



**Systemic Framework for
Enterprise Architecture & Transformation**

Theoretical Foundations

Introduction

- This document is an integral component of the SysFEAT architectural framework. It provides foundations to address the challenges posed by Enterprise Architecture in the 21st century, which include :
 - Increasing complexity in system structures and behaviors.
 - Growing intricacy in architecture, management and governance of these systems.
 - The mission of the framework is to demystify these complexities, ensuring they are comprehensible to a broad audience, thereby facilitating the design and management of complex-systems across all scales, from micro-systems to enterprise level systems.
- Enterprise Modeling refers to the overarching language and conceptual framework used to describe, understand, and communicate the complex structures and dynamics of an enterprise and its sub-systems.
- The following slides present the **theoretical foundations** used by SysFEAT to establish the discipline of enterprise and system modeling.

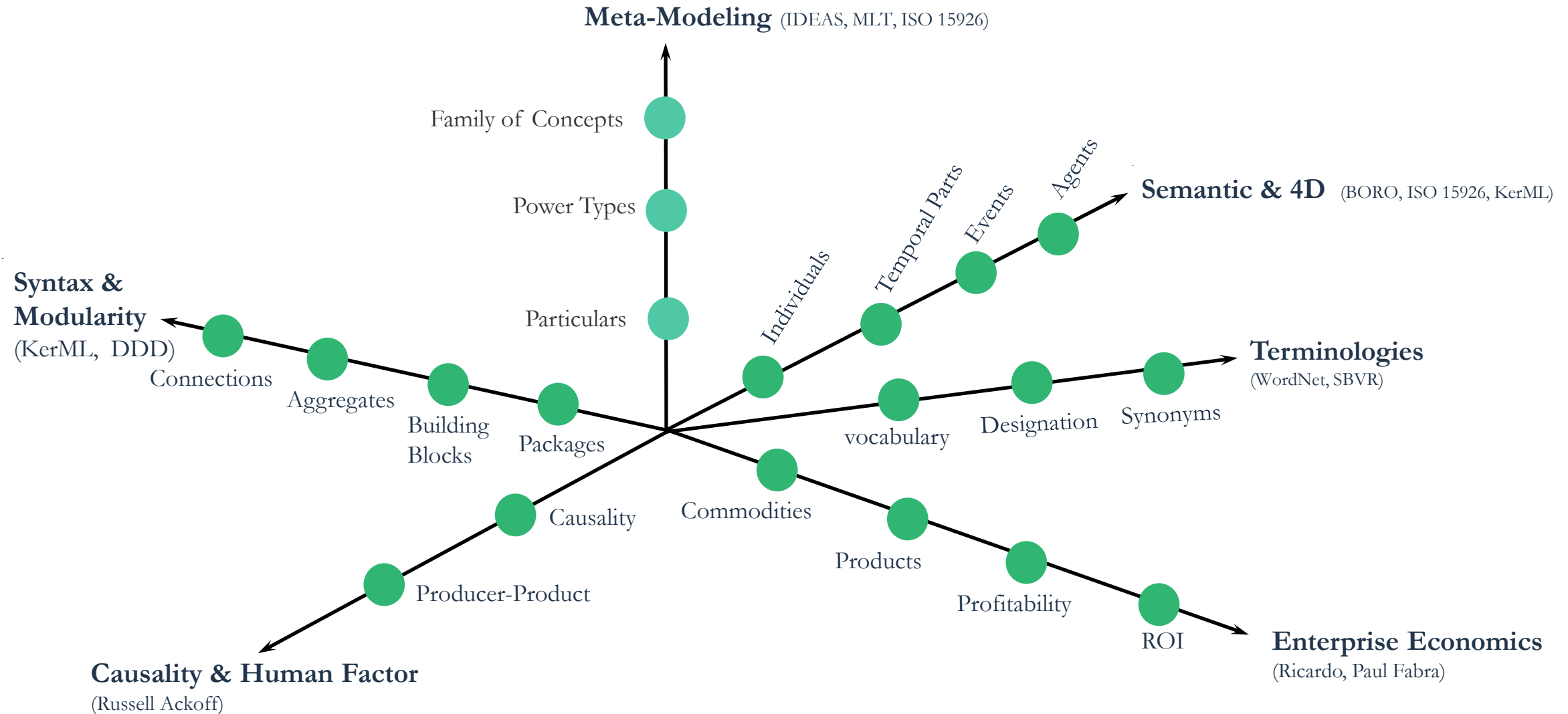
Introduction - Meta-ontological choices

- SysFEAT is at the cross-road of multiple initiatives in the domain of ontological-based approach to architecture and management.
- It has looks at multiple modeling standard to get the best of bread of each, while extending them when functional parts as missing (such as Compositionality).

Summary of SysFEAT theoretical foundations

- Lexical scoping: provide a directed formalization of locality of relationships.
- Compositionality : provide locality (contexts and boundaries) at the syntax level.
- Typology: provide open classifications based Higher-order meta-modeling: be able to handle multiple abstraction dimensions.
- Time: the 4D approach – ISO 15926 – Matthew West - BORO
- KerML (synthesis of mereological inclusion and topological inclusion).
- Systemic approach:
 - Russell Ackoff for holistic organization structures and human decisions.
 - Causality and Human factor:
- Terminology support
- Effective organization - Modular ROI, from Paul Fabra and Dominique Michaut for product driven enterprise and sound profitability driven enterprises.

Foundations for SysFEAT



Terminology

*"To name things wrongly is to add to the misfortune of the world."
— Albert Camus (related sentiment)*

WordNet resource

