Top Level System Classification
System Descriptions

Abstract

This document contains system descriptions for Top Level System Classification that integrates the Living Systems approach from Fritjof Capra and the system classification system from Peter Checkland.

The top level system classes are the following:

- Natural Systems
- Human Activity Systems
- Designed Physical Systems
- Designed Abstract Systems
- Transcendental Systems

These systems provide a top level system classification for all identified systems. This Top Level System Classification highlights the impacts and potential of human activity for the Anthropocene.

PDF: System Description: System (Abstract), Version 0.30, 27-December-2023 (working draft)

Link to the System Patterns PDF

Link to the Top System Classifications PDF

Author and Version

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Contents

Revision History

V0.1 20-August-2022 Revise the various system descriptions to latest understanding.

V0.0 05-July-2019 Initial Draft

Top Level System Classification Overview

This document contains system descriptions for Top Level System Classification that integrates the Living Systems approach from Fritjof Capra and the system classification system from Peter Checkland.

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System Classification Framework

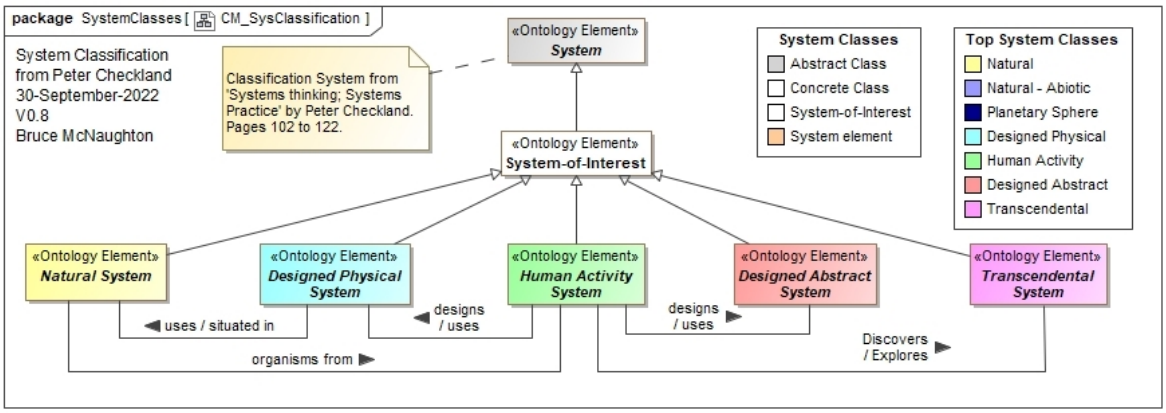
A System Classification Framework provides a way to position a system-of-interest in a wider context of systems. This System Classification Framework is used to:

- 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:



