2.4
The ARCON modeling framework [*]

A framework is defined for ARCON reference modeling, introducing multiple modeling perspectives of: Environment characteristics, life cycle stages, and modeling intents. This novel modeling framework takes into account contributions from previous related works, mainly on enterprise modeling, and extends them further to the context of collaborative networked organizations, aiming at provision of a comprehensive environment for modeling the variety of cases of collaborative, namely the VO Breeding Environment, Virtual Organization, Professional Virtual Community, and Virtual Team.

1. INTRODUCTION

Modeling complex systems requires a proper framework to capture their complexity. Collaborative Networks (CNs) inherit their complexity from both aspects related to ***collaborations*** and aspects related to ***networks***, and thus are no exception to this rule. Inspired by the modeling frameworks introduced earlier in the literature related to these two areas (Camarinha-Matos, Afsarmanesh, 2007), (Katzy, Zhang, Loeh, 2005), (Tolle, Bernus, Vesterager, 2002), and considering the complexity of CNs (Camarinha-Matos, Afsarmanesh, 2005a, 2005b, 2004), as well as their wide variety of aspects, features, and constituting elements, the ARCON (A Reference model for Collaborative Networks) modeling framework is developed. In order to comprehensively and systematically cover all relevant aspects of the CNs, the framework of ARCON divides this complexity into a number of perspectives, as addressed in details in Section 2.

The vision behind the development of ARCON reference model for collaborative networked organizations is to develop a generic abstract representation – intended as an authoritative basis - for understanding the involved entities and significant relationships among these entities. The reference model is also intended to be used as a basis for derivation (specialization) of other specific models for particular cases in various manifestations of CNs (Camarinha-Matos, Afsarmanesh, 2007).

In other words, the aim of developing the reference model for CNs, and more specifically to the most relevant case of collaborative networked organizations (CNOs), and the specific derivations/specializations to its variety of cases is to enhance the understandability of its related concepts for the purposes of discussion among researchers, education, as well as for designing architectures for its system

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development. Considering this aim, preferably the ARCON reference model shall be based on a ***small number of unifying concepts*** addressing the most generic elements for modeling different CNOs.

In ideal terms, the most important attributes characterizing a reference model for a complex system such as ARCON, shall include:

- **Simplicity** (to increase its usability by CNO's stakeholders) – easy to understand, clear, not technical, and purely logical.
- **Comprehensive capturing of the unifying concepts** (towards holistic understanding of CNOs) – as much as possible addressing the CNO in its entirety; so that any element can be mapped against it to understand where they fit within the context of the CNO as a whole.
- **Neutrality** (applying a base uniform presentation of CNO notations) – being defined totally independent of the tools or methodologies that can further model or implement different aspects of CNOs, and such that any tool or any methodology can be mapped against it, in order to understand their implicit trade-offs (what they can or cannot do).

Stakeholders

In the development of ARCON, the following main stakeholders are considered:

- Researchers – The main target group for ARCON are CNs researchers that may use the reference model as a consolidated basis for further conceptual developments.
- Engineers and other practitioners – Professionals with a reasonable background and experience on CNs can also use the reference model as a basis for their practical developments as it is supposed to clarify the main concepts and their inter-relationships. However, clearly the ARCON alone cannot be used as a text book by people not familiar with the area of CNs.
- Decision makers – The most general components of ARCON, i.e. high level definitions of main concepts, are also useful to provide background knowledge about the area to industrial decision makers and other development policy makers.
- Educators – Similarly to researchers, educators can use ARCON models as a basis for introduction of concepts and preparation of focused training material.

Limitations

Next to the high level aims considered for developing ARCON, it is necessary to also address and consider the following limitation. Provision of theoretical definitions for ARCON components, although could support the verification of their consistency and correctness, are not fruitful at this stage of ARCON's life cycle due to the following main reasons:

1) It would not be suitable for supporting the majority of the current ARCON's stakeholders,

2) At the current stage of the CNO's reference model definition, many of the ARCON's concepts are either being introduced for the first time or are only semi-formally defined, and thus require further elaboration and research, before finalization.

2. MODELING PERSPECTIVES

For the purpose of modeling all features of the CNO components, at the highest level of abstraction, three perspectives are identified and defined in the ARCON framework, as represented in Figure 1.

