connections to reuse patterns, ontology elements, etc.

System Breakdown Structure

The System Breakdown Structure (SBS) is a way to identify the structure of the system-of-interest and establish common terminology (ontology elements).

The System Breakdown Structure has the following pattern:


package SystemClasses [SYS_SOI_Breakdown]
System Breakdown Structure (SBS) Conceptual Model
System Breakdown Structure (SBS)
Conceptual Model
20-May-2022
V0.1
Bruce McNaughton
System Classes
Abstract Class
Concrete Class
System-of-Interest
System element
The System Breakdown Structure forms the core of a conceptual model of a system-of-interest
«Ontology Element» System-of-Interest
Named System
Named thing as a system-of-interest
«System Class» Holon
A Holon is both a system element and a system
«System Class» System Element
System Breakdown Structure (SBS) This diagram is based upon Figure 2 of ISO 15288:2015

This pattern contains a simple pattern representing the abstract system definition that the system-of-interest and each holon has inherited. This pattern provides a way to capture the elements in a system-of-interest and identify related items. These types of holons may be mixes of living systems and designed physical and abstract systems.

Correspondences

Correspondences can also be created or used to establish relationships across the various Architecture Description Elements. The SysDesc ADF Correspondence Section provides the primary source for finding existing correspondences and correspondence methods. The existing correspondences should be checked and if appropriate correspondences are found, these should be used before creating new correspondences and correspondence methods. These correspondences can also be used to connect across the systems within a System Breakdown Structure and across System Breakdown Structures in other systems (or related system descriptions).

Link to the SysDesc ADF Correspondences

Decisions and Rationale

Decisions and rationale provide a log of significant learning and changes to the System Description

These entries should be as close to the decision point or learning event as possible.

Context and Use of the System Description.

The context and use within ISO 15288:2015 may also be important. There may be System Descriptions that are created during the early life cycle processes that do not have a corresponding SoI ADF. These system descriptions do focus the stakeholders relevant to this system and provide a common ontology and understanding in the context of the whole system-of-interest. This type of system description may be for a holon in the System Breakdown Structure. As an example, the Enterprise has one SoI ADF and multiple system descriptions within the System Breakdown Structure.

Create the ADF for the System-of-Interest

System-of-Interest ADF

Create or revise a system-of-interest Architecture Description Framework based upon the System Description that has been created for the system-of-interest. This whole system view of the system-of-interest provides a sound basis for developing the specific viewpoints / views that express the specific stakeholder concerns. This provides the following benefits:

- The System-of-Interest ADF uses consistent terminology and structural models
- Any correspondences are integrated from the System Description allowing AD Element reuse.
- Any stakeholder perspectives can be identified

The steps to create an Architecture Description Framework for a system-of-interest are as follows:

- Identify the system-of-interest
- Create the work product Architecture Viewpoint Definition (AVPD) for the system-of-interest to define the viewpoints.

    - Identify the context: Stakeholders and Purpose
    - Create the Ontology Definition View using one of the following:
        - The Conceptual Model of the system-of-interest created for the system-of-interest (See Abstract System CM)
        - or use elements from or reference the System Description for the System-of-interest as the basis for the Ontology Definition View.
    - The Viewpoint Relationships View: All of the Viewpoints
    - Each Viewpoint definition
    - Correspondences
    - Rationale
- Create all of the other AD elements for the Architecture Description Framework
- Create an Architecture Description to test the SoI ADF

The System Description created for the system-of-interest will be the starting point for creating a new system-of-interest architecture description framework.

The stakeholders, concerns or interests should already be in the system description. The conceptual models found in the Structure (Pattern of Organization) section can be used as a starting point for the Ontology Definition View. The View Relationship View will be the starting point for the Architecture Viewpoint Definition (AVPD).

This process may benefit from workshops on each view as the conversations may raise further interests and concerns or changes to existing AD Elements. This type of iteration is normal and expected.

If there are differences between stakeholders, the CSH process may be useful to align the thinking.

See the topic about the creation of the Architecture Viewpoint Definition (AVPD).

To complete the creation, both the System Description and the resulting Architecture Viewpoint Definition (AVPD) should be reviewed together to ensure that the stakeholders are in agreement and the ontology elements (aspects) are understood.

Finally, the first Architecture Description can be created and reviewed to confirm that the architecture of the system-of-interest is understandable and meets the needs ot the stakeholders.