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

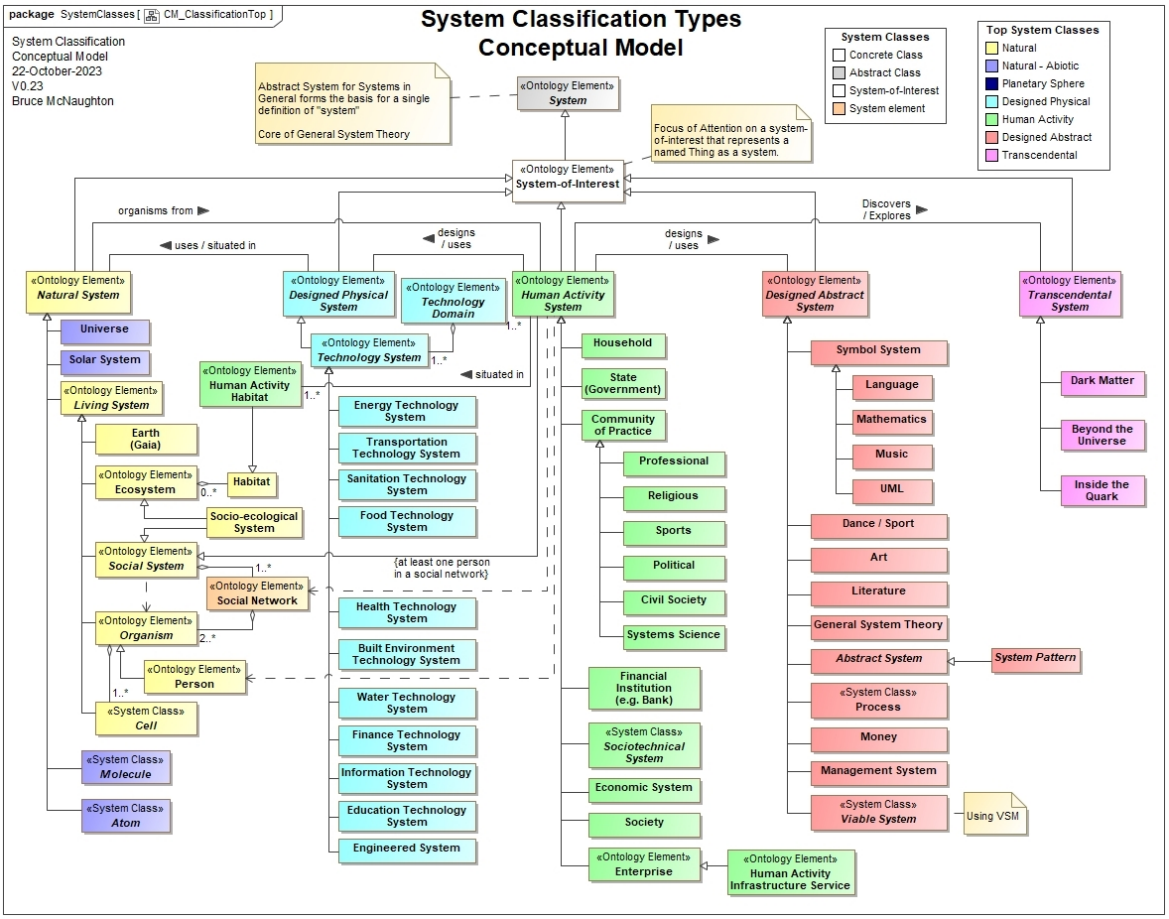
- Deterministic System
- Animated System

- 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:



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.

Natural Systems

View: System Name and Class

Name: Natural System

Based on: System (Abstract)

View: System Purpose

Each system will have its own purpose. Many of the systems identified will have their purpose within the context of an Ecosystem.

- Provide a natural physical environment for life to flourish (land, water, mountains, etc.)
- Evolve the biological organisms living on Earth

View: System Properties

Systemic Measurable Variables

The emergent properties created or used through the interaction of the elements. This includes both desired and undesired.

Systemic Capabilities or Functions

Each natural system will have their own unique capabilities or functions.

- Home for all species of living organisms
- Maintaining an environment for life (oxygen, water, food, land, etc)
- Events (volcanoes, storms, earthquakes, etc)

System States

The various defined states that the system-of-interest can be in.

- Architectural states
- Transformational States
- Operational States

View: System Stakeholders and Concerns

The stakeholders for a Natural System are formed in a Human Activity System where the members have an interest in the system-of-interest. There may be associated Human activity systems that form a cross-disciplined team to explore more of the aspects of a particular system. In addition to the humans (organisms), the following additional systems are also stakeholders:

- all organisms living in an ecosystem (whole planet or specific ecosystem)
- Any abiotic systems in the ecosystem (whole planet or specific ecosystem)