- Before building a domain ontology, provide a **head start** so you aren't starting from scratch with every concept and relationship WordNet acts as a **semantic scaffold**:
- Essentially, it gives you a **head start** so you aren't starting from scratch with every concept and relationship.
 - It helps define **classes and subclasses**.
 - It disambiguates **word senses**.
 - It expands **vocabulary and synonyms**.
 - It ensures **semantic consistency**.
 - It supports **inference and reasoning** once the ontology is operational.
- SysFEAT wordnet resources:
<https://www.framework.sysfeat.com/pages/0ffefae6600be4de.htm>

Example: “Is Human a Sub-Type of Person ?”

- Looking at “*Person*” in WordNet: <https://en-word.net/ili/i35562>
- Looking at “*Human*” in WordNet: <https://en-word.net/ili/i48657>
 - => they are synonyms when considered as singular entities and unrelated when looking at biological classification.
- Lesson learned: **don’t start from a blank page !**

Person

Nouns

(n) individual, mortal, person, somebody, someone, soul *a human being; person, singular, assertive existential pronoun; pronoun, person, singular; quantifier: assertive existential “there was too much for one person to do”*

Hypernyms (1)

Hyponyms (60)

Derived Forms (4)

Holonyms (member) (1)

Meronyms (part) (2)

Human

Nouns

(n) homo, human, human being, man *any living or extinct member of the family Hominidae characterized by superior intelligence, articulate speech, and erect carriage*

Hypernyms (1)

(n) hominid *a primate of the family Hominidae*

Hypernyms (1)

Hyponyms (7)

Derived Forms (1)

Holonyms (member) (1)

SBVR - Semantics of Business Vocabulary and Business Rules

- SBVR is an OMG specification about *"documenting the semantics of business vocabularies and business rules for the exchange of business vocabularies and business rules among organizations and between software tools."*
- Key concepts introduced by SBVR:
 - **Designation**: The formal link between a concept and the terms or phrases that represent it.
 - **Synonymy**: The explicit recognition that different terms can designate the same concept.
 - **Vocabulary & Speech Communities**: Emphasizes that meaning is defined within the context of a specific community that shares a common language (vocabulary)."
- SysFEAT references to SBVR:
<https://www.framework.sysfeat.com/pages/732afa5663d7d175.htm>

Modularity & Compositionality

Why?