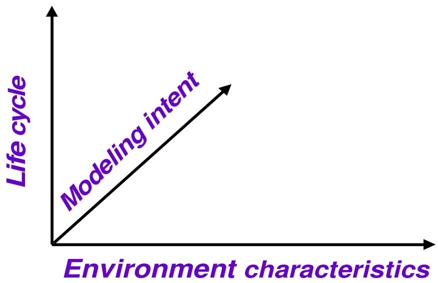


Figure 1 – Modeling perspectives in ARCON

The first defined perspective addresses the timing cycle of different CNO life stages. This perspective captures the evolution of CNOs and the diversity during their entire life cycle, represented by the vertical axis, labeled as “Life cycle stages”. The second defined perspective focuses on capturing the CNO environment characteristics, represented by the horizontal axis, labeled as “Environment characteristics”. This perspective further includes two subspaces (points of view) that comprehensively cover, the internal elements characteristics (labeled “Endogenous Elements”) of CNOs, as well as the external interactions characteristics (labeled “Exogenous Interactions”) that address the logical surrounding of the CNOs. The third defined perspective for ARCON reference modeling is related to the different intents for the modeling of CNO features, represented by the diagonal axis, labeled as “modeling intents”. This perspective addresses the three possible modeling stages for CNO elements, from the general representation, to the specific models (e.g. using a specific modeling approach or theory), and finally to the detailed specification of the implementation architecture for CNO element. These three perspectives are further described below.

When planning these three perspectives, the following main usages were considered for the ARCON development:

- Providing a model that can be instantiated to capture the definition of all potential CNOs.
- Supporting the reusability and portability of its defined concepts.
- Facilitating the co-working and co-development among the stakeholders.
- Providing the high level base for design and building of the architectural specifications of modular CNO components.
- Providing insight into the modeling tools/theories that are appropriate for mapping different CNO components (in further research).

3. LIFE-CYCLE PERSPECTIVE

In a typical (long-term) organization, usually its operation stage constitutes its entire livelihood. In other words most successful organizations spend only a negligible fraction of their life time on setting up and dissolution stages. Therefore, earlier research on reference modeling of enterprises did not need to elaborate much on its life cycle perspective. But unlike single organizations, for a wide variety of classes of CNOs (e.g. the state of the art in emerging clusters/networks of organizations in manufacturing industry) their creation stage, as well as their dissolution or metamorphosis stages, are complex and take up considerable effort. This is certainly not a negligible fraction of time, and due to the involved complexity, it requires receiving proper attention during the build up of the reference model. Our earlier study of the life cycle stages for CNOs has revealed 5 main common stages for the CNO's life cycle. These stages also match some typical pattern of the self-organizing systems in chaordic systems of thinking (van Eijnaten, 2005), as presented on the left side of the Fig. 2. Therefore, presence of the CNO's life cycle as a perspective in the ARCON reference modeling framework is justified, to guarantee the coverage of all stages of its life span.

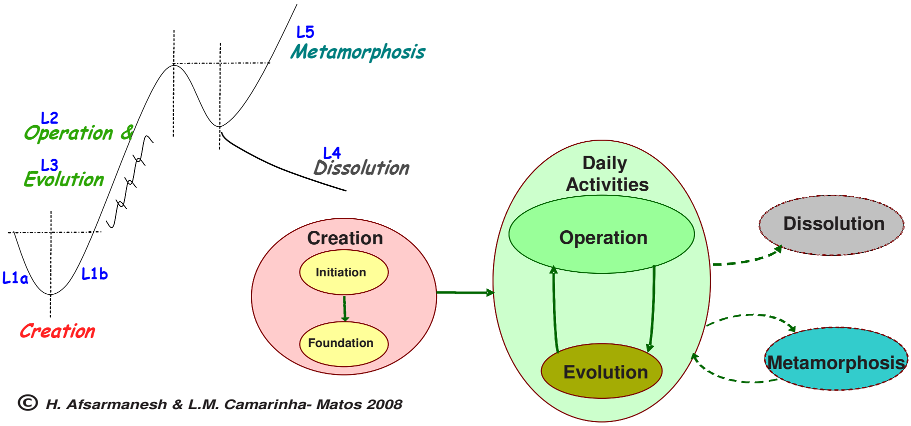


Figure 2 – CNO's life cycle stages

As illustrated in Fig. 2, the **CNO-Life-Cycle** perspective consists of a number of stages:

- ***L1. Creation*** – The creation stage deals with incubation, system parameterization, databases creation, generation and definition of ontology, data/information loading, etc., and can be divided into two phases, namely:
    - (i) ***L1a.*** *Initiation and Recruiting*, dealing with the strategic planning and initial incubation of the CNO, and
    - (ii) ***L1b.*** *Foundation*, dealing with the constitution and start up.
- ***L2. Operation*** – Certainly the most important phase, when the CNO actually operates towards achieving its goals. Depending on the type of CNOs, different tasks will be executed at this stage. For example, during this stage, the Virtual organizations Breeding Environments – VBEs (Afsarmanesh, Camarinha-Matos, 2005), involve in member registration, establishment/maintenance of partners directory of profiles/competencies, VO establishment and contracting, etc. But

the VOs during this stage are mostly focused on co-developing their aimed products/services.

- ***L3. Evolution*** – During the daily operation stage of a CNO, it becomes necessary to make some changes to the CNO, e.g. to its membership, structural relationships, roles of its members, etc. Therefore, the CN can go through daily adjustment or evolution process simultaneous to its operation stage.
- ***L4. Dissolution***– A short-term CNO, such as a Virtual Organization (VO), will typically dissolve after accomplishing its goals.
- ***L5. Metamorphosis*** – In the case of a long-term alliance, e.g. a VBE or PVC – Professional Virtual Communities (Bifulco, Santoro, 2005), considering its valuable bag of assets gradually collected during its operation, its dissolution is very unusual. Usually instead of dissolution, it is much more probable that such a CNO goes through a *metamorphosis* stage, where its general form and/or purpose can evolve. Therefore, metamorphosis may be considered as a ***huge evolution leap*** within the CN. Such stage may involve the transfer of collected knowledge/information, as well as the members to a third party.

4. ENVIRONMENT CHARACTERISTICS PERSPECTIVE

The reference model for CNs or more specifically collaborative networked organizations (CNOs) shall comprehensively represent its environment characteristics, including both its internal aspects, as well as the influence/interaction from the external aspects in its environment (Fig. 3). Namely, to understand and model the network both from inside (as in the traditional systems modeling) addressing its *Endogenous elements*, and from outside (i.e. the interactions between the CNO and its surrounding environment) addressing its *Exogenous Interactions* (Camarinha-Matos, Afsarmanesh, 2006a, b). Therefore, these endogenous and exogenous aspects constitute two subspaces of the CNO's environment characteristics, as further addressed below.

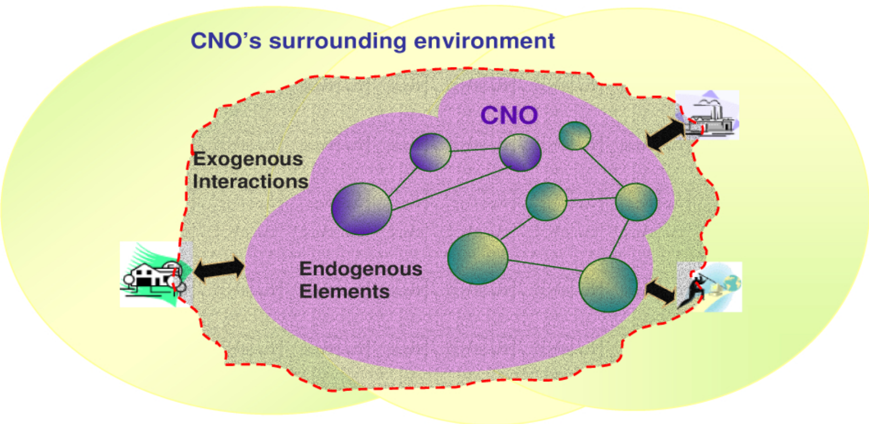


Figure 3 – CNO environment characteristics

Endogenous Elements (Endo-E) subspace. This subspace of the CNO's *environment characteristic* perspective aims at the abstraction of its characteristics *from inside* (Fig. 4), namely the identification of the main set of elements/properties that can together capture and represent CNOs. As discussed earlier, abstraction and classification of CNO's Endo-E is challenging due to the large number of their distinct and varied entities, concepts, functionality, rules and regulations, etc. inside the CNOs. In addition to various tangible elements and resources, in some forms of CNOs, e.g. the Virtual Organization Breeding Environments (VBEs), the reference model shall also capture and represent the networks of organizations configured/established within this CNO, in which every CNO participant can play a specific role and have heterogeneous relationships with other CNO participants. Furthermore, there are certain rules of behavior that either constitute the norms, or shall be obeyed by the CNO participants, and needless to say that in every CNO there are a set of activities and functionalities that also need to be abstracted in its reference model. To better characterize these diverse set of aspect, **four dimensions** are proposed and defined to cover all elements of the Endo-E subspace within the reference model, as follows:

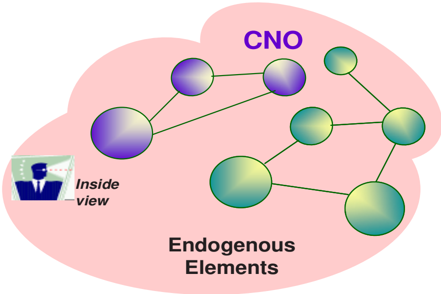
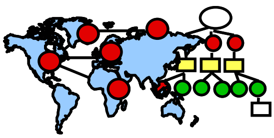


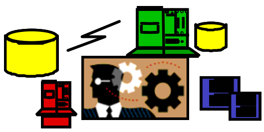
Figure 4 – Endo-E view

- **E1 - Structural dimension.**



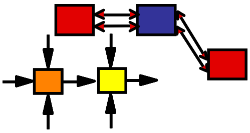
The structure/composition of the constituting elements of CNOs, namely its participants and their relationships, as well as the roles performed by those elements, and any other compositional characteristics of the network such as its typology, etc. are addressed by this dimension. This perspective is introduced and applied in many disciplines (e.g. systems engineering, software engineering, economy, politics, cognitive sciences, manufacturing, etc.), although with different "wording" and diversified tools.

- **E2 - Componential dimension.**



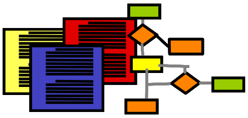
The individual tangible/intangible elements in the CNO's network, e.g. different resources such as the human elements, software and hardware resources, as well as information and knowledge are addressed by this dimension. Not all these elements are "physical" or tangible in a strict sense; in fact some are conceptual, e.g. the collected knowledge in CNOs. Nevertheless, these elements together represent the "things" or components out of which the network is built. Furthermore, the componential dimension also consists of the intangible ontology and the description (meta-data) of the information/knowledge repositories that pertain to the CNO.

• **E3 - Functional dimension.**



The "base functions / operations" running/supported at the network, and time-sequenced flows of executable operations (e.g. processes) related to different phases of the CNO's life cycle are addressed by this dimension. The methodologies and procedures running at the CNO are therefore also addressed by this dimension.

• **E4 - Behavioral dimension.**



The principles, policies, and governance rules that either drive or constrain the behavior of the CNO and its members over time, are addressed by this dimension. Included here are elements such as the principles of collaboration and rules of conduct, principles of trust, contracts, conflict resolution policies, etc.

The four specific dimensions introduced above are chosen for the reason of their "near-orthogonality" in the sense that (i) they completely cover all aspects of importance for modeling the Endo-E elements of the CNO, (ii) they are primarily disjoint in dividing this sub-space, and (iii) that if elements in different dimensions are bound to each other, then changes in one dimension can only weakly affect the elements of the other dimensions, across some region of relevance. For example in a CNO, drastically reducing the "number of workers" in one organization below certain level (a componential element in the model of an organization) may affect its nature and the "role" of this organization in the network (a structural element in the model of that organization).

It is therefore the case that in ARCON, with these four dimensions every CNO can be comprehensively defined (modeled) in relation to its Endo-E, by the collection of its four models for the dimensions, as well as a set of (weak) bindings defined across the constituents of those four models. Every such model will then represent certain set of specific (and orthogonal) aspects related to that perspective/dimension of a CNO.

An example binding that can be defined for all types of CNOs is the one addressing the dependency between the CNO's componential components (e.g. the personnel) and its structural model counterpart (e.g. the role and skill of the personnel) within a CNO. Another example binding that applies to VOs is the one addressing the connection between an organization's structural component (e.g. rights/duties of the organization in a VO) and its behavioral model counterpart (e.g. the organization's contract components in the VO).

Fig. 5 crosses the life-cycle perspective and Endogenous Elements, and exemplifies some elements of each dimension.