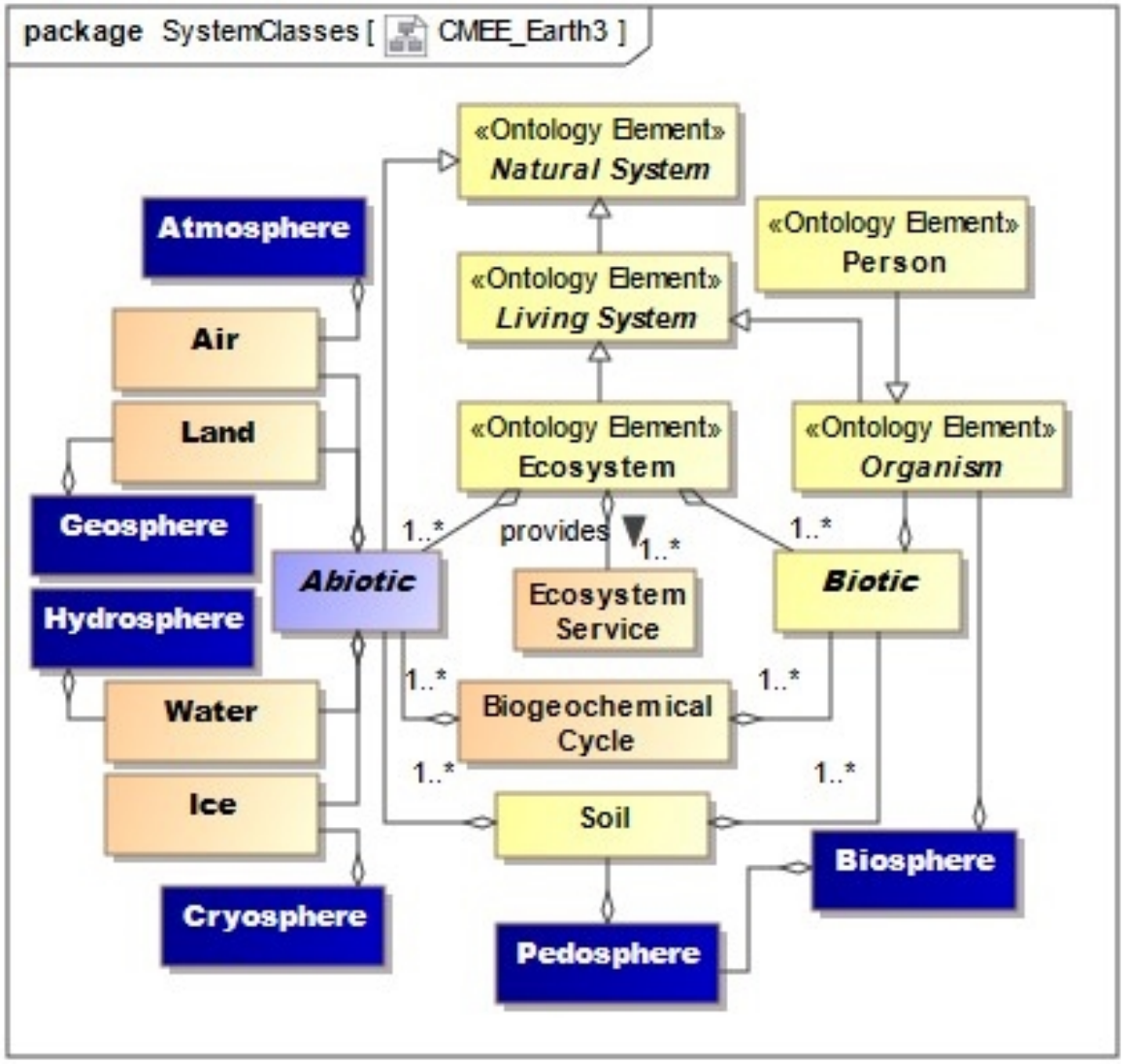
View: System Environment (Context)

Each natural system will have their own unique boundaries and environment. Many of these are established by the ecosystem for the system-of-interest:

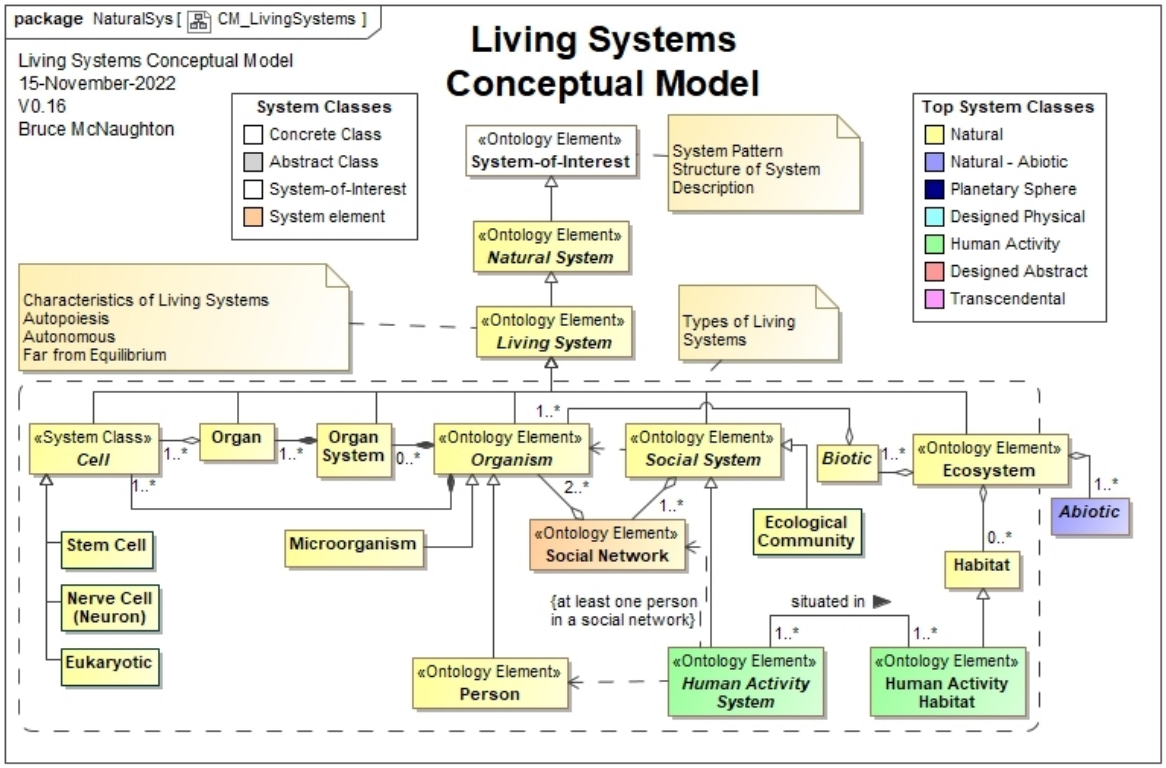
- Boundaries are established with the other types of systems
- Finite capacity and finite ability to maintain system integrity
- Interaction with other parts of the solar system (meteors, solar flares, etc).

View: Pattern of Organization

Natural Systems consist of the following types of systems:



The following diagram highlights the types of Living Systems which are types of Natural Systems.



The natural systems provide a basis for the identification of ecosystems that include the following:

- Land (mountains, under sea, etc)
- Organisms (humans, animals, plants, trees, bacteria, etc)
- Water (including the water cycle).
- Atmosphere (air, protection, etc).

Note: A social system consists of organisms. This accounts for the social systems for ants, Bees and other living systems. When the social system contains one or more people, the social system is called a Human Activity System (HAS)..

View: Structural Changes

Configuration / Scenario:

Describes any configuration / scenario attributes for a specific system-of-interest. This may not be appropriate for all system descriptions (e.g. patterns or abstract systems).

Cyclical (Repeating / Regular) Processes

Natural Systems have a number of types of regular / repeating cycles. Most have regular cycles based upon time.

- Daily Cycle
- Monthly Cycle
- Annual Cycle

Others have patterns based upon the characteristics of the elements within the system:

- Biogeochemical Cycle

Development Life Cycle Processes

Natural Systems also have their own development life cycles that depend upon the environment and the system characteristics. Some of these are:

- Evolution due to normal reactions to change
- Catastrophic events
- Man made changes and events

System: Human Activity System (HAS)

View: System Name and Class

Name: Human Activity System (HAS)

Based on: Social System

The main difference between a social system and the Human Activity System (HAS) is that at least one member of the social network is a Person (Human Being). The capabilities of the Person (Human Being) significantly alter the communication within the social network. Human Beings also are able to create and use symbol systems.

Each specific type of Human Activity System (HAS) will have its own System Description. Key definitions and context are found in the Social System System Description

Abstract System: This system has been identified as an abstract system that cannot be implemented directly. The abstract system establishes a shared pattern of characteristics that any system can use to describe its unique characteristics when referenced in the 'based on' list above. These references are described using a generalization association in UML.

View: System Purpose

The purpose of a Human Activity System (HAS) depends upon the specific type of system. Some examples might be:

- Provide a way for humans to live on Earth (Gaia)
- Promote collaboration, creation, maintenance, etc.
- Create community.

View: System Properties

Systemic Measurable Variables

The emergent properties created or used through the interaction of the elements. This includes both desired and undesired.

Systemic Capabilities or Functions

Systemic Capabilities or Functions depend upon the specific type of Human Activity System (HAS). Some examples might be:

- A place for a person to grow and develop
- Households create / consume to live
- Economic properties

System States

The various defined states that the system-of-interest can be in.