Work Product: Architecture Viewpoint Definition (AVPD)

The Architecture Viewpoint Definition (AVPD) is a work product created when using the COMPASS Architectural Framework Framework (CAFF). The CAFF is a process based upon an earlier version of ISO 42010 that can be used to identify Stakeholders, Concerns, Terminology (Ontology Elements), and viewpoints for a conceptual model or system description. The key output of the work product is the identification and framing of viewpoints. This information is then used to create the Architecture Description Framework.

The creation of an Architecture Viewpoint Definition (AVPD) work product is carried out when creating the following:

- System Description Architecture Description Framework using a conceptual model of an abstract system.
    - Link to System (Abstract) AVPD PDF
- Architecture Description Framework for a system-of-interest using a System Description.
    - An example is the Enterprise (SoS) ADF, Link to EntSoSADF AVPD PDF.

The Architecture Viewpoint Definition (AVPD) work product is included in the same location as the Architecture Description Framework.

COMPASS Architectural Framework Framework (CAFF)

The COMPASS Architectural Framework Framework (CAFF) provides the guidance for creating the Architecture Viewpoint Definition (AVPD). This guidance comes from the COMPASS Project. See the following website for further information:

Link to D21.5b Compass Architectural Framework Framework (Local): CAFF Viewpoint Definitions

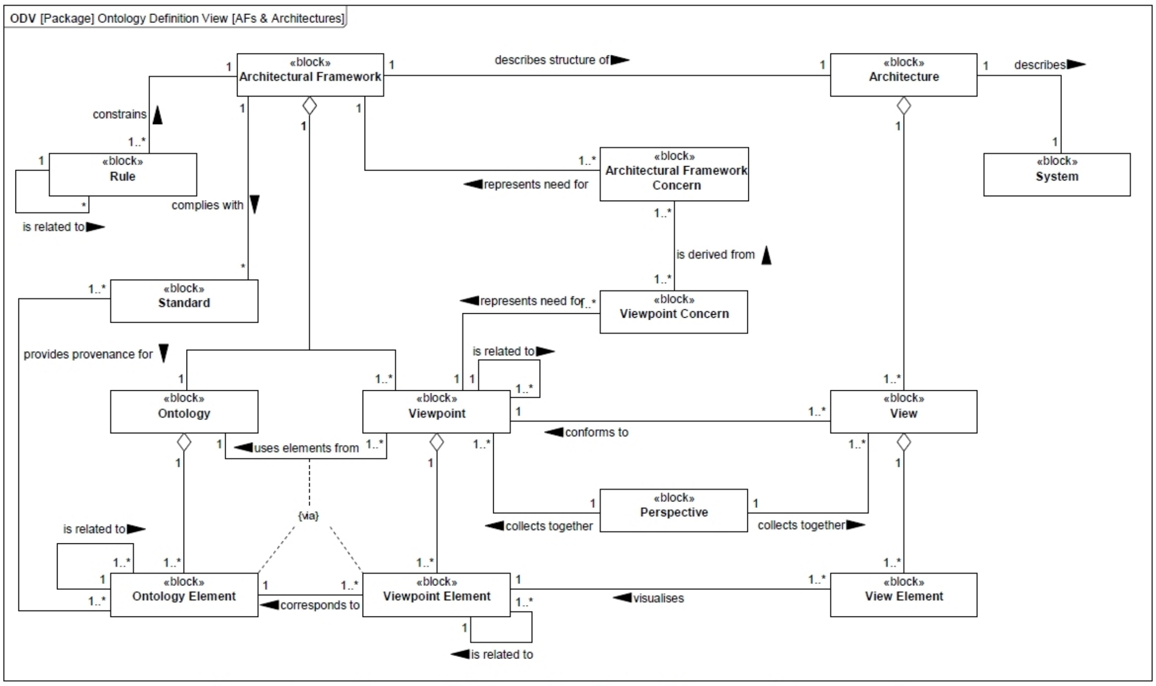


Figure 2 - Ontology Definition View for Architectural Frameworks

Figure 2 from the Ontology View from the COMPASS Architectural Framework Framework (CAFF). The CAFF Viewpoints are shown in the following diagram:

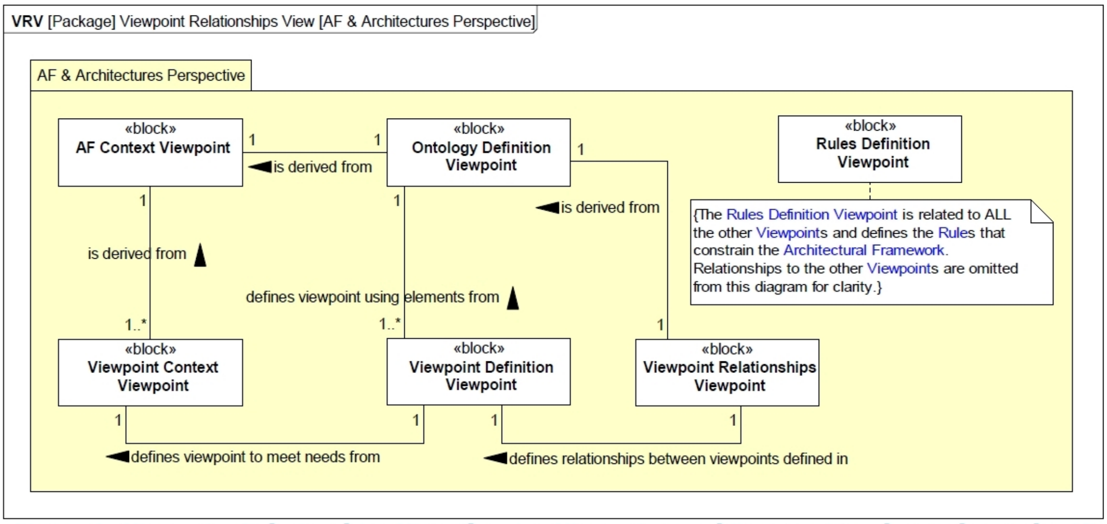

VRV [Package] Viewpoint Relationships View [AF & Architectures Perspective]
AF & Architectures Perspective
«block» AF Context Viewpoint
is derived from
«block» Ontology Definition Viewpoint
«block» Rules Definition Viewpoint
is derived from
{The Rules Definition Viewpoint is related to ALL the other Viewpoints and defines the Rules that constrain the Architectural Framework. Relationships to the other Viewpoints are omitted from this diagram for clarity.}
is derived from
defines viewpoint using elements from
«block» Viewpoint Context Viewpoint
«block» Viewpoint Definition Viewpoint
«block» Viewpoint Relationships Viewpoint
defines viewpoint to meet needs from
defines relationships between viewpoints defined in
1
1..*

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

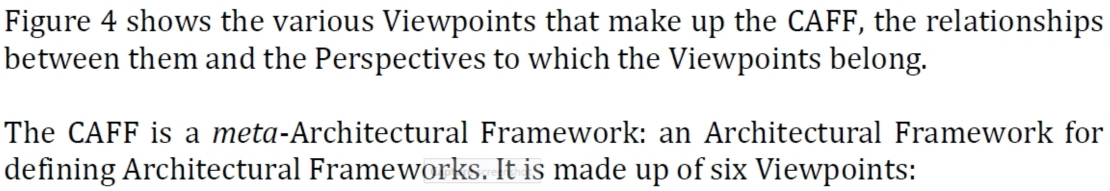


Figure 4 shows the various Viewpoints that make up the CAFF, the relationships between them and the Perspectives to which the Viewpoints belong.

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

The original materials used prior to the CAFF is from presentations at the Model Based System Engineering (MBSE) Festival INCOSEUK and papers presented at the 2014 Annual Systems Engineering Conference (ASEC) INCOSEUK conference.. This information is available from Simon Perry or in the book called "SysML for Systems Engineering, 2nd Edition: A Model-Based Approach".

Reference Materials (posted with Permission)

COMPASS Architectural Framework Framework (CAFF) Compass Research Deliverables

NOTE: The authors of the FAF below contributed to the Compass Guides

Some original information related to the earlier FAF from INCOSE UK

- Presentation on FAF from Simon Perry, INCOSEUK
- Paper on FAF from Simon Perry, INCOSEUK.

