Introduction: System Description AD Framework Viewpoints

System Description Architecture Description Framework

Abstract

This paper contains the current Viewpoint Definitions based upon the AFD for the System Description Architecture Description Framework Viewpoints Definition.

The purpose of the System Description Architecture Description Framework is to support the creation of System Description for a system-of-interest.

The outcome of this process is the creation of a 1 to 10 page system description for a system-of-interest.

Author and Version

Bruce McNaughton, Version 0.5 08-August-2022

Contents

Revision History

V0.5 08-August-2022 Update with current viewpoints.

V0.4 25-August-2019 Update Environment and Behaviour Definitions to match revised system model (all interactions with system elements).

V0.3 24-August-2019 Update to add additional notes from actual use of the framework. Minor corrections and completions and updated diagrams from AFD

V0.2 01-July-2019 Created separate viewpoints based upon Living system terminology.

V0.1 25-June-2019 Update to the AF based upon usage of the architecture description framework.

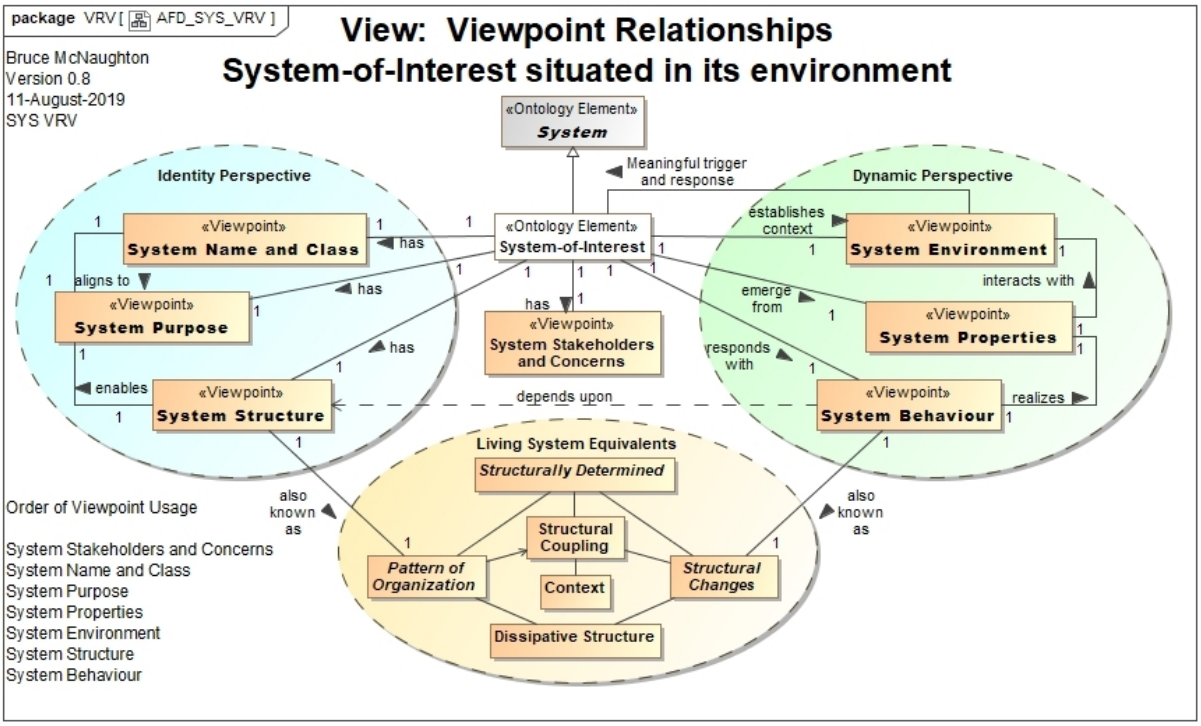
V0.0 09-June-2019 Initial Draft of Viewpoints.

Viewpoint Overview

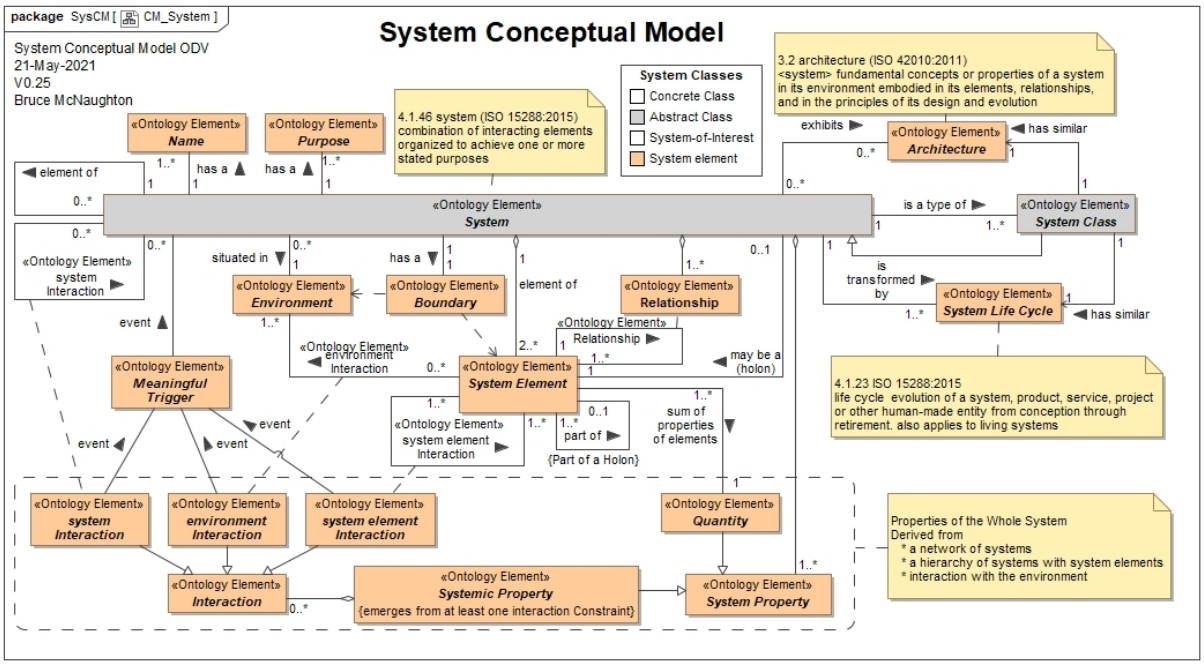
The following viewpoints have been identified for the System Description Architecture Description Framework..

Link to Current SysDesc ADF Viewpoints PDF

The following picture shows the primary viewpoints of the Architecture Description Framework.



The System Ontology (Concepts) used to support this Architecture Description Framework is shown below:



Each of the viewpoints describes the way information (Concepts / Principles) is derived from the following sources:

System Name and Class Viewpoint

Description

This viewpoint provides the instructions to create the System Name and Class View in a System Description.

The initial steps for creating a system description are:

- Identifying the name of the system-of-interest.
- Identifying any base classifier and any of its properties that this system-of-interest inherits.

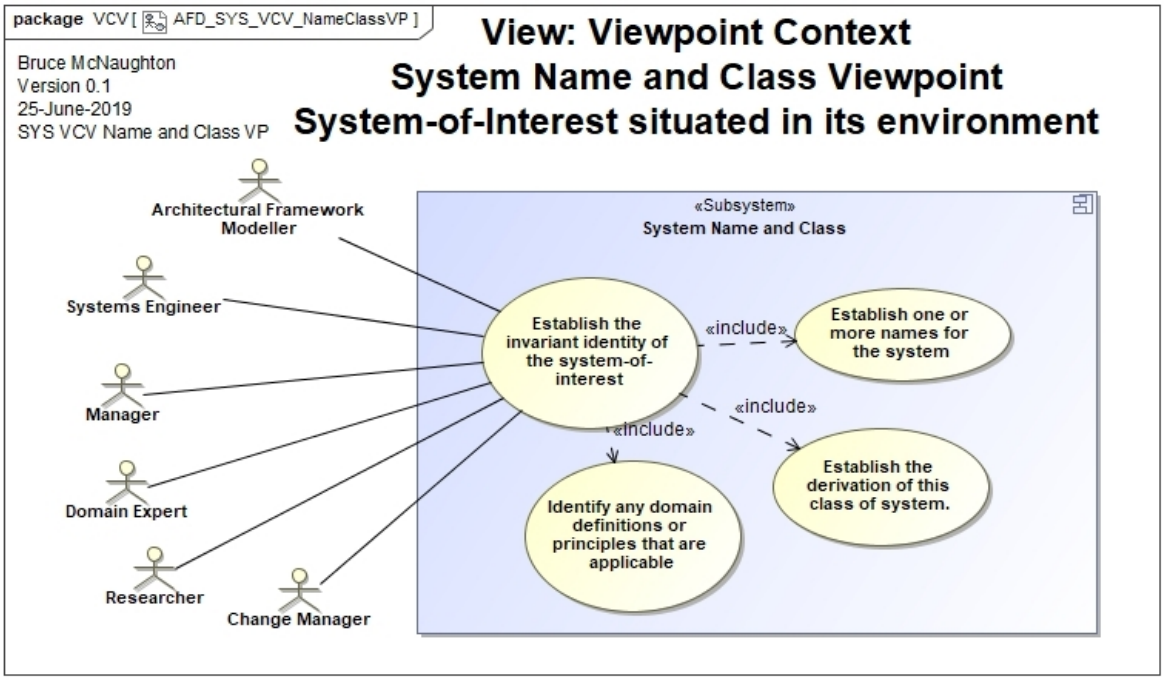
In addition, this section can provide any other system level definitions or concepts used across the whole system.