- Architectural states
- Transformational States
- Operational States

View: System Stakeholders and Concerns

The stakeholders of a Human Activity System (HAS) depend upon the specific type of system. Typically the classes of stakeholders are those who:

- establish the needs and requirements of a System (Abstract)
- architect and design a System (Abstract)
- are members of the Human Activity System (HAS)
- benefit from the System (Abstract)

View: System Environment (Context)

The elements of the Environment for the Human Activity System (HAS) depends upon the specific type of system. At a minimum, the other types of system in the classification system will be present. These are:

- Natural Systems provide the place for living and food supplies
- Designed Physical Systems provide protection from environment, and productivity improvements.
- Designed Abstract Systems provide beauty, arts and music capabilities. Also mental capabilities of

books, etc.

- Transcendental Systems provide areas to explore in our understanding of the world.

The Human Activity System (HAS) is a part of the Human Activity Habitat which is part of the Ecosystem where the system is located.

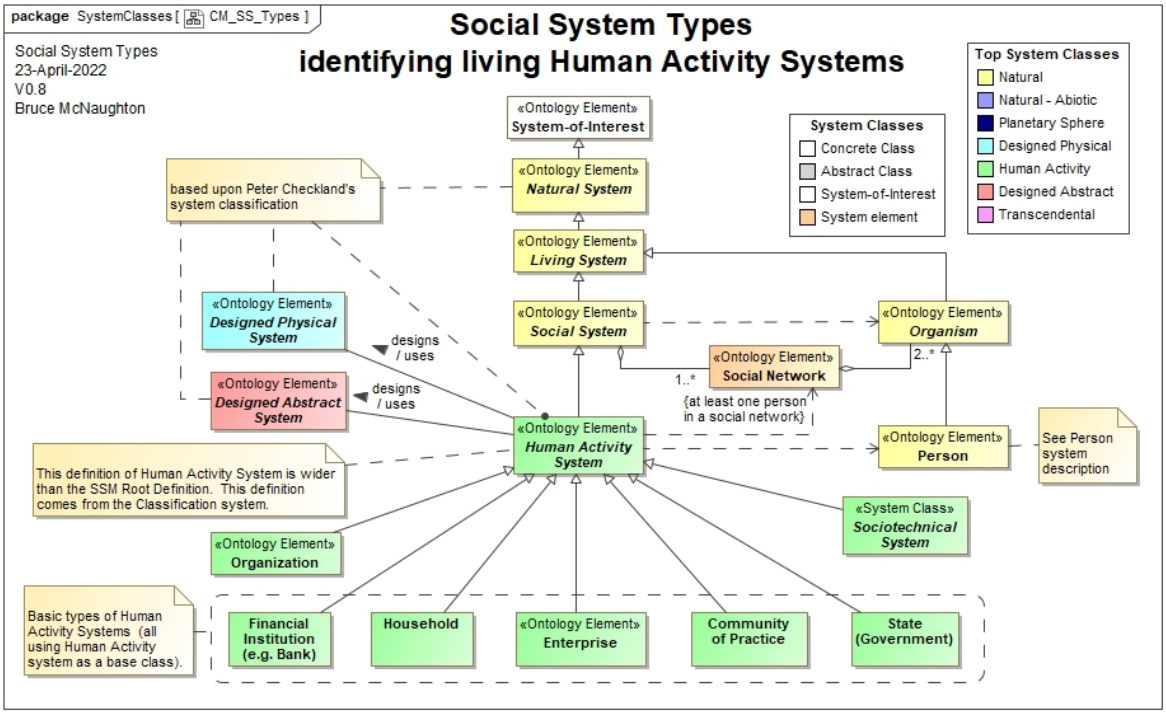
View: Pattern of Organization

System Element: Identification

The members of the social network contain at least one Person (Human Being).

The social structures for human activity systems tend to be written to ensure a shared understanding. They do not need to be written.

The culture developed for the human activity system is created through communication to coordinate actions and behaviour.



Each of the types of Human Activity Systems will have their own System Description unique to the specific type of Human Activity System (HAS).

View: Structural Changes

Configuration / Scenario:

Describes any configuration / scenario attributes for a specific system-of-interest. This may not be appropriate for all system descriptions (e.g. patterns or abstract systems).

Cyclical (Repeating / Regular) Processes

Each system has regular patterns of renewal, maintenance, etc Some are annual, monthly or daily.

Development Life Cycle Processes

Human activity systems are created, maintained and released based upon the various developmental phases of the specific type of systems life cycle (e.g. government, enterprise, household, financial institution, communities, etc). Other governance activities may arise as each system is created and operated.