System Classification Framework

System Classification Framework

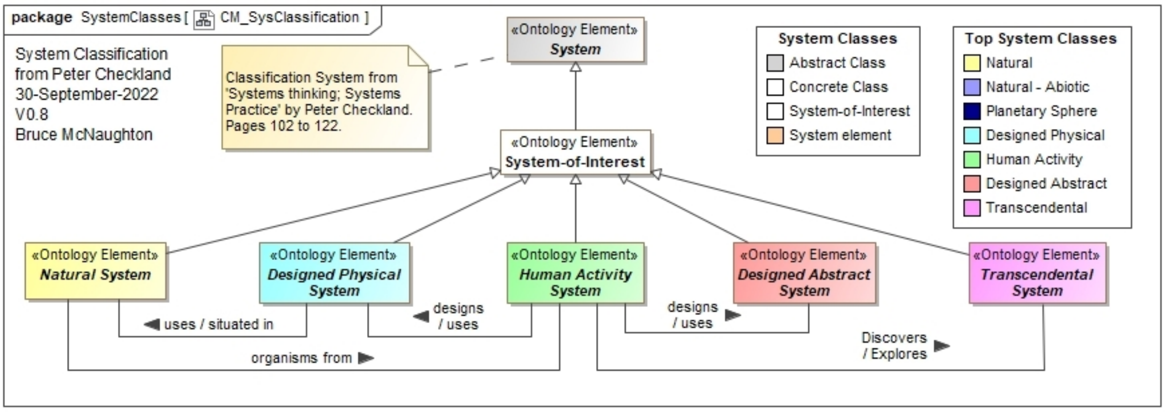
A System Classification Framework provides a way to position a system-of-interest in a wider context of systems. This System Classification Framework is used to:

- Identify types of systems.
- Promote reuse across a set of systems and system types
- Ensure alignment of similar types of systems and reduce duplicate definitions.

The System Classification Framework provides the following benefits:

- A top level set of system types that can be used for any system-of-interest.
- A way to reuse aspects of systems using generalizations that allow inheritance of the key elements of a system.
- A way to integrate across systems based upon consistent references to defined systems using a single abstract system class..
- A way to reuse AD Elements across the full set of defined systems (e.g. viewpoints, views, view components, other system descriptions, etc).

The top level System Classification Framework is based upon Peter Checkland's system classification model. Peter Checkland includes a system classification approach in his book Systems Thinking, System Practice. The following form the top level set of systems in this classification scheme:


package SystemClasses [CM_SysClassification]
System Classification
from Peter Checkland
30-September-2022
V0.8
Bruce McNaughton
Classification System from 'Systems thinking; Systems Practice' by Peter Checkland. Pages 102 to 122.
«Ontology Element» System
«Ontology Element» System-of-Interest
System Classes
Abstract Class
Concrete Class
System-of-Interest
System element
Top System Classes
Natural
Natural - Abiotic
Planetary Sphere
Designed Physical
Human Activity
Designed Abstract
Transcendental
«Ontology Element» Natural System
«Ontology Element» Designed Physical System
«Ontology Element» Human Activity System
«Ontology Element» Designed Abstract System
«Ontology Element» Transcendental System
uses / situated in
designs / uses
designs / uses
organisms from
Discovers / Explores

The top level System Classification Framework is described in the book from page 102 to page 122. Figure 4, page 112 highlights the 5 system classes. These classes are used as a top level classification for system types.