Rationale

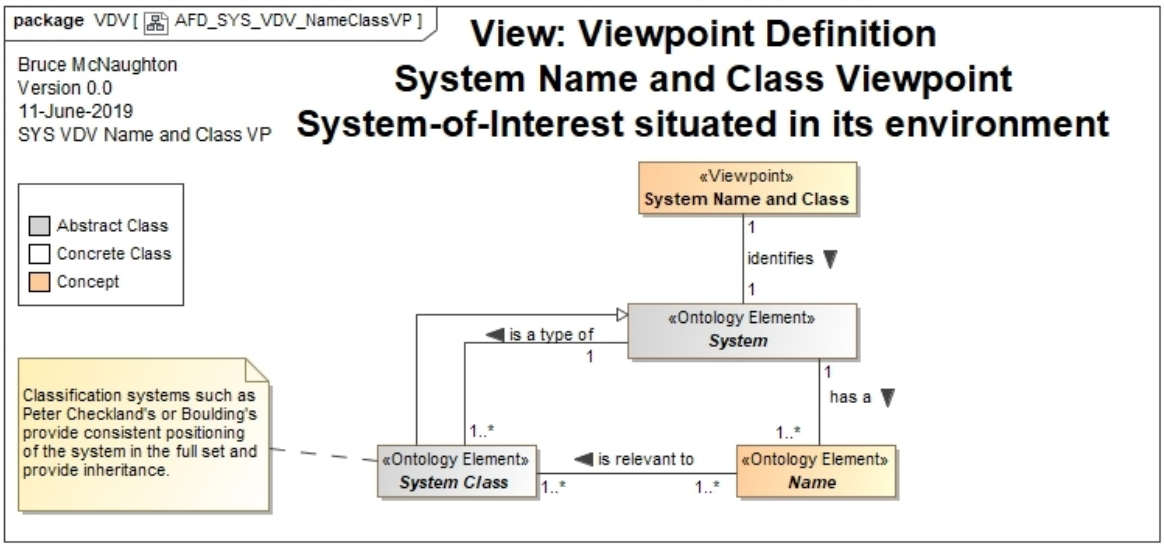
This view is critical to establishing the identity of a system-of-interest. Key elements of the identity are:

- Name
- inherited definitions from other system descriptions

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

The Name can be created as a single class in a class model

The Generalization links to other base classifiers is a critical aspect of creating the identity of the system-of-interest. Here are some examples of Base Classifiers:

- System (Abstract)
- Social System (Abstract)
- Designed Physical System (Abstract)

The class model may also contain the generalizations to the identified 'based on' classes.

A UUML Class model is optional for this view. The simple model is implied in the elements that are captured in this section.

Steps to Create the View

- Identify the names or possible synonyms
- Identify the base classes that this system can be derived from.
- Optional: Create a Class diagram for this section to show the relationship of the system to other base classifiers.

Correspondences

- Any of the inherited elements from the base classes should be visible within the system description.

Examples

See the Household System Description as an example of a System Description that inherits a number of the basic structures and elements from the abstract class: Social System.

T.B.D. Links to be provided to example System Descriptions

Sources

UML Classes and Generalization Associations.

Notes

Though a UML model may not be required in this section

System Purpose Viewpoint

Description

This viewpoint provides the instructions to create the System Purpose View in a System Description

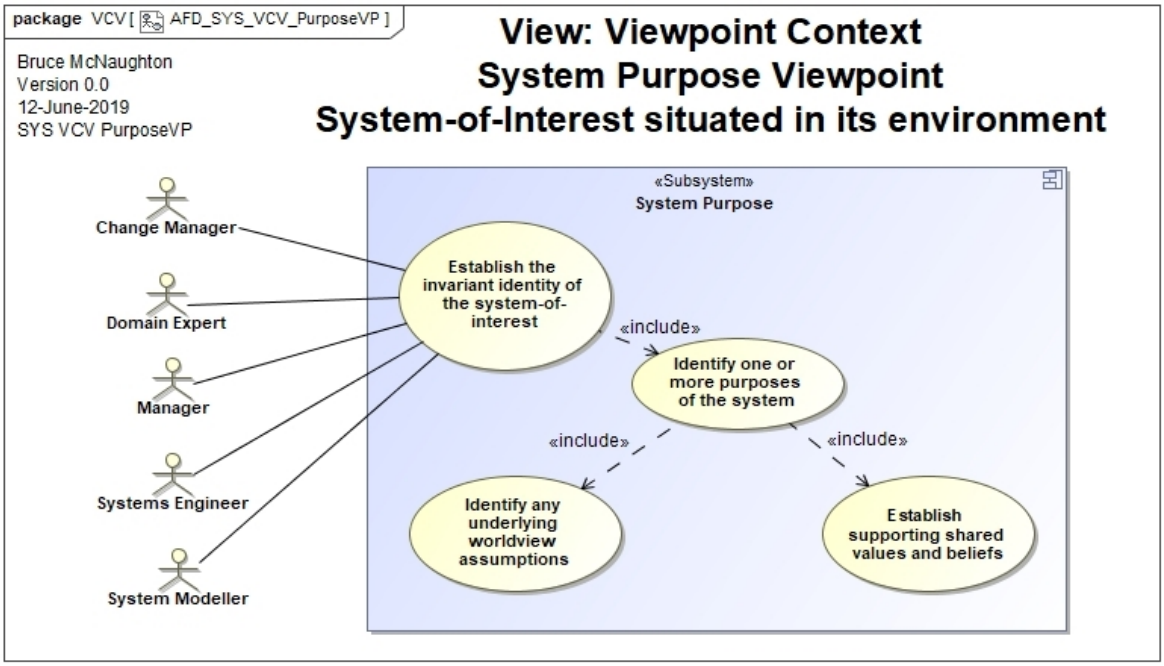
The System Purpose or 'reason for being' of a system-of-interest provides an integrating context for the system.

There is usually a stated or primary purpose of a system-of-interest. Other purposes may be included as part of the design of the system. In addition, other affordances may also emerge as the system is in use or operation. These are also valid system purpose statements.