Designed Physical Systems

View: System Name and Class

Name: Designed Physical System

Based on: System (Abstract)

Abstract System: This system has been identified as an abstract system that cannot be implemented directly. The abstract system establishes a shared pattern of characteristics that any system can use to describe its unique characteristics when referenced in the 'based on' list above. These references are described using a generalization association in UML.

Designed Physical Systems relate to Technology Systems and may be part of a specific technology domain. See Technology System for additional information.

View: System Purpose

Each Designed Physical System will have its own purpose as agreed by the stakeholders of a Human Activity System (HAS) responsible for the creation of a Designed Physical System. Some of these purposes may include:

- To improve productivity of human endeavors / life
- To provide protection for natural systems (flood protection, etc.)
- To provide protection for ecosystems and the biodiversity in these ecosystems.

View: System Properties

Systemic Measurable Variables

The emergent properties created or used through the interaction of the elements. This includes both desired and undesired.

Systemic Capabilities or Functions

Each designed physical system will have unique capabilities and functions as agreed by stakeholders in the Human Activity System. Some examples of these are:

- Function / Capability Provided (take from A to B, dig hole, bridge across river).
- Performance improvement
- Costs / benefits
- Expected life time (time to replace).
- Events (Accident, breakdown, etc)
- States (in development, in use, etc)

System States

The various defined states that the system-of-interest can be in.

- Architectural states
- Transformational States
- Operational States

View: System Stakeholders and Concerns

The stakeholders of a Designed Physical System are members of a Human Activity System (HAS) such as:

- The designers and funders of the System (Abstract)
- The creators or developers of the system (with unique skills).
- The users of the System (Abstract)
- Those people who benefit from the system.

View: System Environment (Context)

Each designed physical system will have their own unique environment as identified by the stakeholders of a Human Activity System (HAS). Some of these consist of:

- Interaction with the Natural Systems (use of resources, interface with natural systems)
- Interaction with humans or other animals (organisms).
- Interface with other designed systems.
- Created, maintained and released by human activity systems and their life cycle (see below).

View: System Structure (Pattern of Organization)

Each designed physical system will be a system-of-interest for a human activity system. The structure of the system-of-interest will typically be a System Breakdown Structure This may be at any level of detail. These examples are examples of domains of Designed Physical System that are found in the following types of Human Activity Infrastructure Service (HAIS).

- Transportation Systems.
- Energy Systems
- Food production systems.
- Built environment (homes, office buildings, sport facilities, etc)
- Communication Systems.
- Computational Systems
- Realized components interacting in the system
- (See Human Activity Infrastructure Services)

View: System Behavior (Structural Changes)

Configuration / Scenario:

Describes any configuration / scenario attributes for a specific system-of-interest. This may not be appropriate for all system descriptions (e.g. patterns or abstract systems).

Cyclical (Repeating / Regular) Processes

There are a number of types of regular / repeating processes in designed physical systems. These will be unique to the system-of-interest and may be in the areas of:

- Operations (regular operations).
- maintenance / repair / event handling

Development Life Cycle Processes

Each Designed Physical System will have a unique life cycle. Some characteristics are:

- Typical product / system development life cycle (e.g. ISO 15288:2015)
- Generally created by a human activity system.

Designed Abstract Systems

View: System Name and Class

Name: Designed Abstract System

Based on: System (Abstract)

Abstract System: This system has been identified as an abstract system that cannot be implemented directly. The abstract system establishes a shared pattern of characteristics that any system can use to describe its unique characteristics when referenced in the 'based on' list above. These references are described using a generalization association in UML.

Designed Abstract Systems are those that can represent the following types of systems:

- Symbol System (Abstract) (Language, Music, Mathematics, etc)
- System (Abstract)
- Money

Note: Designed Abstract Systems may be part of the development life cycle of a designed physical system. Such as a process or architecture. These would be used to help develop the designed physical system.

View: System Purpose

The purpose of a Designed Abstract System is to provide an opportunity for humans to describe a system that may not exist (architecture) or a set of concepts in the mind (conceptual model) that can be described as a system. Some of these types are:

- Enjoyment (art, music, poetry, stories, sports, etc.)
- Understanding the world (mathematics, science, research, etc.)
- Understanding Systems (abstract systems)
- Symbol Systems (Language, Mathematics, Music, etc)

View: System Properties

Systemic Measurable Variables

The emergent properties created or used through the interaction of the elements. This includes both desired and undesired.