Link to the Top System Classifications PDF

Russell Ackoff's System Classification

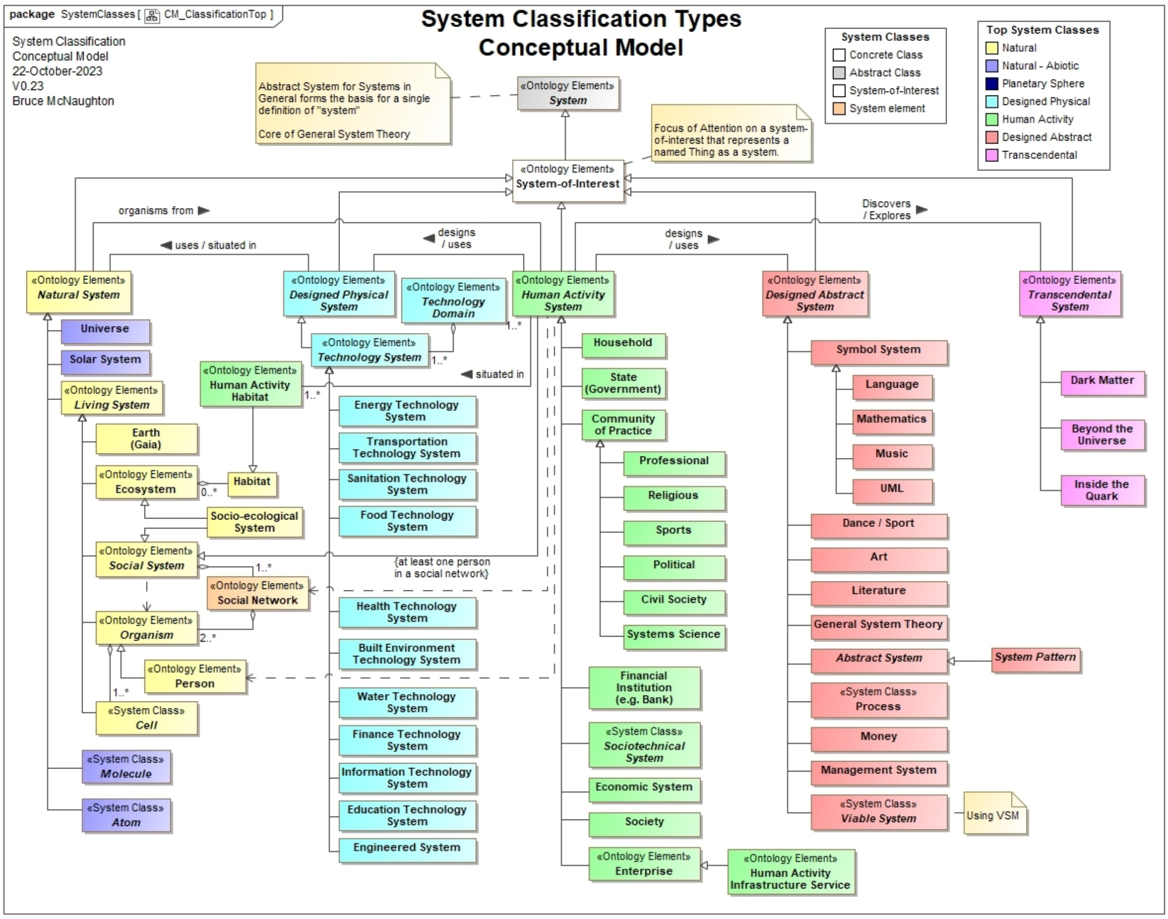
Russell Ackoff's System Classifications were also considered. The following types of systems comes from Re-Creating the Corporation

- Deterministic System
- Animated System
- Social System
- Ecological System.

These classifications were considered; however, they use are use "Purposeful System" as a differentiator between system types and was considered too narrow for this System Classification Framework.

Current Systems in the System Classification Framework

. The current systems that have been identified using the top level classification types are shown in the diagram below:

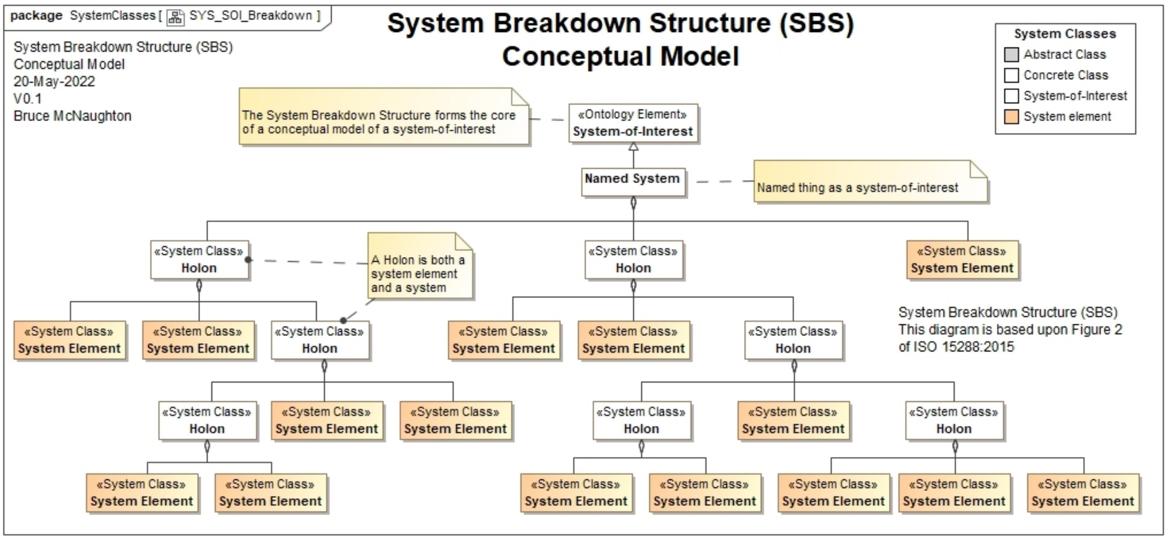

package SystemClasses [CM_ClassificationTop]
System Classification Types
Conceptual Model
System Classification
Conceptual Model
22-October-2023
V0.23
Bruce McNaughton
Abstract System for Systems in General forms the basis for a single definition of "system"
Core of General System Theory
«Ontology Element» System
Focus of Attention on a system-of-interest that represents a named Thing as a system.
«Ontology Element» System-of-Interest
System Classes
Concrete Class
Abstract Class
System-of-Interest
System element
Top System Classes
Natural
Natural - Abiotic
Planetary Sphere
Designed Physical
Human Activity
Designed Abstract
Transcendental
organisms from
uses / situated in
designs / uses
designs / uses
Discovers / Explores
«Ontology Element» Natural System
«Ontology Element» Designed Physical System
«Ontology Element» Technology Domain
«Ontology Element» Human Activity System
«Ontology Element» Designed Abstract System
«Ontology Element» Transcendental System
Universe
Solar System
«Ontology Element» Living System
Earth (Gaia)
«Ontology Element» Ecosystem
Habitat
Socio-ecological System
«Ontology Element» Social System
«Ontology Element» Social Network
«Ontology Element» Organism
«Ontology Element» Person
«System Class» Cell
«System Class» Molecule
«System Class» Atom
«Ontology Element» Human Activity Habitat
«Ontology Element» Technology System
situated in
1..*
0..*
2..*
{at least one person in a social network}
Energy Technology System
Transportation Technology System
Sanitation Technology System
Food Technology System
Health Technology System
Built Environment Technology System
Water Technology System
Finance Technology System
Information Technology System
Education Technology System
Engineered System
Household
State (Government)
Community of Practice
Professional
Religious
Sports
Political
Civil Society
Systems Science
Financial Institution (e.g. Bank)
«System Class» Sociotechnical System
Economic System
Society
«Ontology Element» Enterprise
«Ontology Element» Human Activity Infrastructure Service
Symbol System
Language
Mathematics
Music
UML
Dance / Sport
Art
Literature
General System Theory
Abstract System
System Pattern
«System Class» Process
Money
Management System
«System Class» Viable System
Using VSM
Dark Matter
Beyond the Universe
Inside the Quark

Note: that all of the types of systems are based upon a single definition and model of an abstract system. Each system inherits the single definition of system. This provides a consistent way to describe each type of system using a System Description based upon the SysDesc ADF.

System Classes

Given the consistent inheritance of a single definition of System (Abstract), any of the systems in the System Classification Framework can provide a generalization / inheritance path to retain the essence of the System Description (AD Element).

The identification of the above types of systems allows a consistent breakdown of systems. Here are some examples of further exploration of these systems: The system Breakdown Structure (equivalent to Figure 2 in ISO 15288:2015) is shown below:


package SystemClasses [SYS_SOI_Breakdown]
System Breakdown Structure (SBS)
Conceptual Model
System Breakdown Structure (SBS)
Conceptual Model
20-May-2022
V0.1
Bruce McNaughton
The System Breakdown Structure forms the core of a conceptual model of a system-of-interest
«Ontology Element» System-of-Interest
System Classes
Abstract Class
Concrete Class
System-of-Interest
System element
Named System
Named thing as a system-of-interest
«System Class» Holon
A Holon is both a system element and a system
«System Class» System Element
System Breakdown Structure (SBS)
This diagram is based upon Figure 2 of ISO 15288:2015

Each holon can be considered a system-of-interest and may have an associated System Description and / or System-of-Interest ADF. The top named system should be the primary candidate for the Architecture Description Framework. All holons can have a System Description. These holons can also be a mix of top level system types.

The Enterprise (SoS) System Description is a good example of multiple systems in a system description that mirrors the SBS.