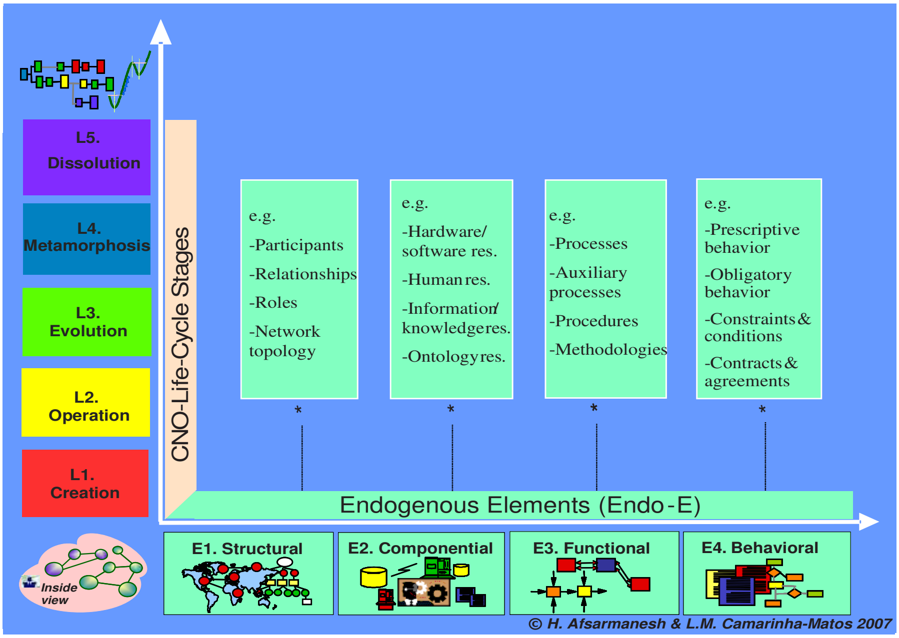


Figure 5 – Crossing CNO life cycle and the Endogenous Elements perspective

Exogenous Interactions (Exo-I) subspace. This subspace of the CNo's *environment characteristic* perspective aims perspective aims at reaching an abstract representation of the CNO as seen *from the outside* (Fig. 6), i.e. which characteristic properties the CNO reveals in its interaction with its "logical" surrounding environment. The purpose here is not to model the surrounding environment but focus on the interactions between the CNO and this environment. A CNO as a whole might interact with, influence, and be influenced by a number of "interlocutors", e.g. customers, competitors, external institutions, potential new partners. The interactions between the CNO and these external entities are quite different, the same as the way each of these entity groups looks at the CNO.

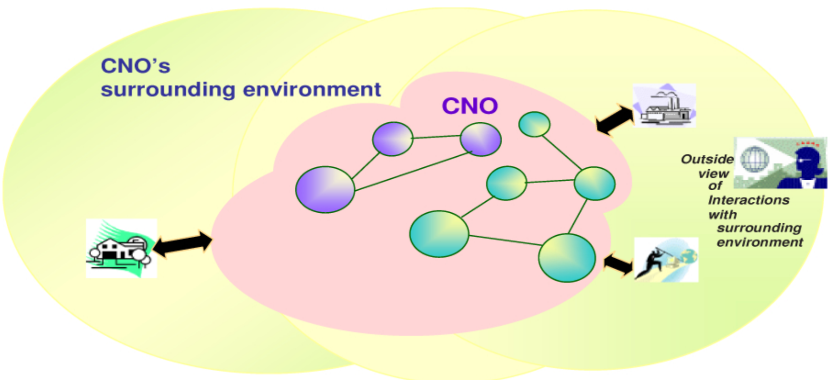
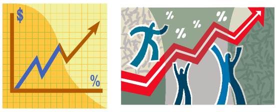


Figure 6 – Exo-I view

In order to better characterize these interactions, the following additional modeling dimensions – I1-Market, I2-Support, I3-Society, I4-Constituency - are proposed for the external or Exogenous Interactions perspective:

- **I1 - Market dimension**.



Issues related to both the interactions with “customers”, representing potential beneficiaries, and “competitors” are covered by this dimension. Facets related to customers include elements such as the transactions and established commitments (contracts with customer), marketing and branding, etc. On the competitors’ side issues such as market positioning, market strategy, policies, etc. can be considered. Also part of this dimension are the purpose / mission of the CNO, its value proposition, joint identity, etc.

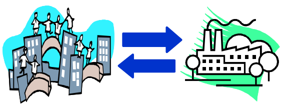
- **I2 - Support dimension**.