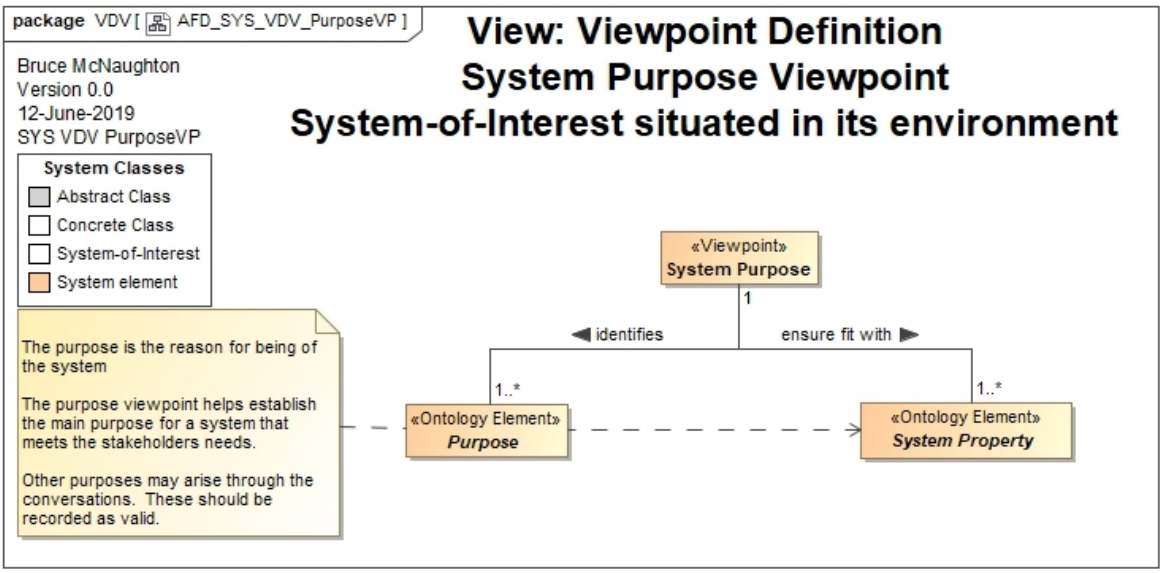
Rationale

The System Purpose is a key attribute of a system-of-interest. The view ensures that the purpose is carefully considered and included in the System Description.

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

Generally this view is created using text.

Visual images can also enhance the value of the purpose of the system. These images can be included in various system models. Rich Pictures can be used to capture the big picture.

Steps to Create the View

- Identify the stakeholders of the system-of-interest.
- Conduct a workshop to gather purpose statements
- Rationalise and prioritise the purpose statements
- Agree a primary and if necessary secondary purpose statements.

Correspondences

- Identify and rules or constraints that must be followed to complete this view

Examples

T.B.D. Links to be provided to example System Descriptions

Sources

State any references or people that have helped to define this viewpoint.

Notes

Provide notes and background information to track any changes or other information.

System Properties Viewpoint

Description

This viewpoint provides the instructions to create the System Properties View in a System Description.

The view identifies the various types of system properties for the system-of-interest. Some of these are:

System Properties

- Quantity - generally the sum of the properties of the system elements (parts)
  Note that these quantities may place constraints or limitations on the system.

Systemic Properties:

- are properties of the whole not found in any of the system elements or parts.
- are created through the interaction of the system elements, the environment, and other systems.
- may emerge as unexpected properties through the operation of the system. These may be desired or undesired.

Examples of systemic properties are:

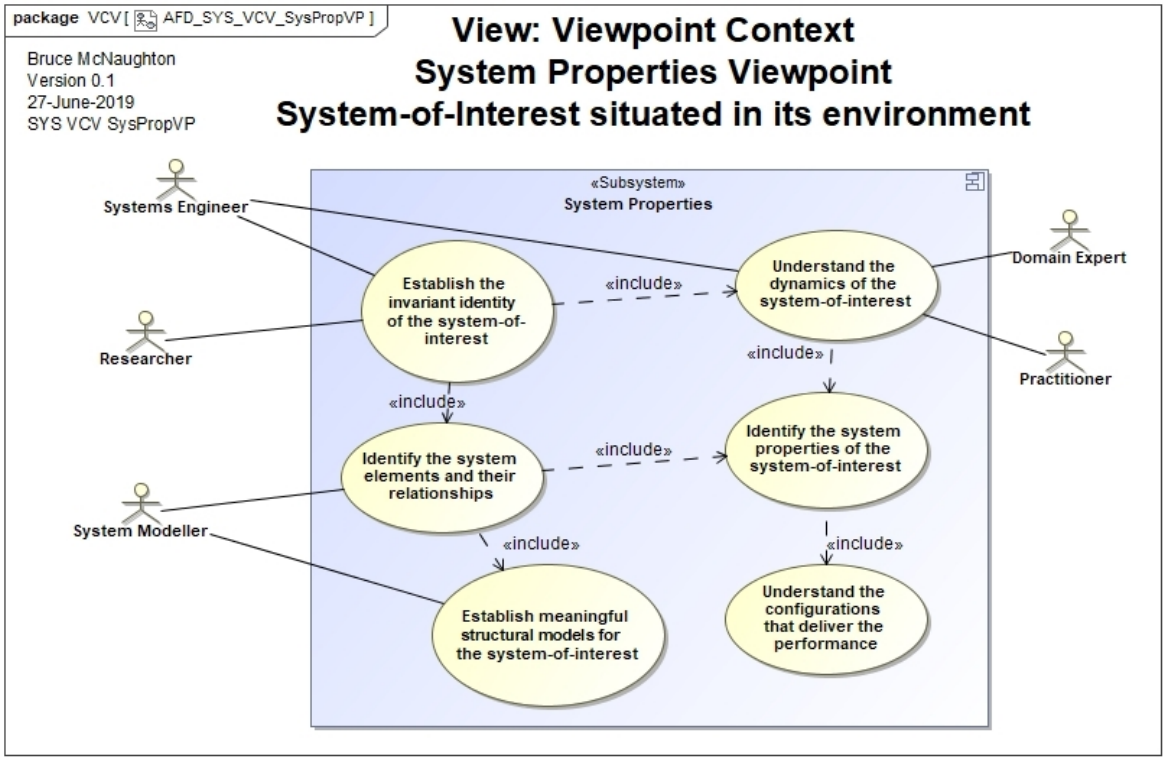
- Qualities that generally emerge but are not easily measured.
- Measurable variables
- Functions or Capabilities
- States

Rationale

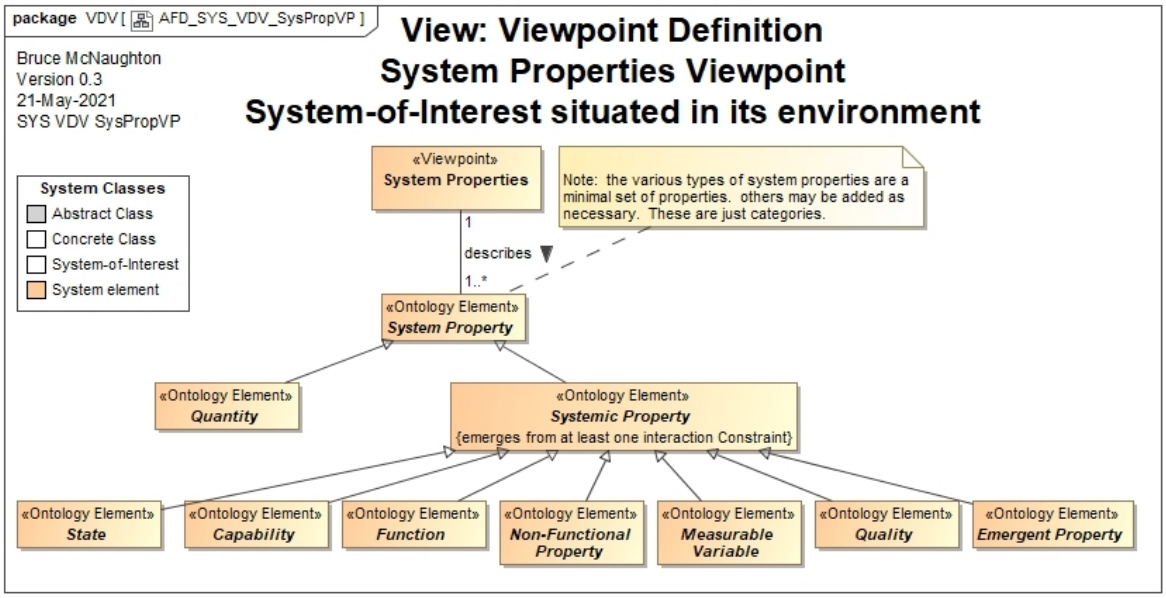
The system properties are key to understanding the value of a system-of-interest. The value is created in line with the overall system purpose. These generally provide the benefits delivered to the environment.

These properties also establish the constraints and limitations of the system in its environment.