PDF: System Description: Enterprise as a System of Systems (SoS), Version 0.17, 24-June-2023

Correspondences

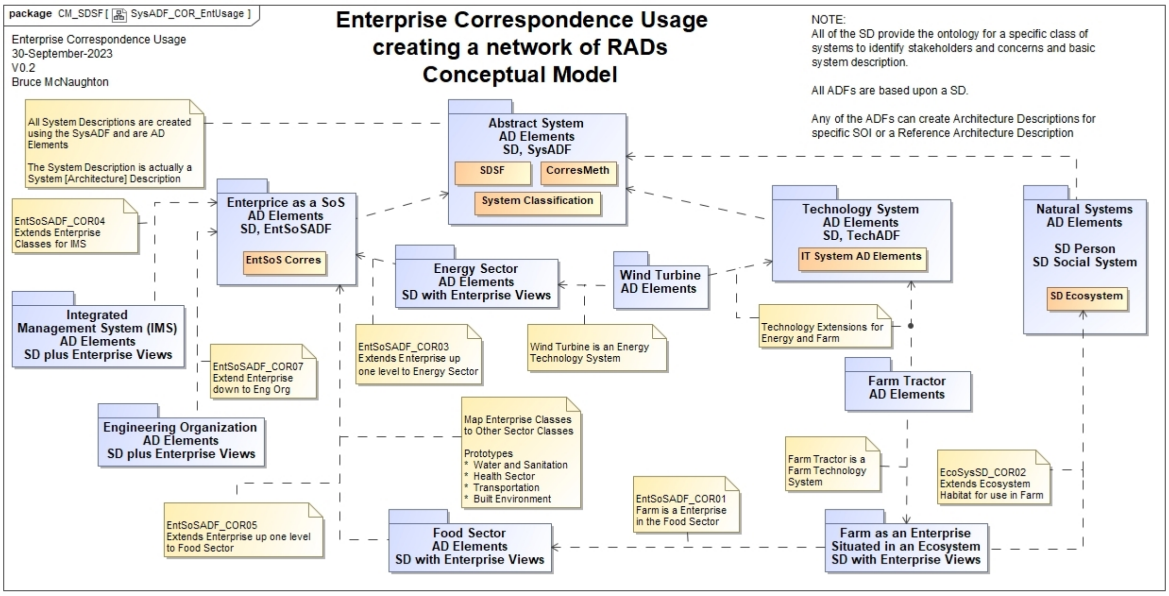
In addition, the correspondences section of any System Description can also provide relationships between AD Elements where an AD element can also be a system Description. This allows correspondences across systems to be documented. This also allows for the sharing of system description AD Elements such as viewpoints, model kinds, correspondences or other AD Elements.

Correspondence Usage

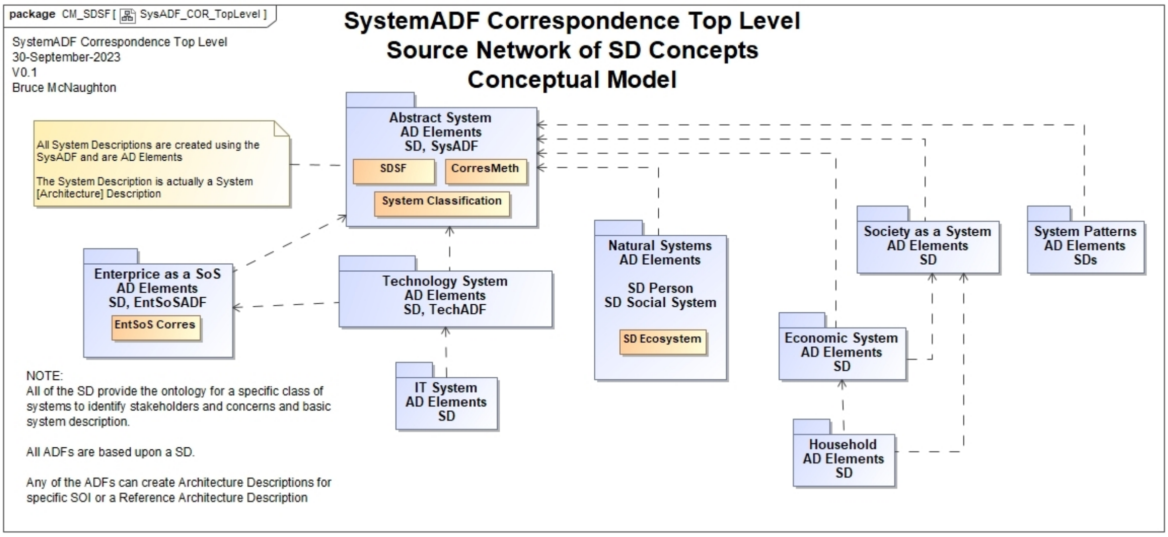
Correspondences provide a way to create an environment for coherence, consistency and usage of basic concepts across a set of System Descriptions that forms a network of Reference Architecture Descriptions.