Complexity is good; It is confusion that is bad

Don Norman

The DESIGN of EVERYDAY THINGS

The need for syntax: scientific foundations

- Holland, John H.. Signals and Boundaries: Building Blocks for Complex Adaptive Systems (The MIT Press) (p. 36).
 - *Typically, the rules of deduction are drawn from symbolic logic, in which the rules manipulate symbols without reference to the interpretation or the meaning of the symbols. That is, the **manipulations are syntactic**, depending only on the arrangement of the symbols. <..>*
 - *This syntactic approach comes close to being a sine qua non for theoretical science. Matters of speculation and interpretation are moved from the argument back to the premise.*
- Not only an ontology concerns, but rather an architectural concept:
 - In business and technology, this is reflected in Modularity Theory, which explains product adoption and market performance, as championed by the Christensen Institute)
 - <https://www.christenseninstitute.org/theory/modularity/>

KerML – Kernel Modeling Language

- KerML is a formal, foundational language designed to provide the precise semantics for the OMG Systems Modeling Language (SysML) v2 and other modeling standards. It serves as a minimal, rigorously defined core language that captures essential modeling constructs—such as objects, relationships, types, and behaviors—in a mathematically precise way.
- Key concepts introduced by KerML at the syntax layer:
 - **Feature**: the contextualization of a type within another type
 - **Classifier**: a type that is made of the contextualization of other types.
- Key pending issues:
 - KerML as many other foundational language relies on a non-local theory of relationships: tuples.
 - Graphs also have natively flat relations (edges between nodes).
- But:
 - Languages and models rely on locality/nesting/scoping (functions inside functions, entities inside entities, modules, namespaces).
 - Netflix initiative relies on “named-graphs” to add locality to RDF.
 - Even LLMs (like programming languages) thrive on scope, hierarchy, and compositionality.

SysFEAT layered approach of relationships

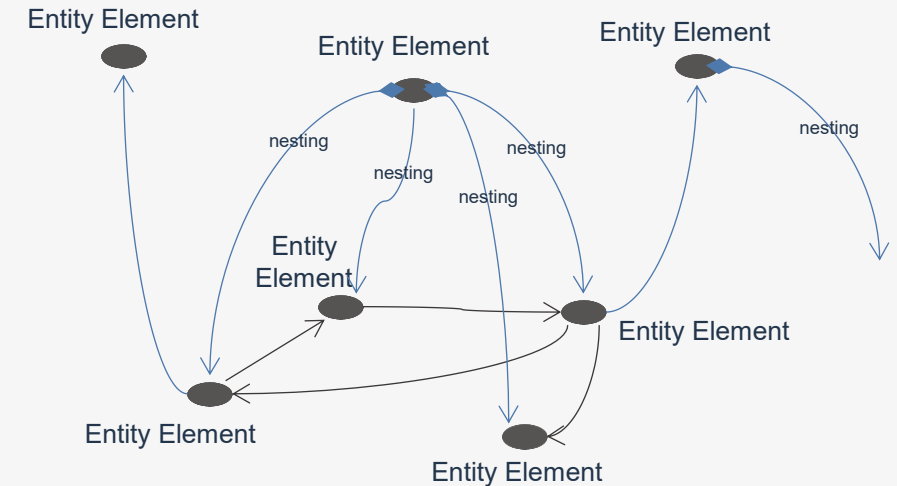
The modularity principles of SysFEAT aim at providing modular connectable structures, using a layered approach of relationships.