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

The following models show the system properties and their relationship to the environment and other systems:

- Conceptual Models (Class Diagrams).
- Property Description (PropDesc)
- System Functional or Capability Models (Class Diagrams or Use Case Diagrams)
- State Machine Diagrams (System State Transitions)

Steps to Create the View

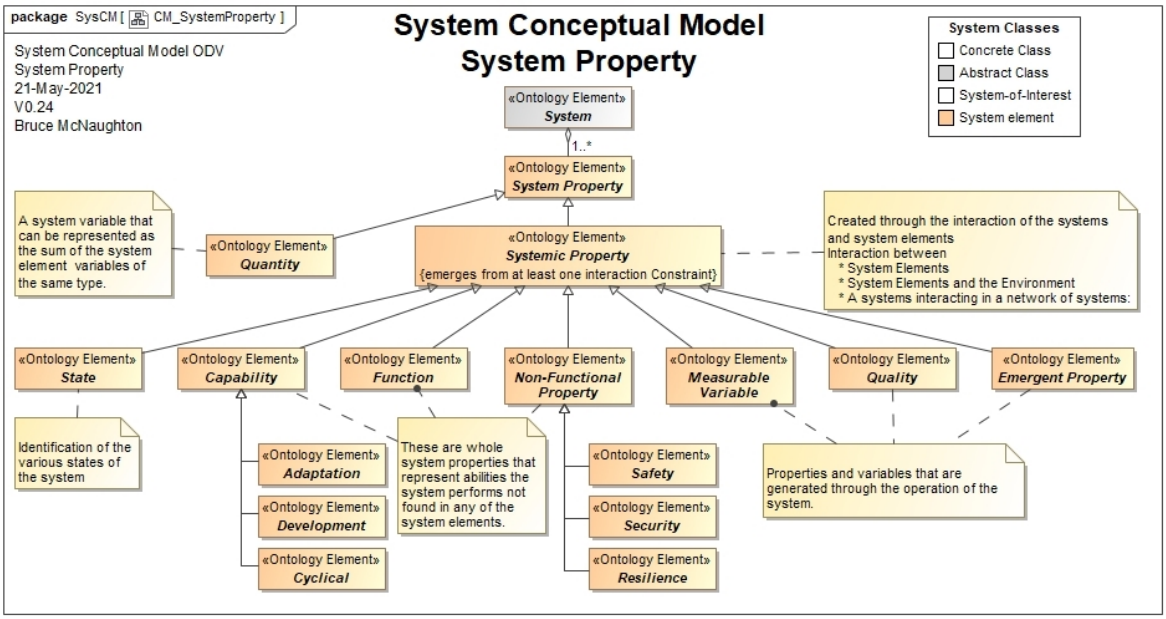
- Where appropriate, create a property Description for each property.
- Identify the models to create (CLD or CM)
- Review the models.

Correspondences

- Identify and rules or constraints that must be followed to complete this view

Examples

T.B.D. Links to be provided to example System Descriptions



Sources

State any references or people that have helped to define this viewpoint.

Notes

Provide notes and background information to track any changes or other information.

System Stakeholders and Concerns Viewpoint

Description

This viewpoint provides the instructions to create the System Stakeholders and Concerns View in a System Description.

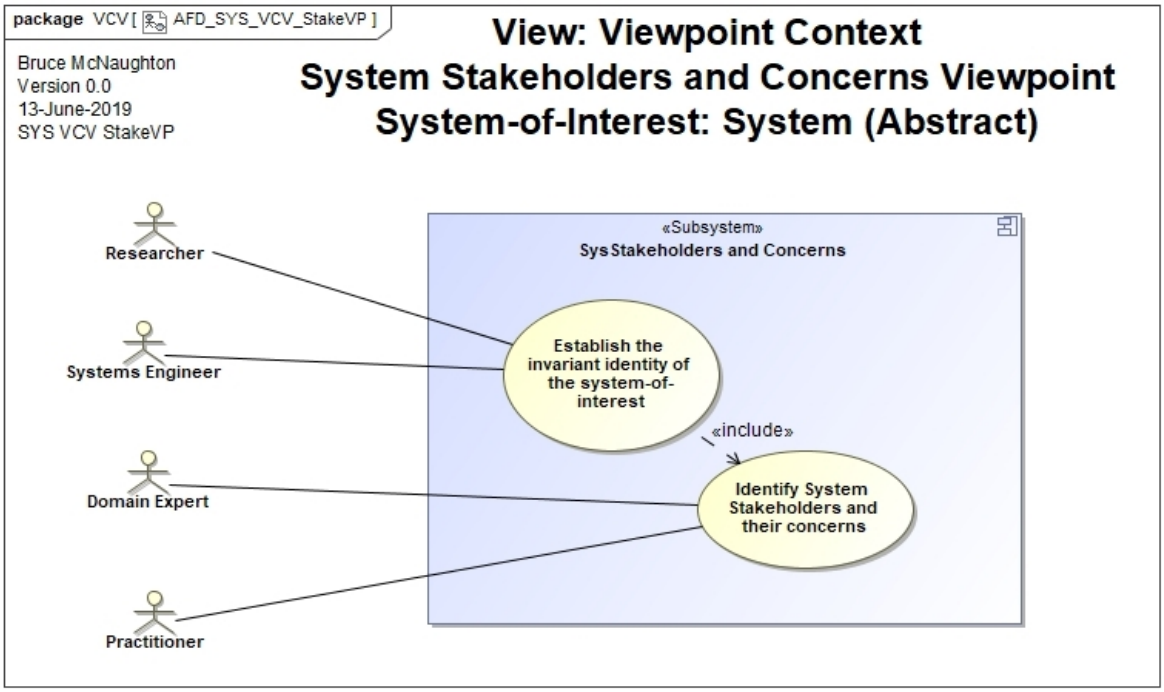
This view identifies the stakeholders and their concerns or interests in the system-of-interest.

This set of concerns may be based upon an 'operational view' where the system exists and is in use or a system-of-interest about to be changed to improve its fit and contribution.

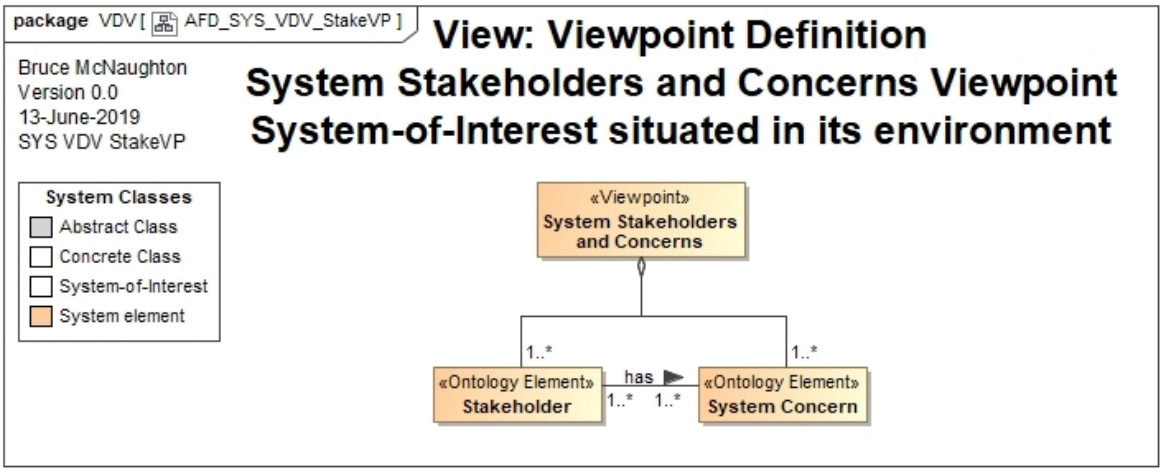
Rationale

The System Stakeholders and Concerns view provides a clear picture of the people and their interests in the system-of-interest. These are the people that should help co-create, revise and agree the System Description.

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

The following models show the systemic properties and their relationship to the environment and other systems:

- Tables
- Use Case Diagram
  - Visual representation of stakeholders and mapping to concerns.

Steps to Create the View

- Identify the models to include
- Create the models
- Review the models.

Correspondences

- Identify and rules or constraints that must be followed to complete this view

Examples

T.B.D. Links to be provided to example System Descriptions

Sources

State any references or people that have helped to define this viewpoint.

Notes

Provide notes and background information to track any changes or other information.

System Environment Viewpoint

Description

This viewpoint provides the instructions to create the System Environment View in a System Description.

The description of the environment provides the context for the system-of-interest. This context includes any external systems that impact or interact with the system-of-interest. This context may also be shaped by the system-of-interest through the various interactions of the system.