Systemic Capabilities or Functions

- Shared understanding or meaning
- Communication
- Beauty
- Accuracy
- Factual

System States

The various defined states that the system-of-interest can be in.

- Architectural states
- Transformational States
- Operational States

View: System Stakeholders and Concerns

The stakeholders of the designed abstract system are:

- The designers / creator s of the System (Abstract)
- The users of the System (Abstract)
- Those who benefit from the System (Abstract)

View: System Environment (Context)

The environment depends upon the type of Designed Abstract System. Some examples are:

- Human activity systems (creation, maintenance, improvement, etc)
- Designed Physical System
- Natural System (reflection of our natural world).

View: System Structure (Pattern of Organization)

The pattern of organization depends upon the specific Designed Abstract System. Some examples are:

- Mental images written down
- Conceptual Models (abstract design) based upon a network of connected concepts
- Skills development
- Documented information about the system.

View: System Behavior (Structural Changes)

Configuration / Scenario:

Describes any configuration / scenario attributes for a specific system-of-interest. This may not be appropriate for all system descriptions (e.g. patterns or abstract systems).

Cyclical (Repeating / Regular) Processes

- Trigger: event starting a process; Process: a response to the trigger relative to the Designed Abstract System.

Development Life Cycle Processes

- Life cycles of development of abstract things (art, music, poetry, stories, etc).

Transcendental Systems

View: System Name and Class

Name: Transcendental System

Based on: System (Abstract)

View: System Purpose

Each system being explored will have a unique purpose. This type of system begins to create a system description for this type of named system:

- To understand things beyond our current knowledge
- (Ref: Boulding, systems beyond knowledge).

View: System Properties

Systemic Measurable Variables

The emergent properties created or used through the interaction of the elements. This includes both desired and undesired.

Systemic Capabilities or Functions

Each system will have their own unique types of capabilities or functions. As these emerge, they will be identified in this section. Some examples are:

- Intuition
- Spirituality
- Dark Matter
- Beyond the universe

System States

The various defined states that the system-of-interest can be in.

- Architectural states
- Transformational States
- Operational States

View: System Stakeholders and Concerns

At a minimum, there will be a Human Activity System established to explore this named area. This HAS will establish a set of stakeholders and a community of practice to explore this area. This team will:

- Explore and establish elements of a system description.
- Agree on boundary, shared terminology and definitions for this system
- Open to new ideas and innovation

View: System Environment (Context)

The environment consists of the existing identified systems in the overall classification. Any of these existing systems can be used to help identify or provide base information.

- Full classification system to date to inform the new systems
- Use of cross discipline explorations into related areas.

View: Pattern of Organization

Each system will have their own pattern of organization

- Conceptual Framework of Ideas
- System elements
- System properties (phenomenon we don't understand but experience)

View: Structural Changes

Configuration / Scenario:

Describes any configuration / scenario attributes for a specific system-of-interest. This may not be appropriate for all system descriptions (e.g. patterns or abstract systems).

Cyclical (Repeating / Regular) Processes

Routine operational processes to maintain the system
Provides support to deliver the capabilities or functions of the system.

Development Life Cycle Processes

Each system will have their own development life cycles. These will be identified in this area.

- New idea formulation
- Relationships to other classifications and their type of life cycle.
- Possible emergence of new life cycle concepts

References

The Systems View of Life, Fritjof Capra and Pier Luigi Luisi

The Systems View of Life

This book is supported by the Capra Course which provides a 12 week course covering the four dimensions of life: Biological, Cognitive, Social, and Ecological.

A Capra Course Glossary is available in the Capra Course Alumni Network - A global Community of Practice related to the book.

See chapter 14 for information on social systems.

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

Doughnut Economics, Kate Raworth

Doughnut Economics

Two models in the book are being used heavily in the development of the Human Activity Ecosystem models: The **Doughnut** and the **Embedded Economy**. The Doughnut is like a balanced scorecard for the planet and the Embedded Economy model is a good starting point to explore the systems that are creating the doughnut problems and the changes that are needed to bring the world into the doughnut safe and just place.

Kate Raworth and Herman Daly Video

Doughnut Economics pictures used with permission, Kate Raworth, 2017