1. Locality of relationships is supported by Kuratowski ordered pair, which embeds order and source–target asymmetry inside set theory:

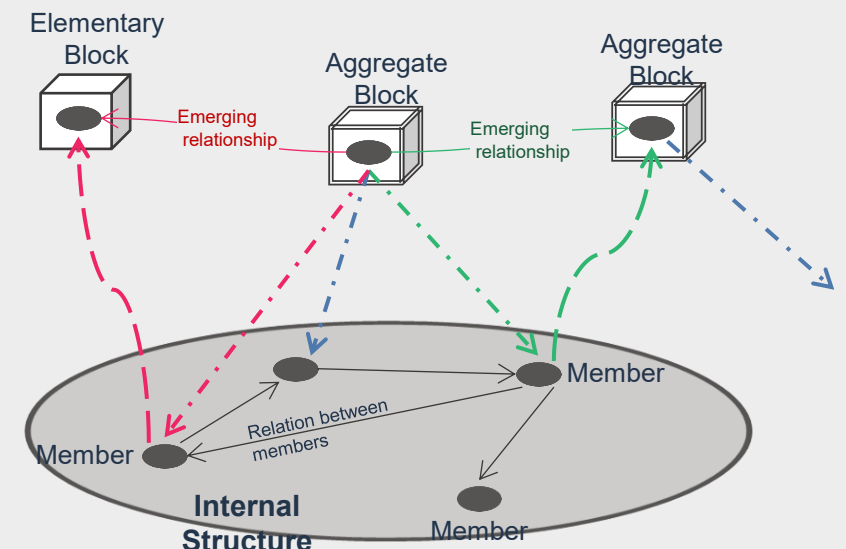
$$\langle a, b \rangle = \{ \{a\}, \{a, b\} \}$$

2. Lexical scoping provides the ability to nest entities (*namespace in KerML*).
3. Compositionality provides dynamic locality for entities (*aggregates in DDD, that and connectors in KerML*).

Elementary Graph



Secondary Graph



Metamodeling, Higher order types and conceptual partitioning

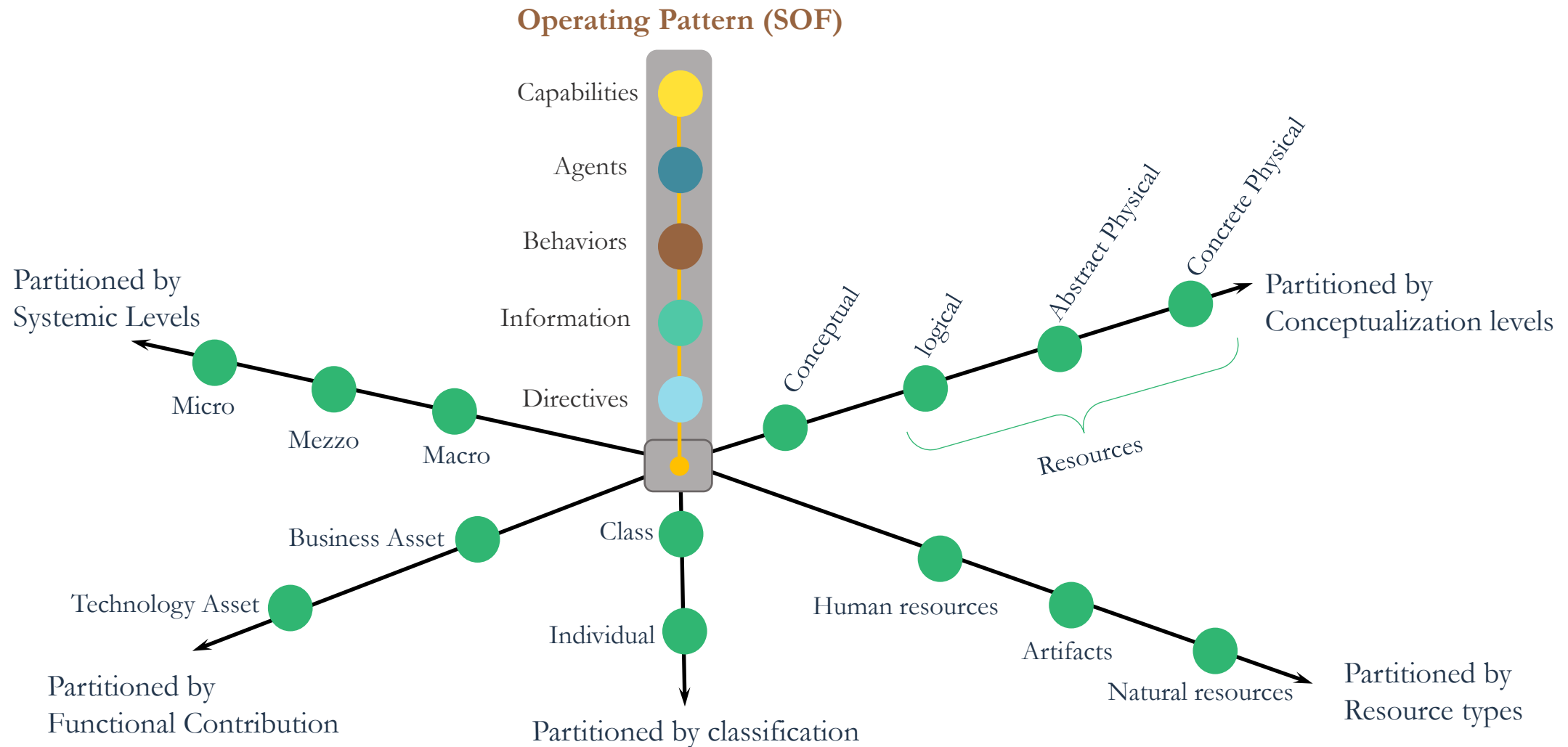
*"The major problems in the world are the result of
the difference between how nature works and the
way people think."*