Those issues related to support services provided by the third party institutions (outside of the CNO) are to be considered under this dimension. The Certification services, auditing, insurance services, training, accounting, and external coaching are among example related issues.

- **I3 - Societal dimension**.

Issues related to interactions between the CNO and the society in general are captured by this dimension. Although this perspective can have a very broad scope, the idea is to model the impacts that CNO has or potentially can have on the society, for example its impact on employment, economic sustainability of a given region, potential for attraction of new investments, as well as the constraints and facilitating elements (e.g. legal issues, public body decisions, education level) the society provides to the CNO development.

- **I4 - Constituency dimension**.



The interaction with the universe of potential new members of the CNO, i.e. the interactions with those organizations that are not part of the CNO but that the CNO might be interested in attracting them, are focused in this dimension. Therefore, general issues like sustainability of the network, attraction factors, what builds / provides a sense of community, or specific aspects such as rules of adhesion and specific “marketing” policies for members, are considered here.

Fig. 7 crosses the life-cycle perspective with the Exogenous Interactions, and exemplifies some elements of each dimension.

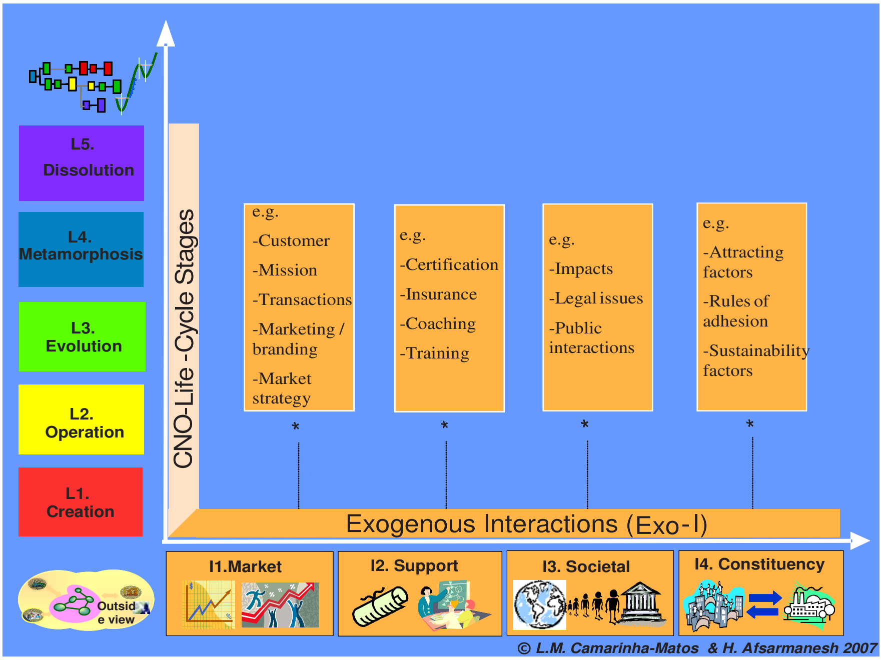


Figure 7 – Crossing CNO life cycle and Exogenous Interactions perspective

5. MODEL INTENTS PERSPECTIVE

In addition to these perspectives, a CNO reference model can be defined at multiple levels of abstraction. Following the research practices in modeling, the following three layers are considered in ARCON:

- **General Representation (GR) layer** – that includes the most general concepts and related relationships, common to all CNOs independently of the application domain (e.g. all kinds of VBEs independent of the area).
- **Specific Modeling (SM) layer** – an intermediate level that includes more detailed models focused on different classes of CNOs (the CNO typology).
- **Implementation Modeling (IM) layer** – that represents models of concrete CNOs.

Each of these modeling layers crosses with all of the elements in the other two perspectives. We will further address the role of modeling intents in Section 6. Fig. 8 crosses the environment characteristics with the model intents.