The key aspect of the environment is the value delivered by this system-of-interest to the environment.

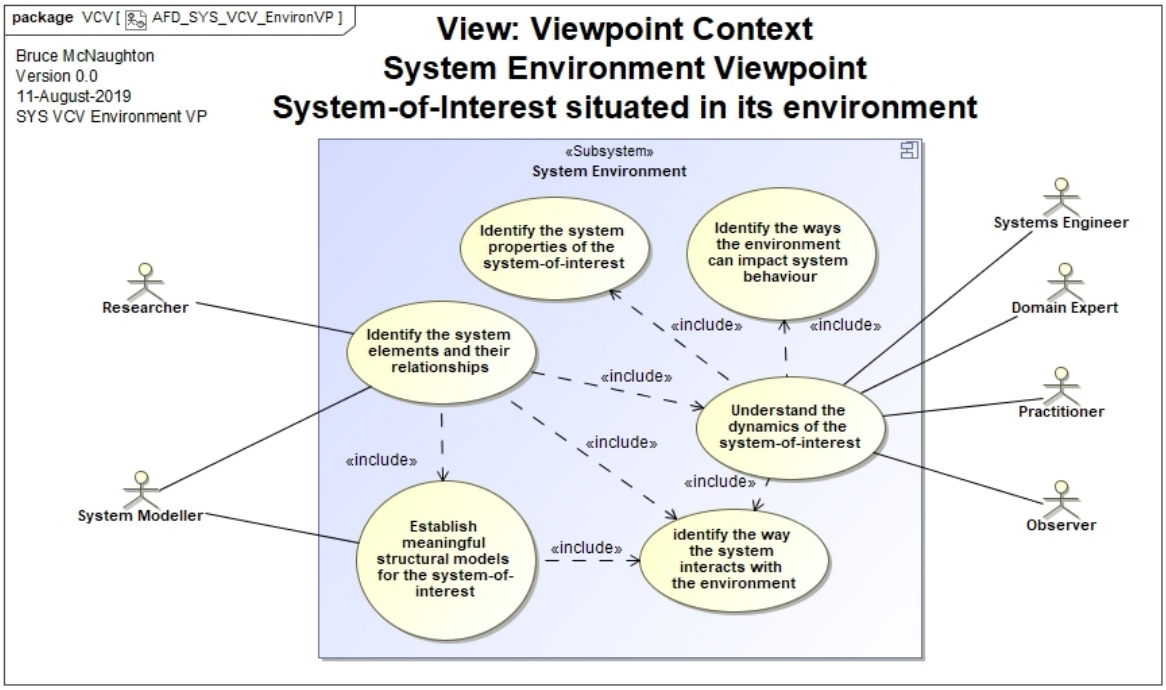
Rationale

This viewpoint is necessary to ensure that the impact of the environment on the system-of-interest and the impact of the system-of-interest on the environment is understood.

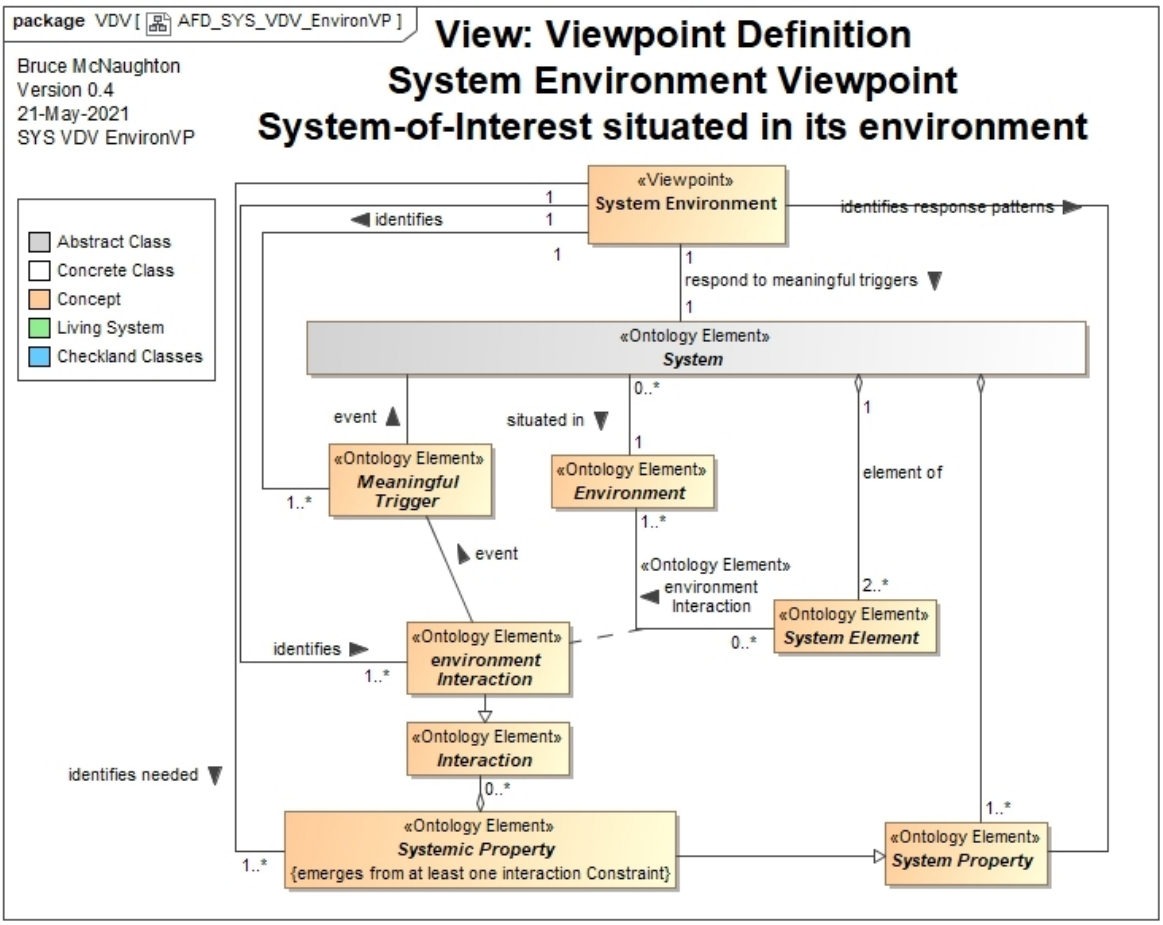
This two way interaction is the essence of the fit of the system-of-interest and the environment. This mutual causality establishes a level of interdependence both horizontally and vertically in the context of other systems.

The environment may also place constraints on the system-of-interest. These constraints are important looking at any of the capabilities / functions of the system.

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

The models that can be used to describe the fit with the system environment are:

- Conceptual Models (concepts and interactions) of other systems in the environment.
- The behavioural models can also be used in this section:
  - Activity Diagram
  - Causal Loop Diagram
  - Sequence Diagram.
  - State Machine Diagram

Steps to Create the View

- Identify or create a conceptual model of the context where the system is situated.
- Identify the triggers and the resulting interactions with the system properties (this can look like the behavior (structural changes) view).
- Create any of the behavioural diagrams (if necessary)
- Review the various diagrams.

Correspondences

- There should be alignment with the environmental interactions and the various system properties.
- No new functions or properties should be identified

Examples

T.B.D. Links to be provided to example System Descriptions

Sources

UML References

Notes

Provide notes and background information to track any changes or other information.

System Structure (Pattern of Organization) Viewpoint

Description

This viewpoint provides the instructions to create the System Structure (Pattern of Organization) View in a System Description.

The System Structure identifies the system elements and their relationships.