The relationship of the correspondences created from the various System Descriptions created from the System Description Architecture Description Framework can be shown in a diagram that highlights the guidance and constraints applied to derived System Descriptions.

This diagram focuses on the use of Enterprise Correspondences.



This diagram focuses on the top level System Descriptions.


package CM_SDSF [SysADF_COR_TopLevel]
SystemADF Correspondence Top Level
30-September-2023
V0.1
Bruce McNaughton
SystemADF Correspondence Top Level
Source Network of SD Concepts
Conceptual Model
All System Descriptions are created using the SysADF and are AD Elements
The System Description is actually a System [Architecture] Description
Abstract System
AD Elements
SD, SysADF
SDSF
CorresMeth
System Classification
Society as a System
AD Elements
SD
System Patterns
AD Elements
SDs
Natural Systems
AD Elements
SD Person
SD Social System
SD Ecosystem
Enterprise as a SoS
AD Elements
SD, EntSoSADF
EntSoS Corres
Technology System
AD Elements
SD, TechADF
Economic System
AD Elements
SD
IT System
AD Elements
SD
Household
AD Elements
SD
NOTE:
All of the SD provide the ontology for a specific class of systems to identify stakeholders and concerns and basic system description.
All ADFs are based upon a SD.
Any of the ADFs can create Architecture Descriptions for specific SOI or a Reference Architecture Description

References

ISO 42010:2022 Software, Systems and Enterprise - Architecture Description

ISO 42010:2022 (Software, Systems and Enterprise - Architecture Description). ISO 42010:2022 replaces ISO 42010:2011 and IEEE 1472.
Main website for ISO 42010 is:
http://www.iso-architecture.org/42010/
Alternative website:
http://www.iso-architecture.org/
Conceptual Model contained in ISO 42010
http://www.iso-architecture.org/42010/cm/
Wikipedia: ISO 42010
The architectural concepts from the Compass Project and this international standard have been integrated into the change and transformation approach.
Rich Hilliard

ISO 15288:2023 Systems and software engineering — System Life Cycle Processes

ISO 15288 System Life Cycle Processes
ISO 15288:2023 Systems and software engineering — System Life Cycle Processes.
Integrated Management System

Systems Thinking, Systems Practice, Peter Checkland

Systems Thinking, Systems Practice: Includes a 30 Year Retrospective
This book contains a good description of Human Activity Systems (HAS) based on a root definition to describe a human activity system (CATWOE). These are both used in the Soft Systems Methodology (SSM).
The concept of the Root Definition has been extended to the System Description that is produced using the System Description Architecture Description Framework. The Human Activity System has also been extended from living social systems.
The book also contains a simple system classification scheme that is being used to define a Earth (Gaia) as a System of Systems model. The system classification system is described in the book from page 102 to page 122. Figure 4, page 112 highlights the 5 system classes. This book also has a good glossary of terms.
This system classification scheme is also being used as the System Classification Framework for the System Description Architecture Description Framework. This framework captures the identified systems and their type.

Re-Creating the Corporation, Russell Ackoff

Re-Creating the Corporation: A Design of Organizations for the 21st Century
Definition of a System and 5 Conditions; Multi-Dimentional Organization Design; Interactive Planning; and more.
System of System Concepts

The Compass Project, The Compass Club

The Comprehensive Modelling for Advanced Systems of Systems.or the COMPASS Project provides the terminology and concepts used in this document for a system of systems. This project is now closed and information about the COMPASS Project has been archived.

The COMPASS Architectural Framework Framework (CAFF) is closely aligned to the Framework for Architecture Frameworks (FAF) written by Simon Perry and Jon Holt. This CAFF is still used as the basis for the Architecture Viewpoint Definition (AVPD) work product.

Here is the final version of the COMPASS Architectural Framework Framework (CAFF) available for this work product:

Link to D21.5b Compass Architectural Framework Framework (Local): CAFF Viewpoint Definitions

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Some original information related to the earlier FAF from INCOSE UK

- Presentation on FAF from Simon Perry, INCOSEUK
- Paper on FAF from Simon Perry, INCOSEUK.

SysML for Systems Engineering, Jon Holt and Simon Perry

SysML for Systems Engineering

Includes a description of the Framework for Architecture Frameworks (FAF). This is the basis for the COMPASS Project CAFF.