— Gregory Bateson,

Metamodeling foundations.

- **Mutli-level stratification:** the word is higher-ordered.
- **Power-types as meta-classes:** it gives the foundation for a layered classification of higher order types.
- **Meta-circularity:** need for self-referential meta-classes, that live at higher levels but can instantiate themselves
 - This avoids artificial separation between meta-class levels. The system can represent and reason about itself
- Meta-Patterns: need to Partitions provides level of
- SysFEAT combines and extend ISO-15926, MLT, BORO, Cyc approaches by:
 - Grounding multiclassification on power-types (IDEAS)
 - Adding meta-circularity (Cyc), based on non-well founded set theory (Matthew West and [Stanford Encyclopedia of Philosophy](#)) and power-types.
 - Organizing conceptualization patterns as set theory partitions.

The SOF as an example of partition based conceptual patterns



4D, Time and semantics

*"He who has been can no longer not have been:
henceforth this mysterious and profoundly obscure
fact of having lived is his viaticum for eternity"*

Vladimir Jankélévitch, *L'Irréversible et la Nostalgie*.

Matthew West – ISO 15926 - BORO

- 4-dimensional foundation (Matthew West)
 - 4-dimensional spatio-temporal extents with extensional identity,
 - Dissective and non-dissective classes,
 - 4-Dimensional Patterns,
 - Replaceable parts,
 - Levels of reality for what things are constituted from,
 - Activities and events,
 - Roles as temporal parts of individuals,
 - Relationships as states with states of individuals as parts,
 - Possible Worlds for dealing with plans,
 - Classes as sets, since membership does not change,
 - Properties of various sorts including physical quantities
- SysFEAT integrate the 4D the above foundations while integrating them with KerML and the pattern of Compositionality.
 - Event as boundaries.
 - Interaction behaviors as boundaries.
 - Contextual properties to qualify internal parts.
 - Inheritance from dynamic locality (an aspect of compositionality).

Undergoing work to map with UFO (properties and identity)

- Matthew West (about properties)
 - On the other hand, the traditional idea of a property, with the notable exception of temporal properties, would seem to correspond closely to temporally disjunctive sets of individuals.
 - Thus properties are inherited by states of the spatio-temporal extent to which they apply (although it is not only individuals that can have properties).
- Mathew West (this is about UFO Kind):
 - It is interesting to note that temporally non-disjunctive sets correspond closely to the traditional idea of natural kinds, and can perhaps be thought to usefully be the 4-dimensional definition of a natural kind. (Ontology Meet business)

Causality and Human Factors

Russell Ackoff

Enterprise Economics