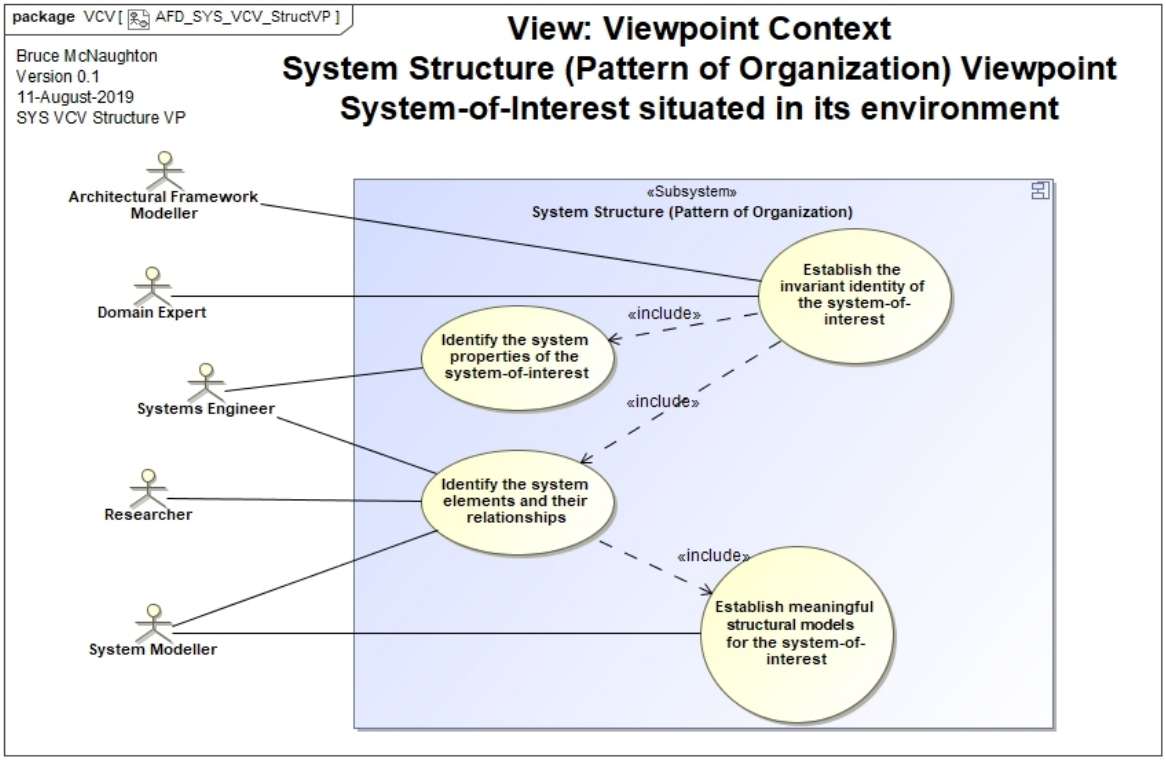
This establishes the pattern of elements that will create the systemic properties.

Rationale

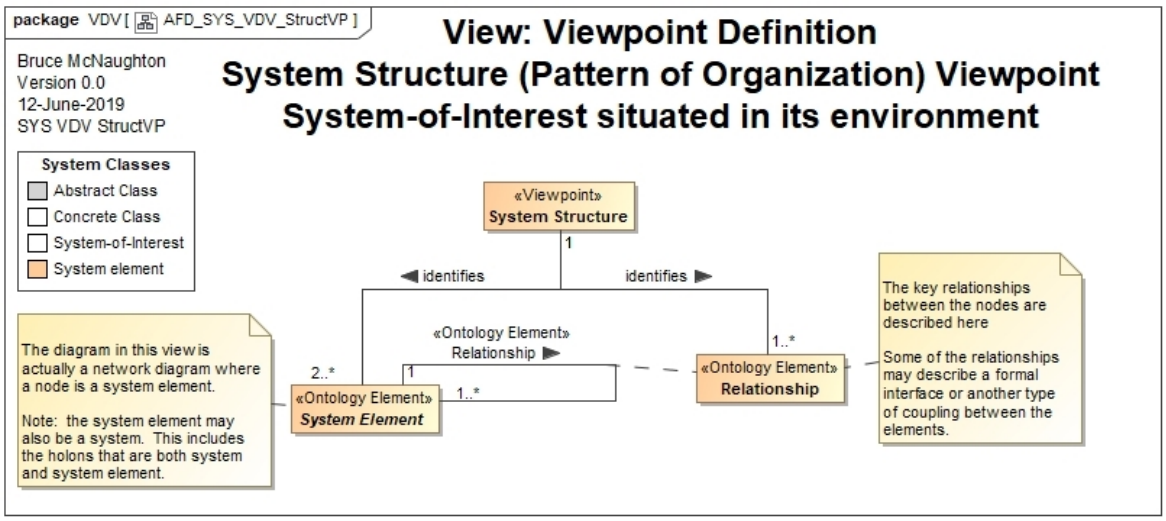
This view establishes the names and attributes of each of the system elements and defines the relationships between each of the system elements.

This view helps to establish the identity of the system-of-interest.

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

The following models help identify the system structure:

- System Breakdown Structure (SBS) Diagrams
- Conceptual Models (Class Diagrams)
- Entity Relationship Diagram
- Network Diagram

Note: The conceptual model for a system-of-interest (Figure 2 ISO 15288:2015) is also known as a System Breakdown Structure (SBS). This includes both the hierarchical representation of systems within a system and a network of systems .

These models describe both the horizontal and vertical arrangement of the system elements. These elements may highlight:

- Systems within a System (holons)
- Systems of Systems (constituent systems interacting)

Steps to Create the View

- Identify the models to create for the view
  - At a minimum, a System Structure or SBS Diagram (system element identification)
- Create the models
- Validate the models through a review.

Correspondences

- Identify and rules or constraints that must be followed to complete this view

Examples

SoI: System (Abstract)

SoI: Enterprise (SoS)

SoI: Person

SoI: Farm as an Enterprise situated in an Ecosystem See: System Description with Structure Section

Sources

State any references or people that have helped to define this viewpoint.

Notes

Provide notes and background information to track any changes or other information.

Pattern of Organization Viewpoint

Description

This viewpoint provides the instructions to create the Pattern of Organization View in a System Description.

The Pattern of Organization identifies the system elements and their relationships.

This establishes the pattern of elements that will create the systemic properties.

The network pattern is the typical pattern used for this view.

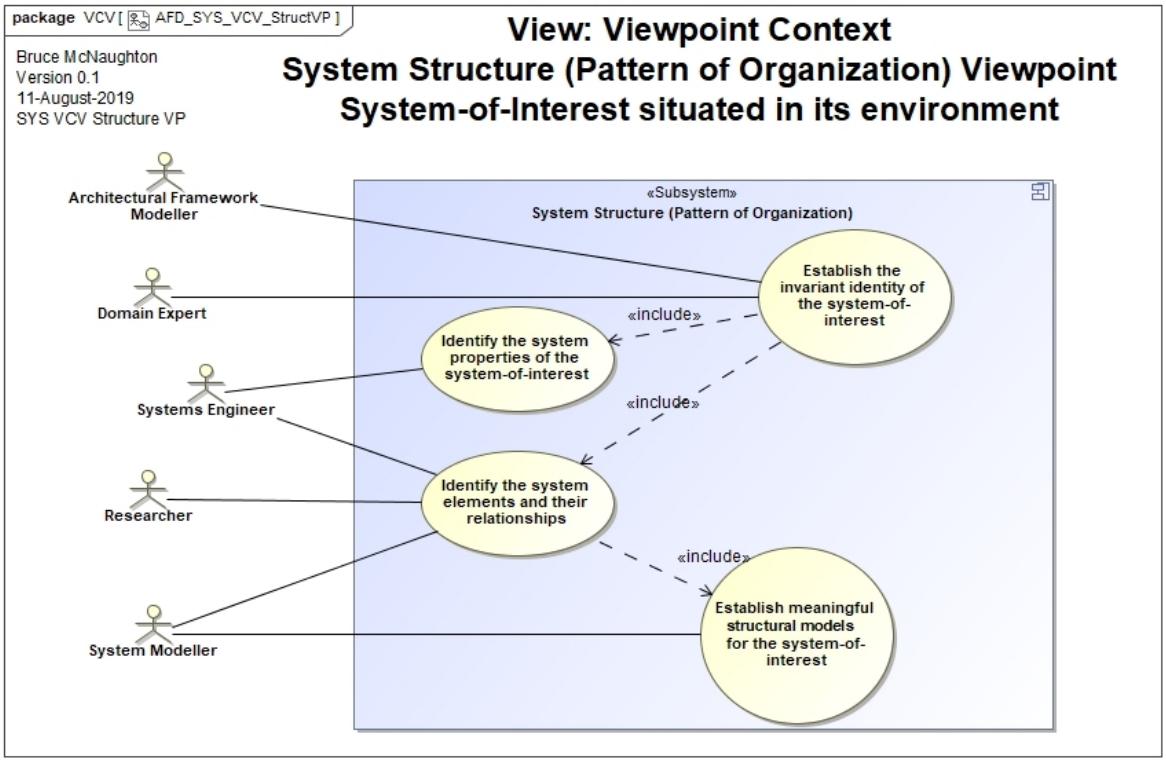
Rationale

This view establishes the names and attributes of each of the system elements and defines the relationships between each of the system elements.

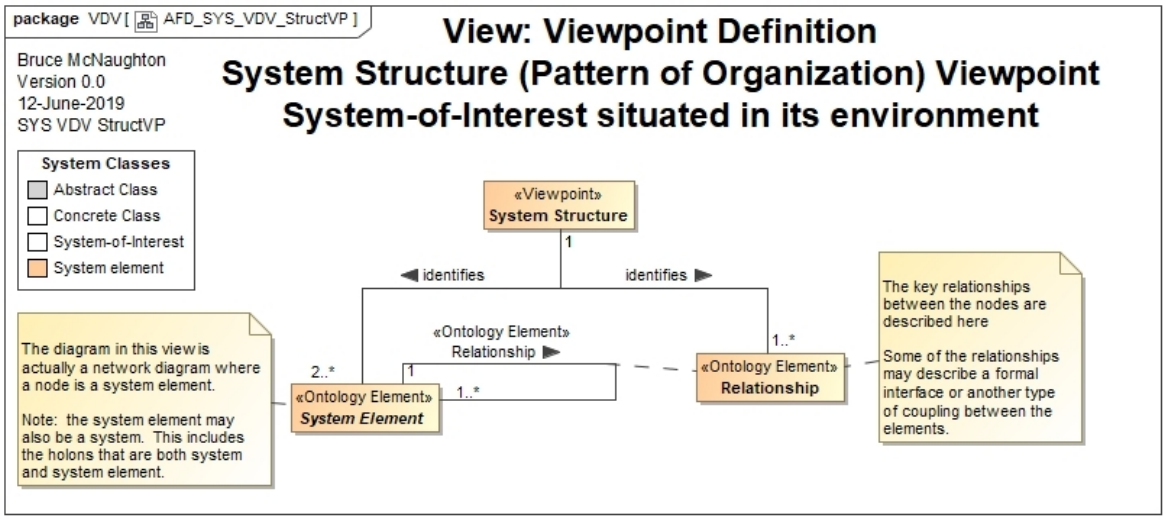
These elements and relationships remain constant across the many options / alternatives or instances of this pattern in a system.

This view helps to establish the identity of the system-of-interest.

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

The following models help identify the system structure:

- System Breakdown Structure (SBS) Diagrams
- Conceptual Models (Class Diagrams)
- Entity Relationship Diagram
- Network Diagram

These models describe both the horizontal and vertical arrangement of the system elements. These elements may highlight:

- Systems within a System (holons)
- Systems of Systems (constituent systems interacting)

Steps to Create the View

- Identify the models to create for the view
- Create the models
- Validate the models through a review.

Correspondences

- Identify and rules or constraints that must be followed to complete this view

Examples

SoI: System (Abstract)

SoI: Enterprise (SoS)

SoI: Person

SoI: Farm as an Enterprise situated in an Ecosystem See: System Description with Structure Section

Sources

UML Reference.

Notes

This version of the viewpoint uses terminology for living systems.

System Behaviour (Structural Changes) Viewpoint

Description

This viewpoint provides the instructions to create the System Behaviour (Structural Changes) View in a System Description..

The view provides insight into the dynamics of the system-of-interest in use or operation of a specific configuration of system elements and interfaces.

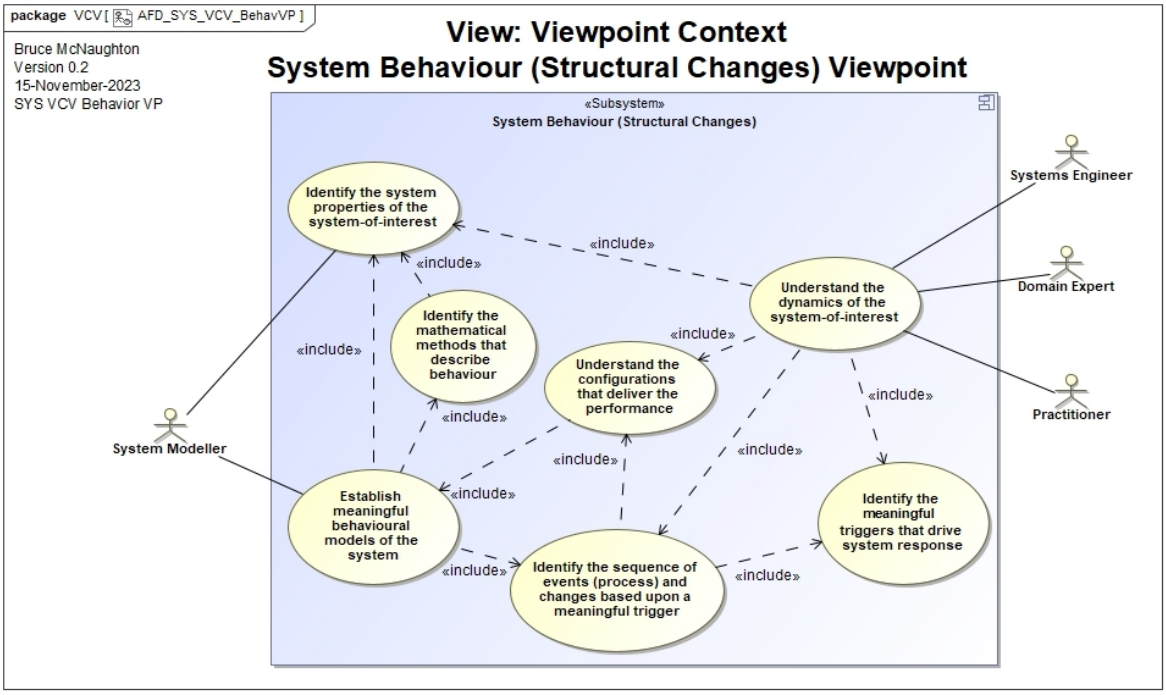
The models provide a way to visualise systemic properties such as performance variables over time.

The models also give insight into the various state changes and the routine operations and development operations that are visible in the system-of-interest

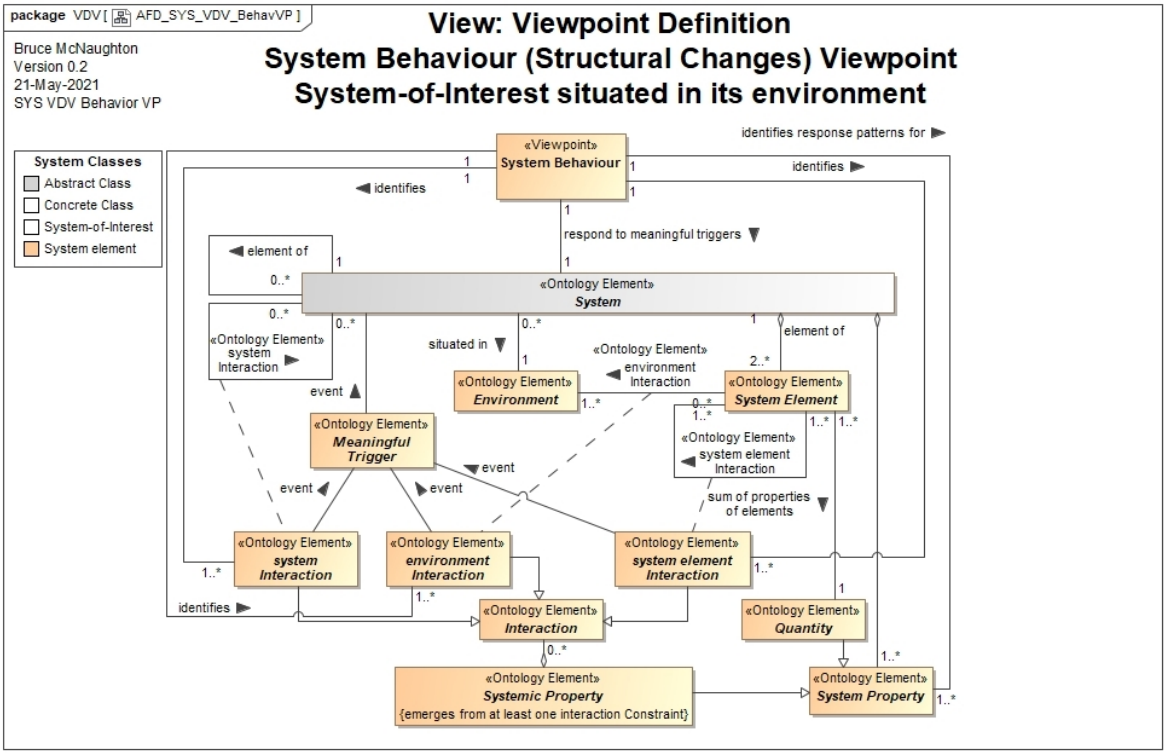
Rationale

The dynamic nature of a system-of-interest is important to understand both in the early stages of understanding or development as well as in the actual use or operation of the system-of-interest.

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

Typically the following models would help describe behaviour or structural change:

- Sequence Diagrams (UML)
- State Machine Diagrams (UML)
- Activity Diagrams (UML)
- Causal Loop Diagram (CLD)

In addition, many mathematical models apply:

- Transfer Functions
- State Space Models
- Markov Chain (probability of state change)
- Monte Carlo Methods (simulation based upon probabilities)

Steps to Create the View

- Identify the models to create.
- Create the models
- Review the models

Correspondences

- Ensure that all elements in models are contained in a model repository and defined only once.

Examples

T.B.D. Links to be provided to example System Descriptions

Sources

UML references.

Notes

See the System AFD.

Structural Changes Viewpoint

Description

This viewpoint provides the instructions to create the Structural Changes View in a System Description.

The view provides insight into the dynamics of the system-of-interest in use or operation of a specific configuration of system elements and interfaces.

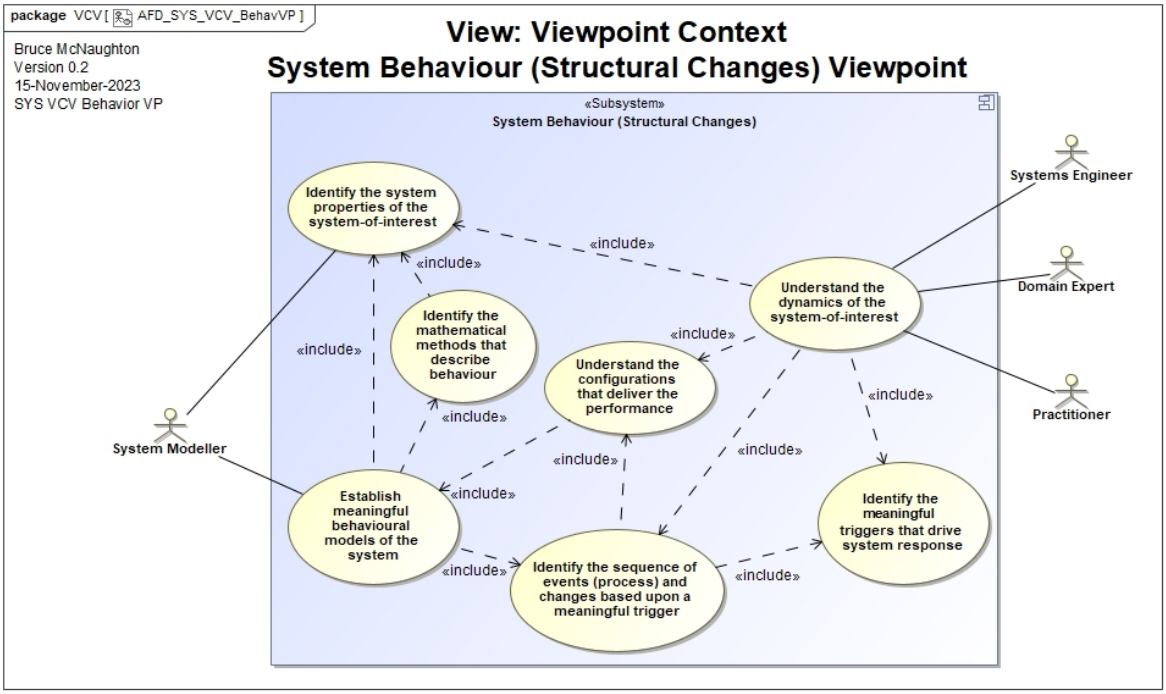
The models provide a way to visualise systemic properties such as performance variables over time.

The models also give insight into the various state changes and the routine operations and development operations that are visible in the system-of-interest

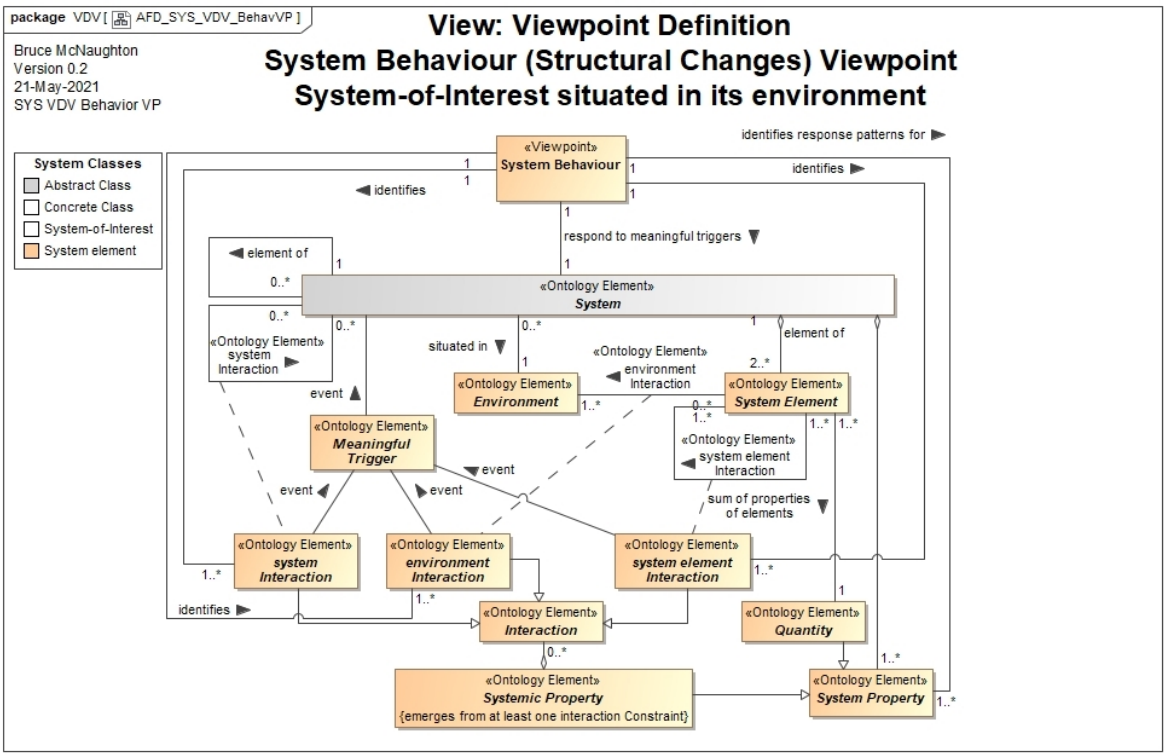
Rationale

The dynamic nature of a system-of-interest is important to understand both in the early stages of understanding or development as well as in the actual use or operation of the system-of-interest.

Stakeholders and their Concerns



Ontology Concepts and System Descriptions



Models

Typically the following models would help describe behaviour or structural change:

- Sequence Diagrams (UML)
- State Machine Diagrams (UML)
- Activity Diagrams (UML)
- Causal Loop Diagram (CLD)

In addition, many mathematical models apply:

- Transfer Functions
- State Space Models
- Markov Chain (probability of state change)
- Monte Carlo Methods (simulation based upon probabilities)

Steps to Create the View

- Identify the models to create.
- Create the models
- Review the models

Correspondences

- Ensure that all elements in models are contained in a model repository and defined only once.

Examples

T.B.D. Links to be provided to example System Descriptions

Sources

State any references or people that have helped to define this viewpoint.

Notes

Provide notes and background information to track any changes or other information.