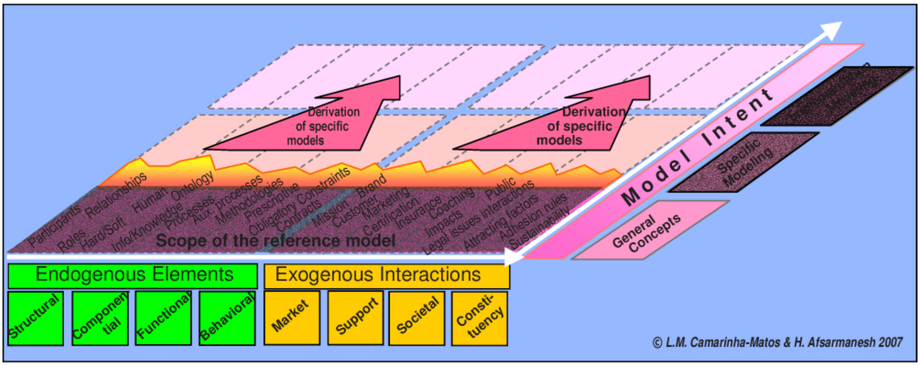


Figure 8 – Modeling intents and scope for reference model

6. THE ARCON MODELING FRAMEWORK

A comprehensive framework is thus developed for the reference modeling of CNOs that captures all of its complexity through the definition of all specific elements needed related to cross section of its three perspectives, as explained below.

Fig. 9 crosses the three perspectives addressed above in one 3D diagram.

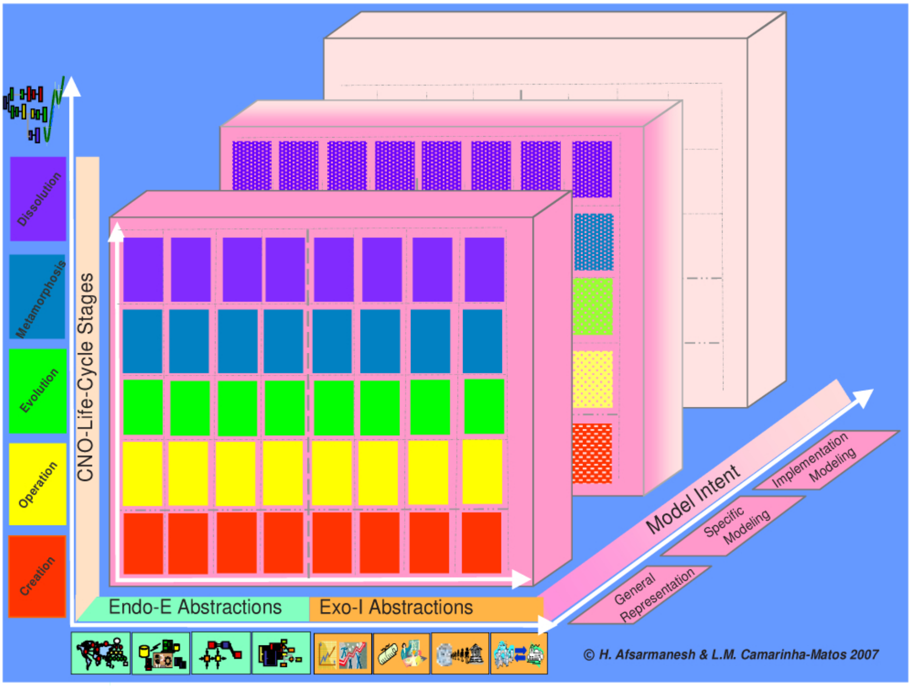


Figure 9 – ARCON Reference modeling framework

In this matrix, for the two subspaces of the *Endogenous Elements* and *Exogenous*

Interactions within the CNO **Environment characterization perspective,** their respective dimensions (E1 to E4 and I1 to I4, addressed in Section 4) are depicted as different columns. Similarly, for the CNO **Life-Cycle stages perspective**, each stage of the life cycle (L1 to L5, addressed in Section 3) is depicted as one row. The **Model Intent perspective** constitutes the third axis of the matrix, with its three respective elements addressed in 5. Each cell in the ARCON reference table therefore, represents the intersection of a particular life cycle stage with one dimension (either within the *Endogenous Elements* or *Exogenous Interactions)*, and for one specific model intent.

What will be recorded in each cell determines the "subjects" (kinds of element) that needs to be addressed and modeled in relation to these three axes. Without the proper perspectives representing each cell, the information recorded in them cannot be properly interpreted. In other words, by elimination of any of the three perspectives introduced for ARCON (from the mind), trying to describe a CNO may lack some of its aspects. Namely, this framework suggests that a CNO can be properly and comprehensively described with these three perspectives.

Each of the two environment characterization subspaces (i.e. *Endogenous Elements* and *Exogenous Interactions*) defines a point of view or a level of abstraction for the information contained in its related cells. For example, if we consider all of the cells in the single *Endogenous Elements* sub-space, we will have the abstraction of all the *subjects* that need to be defined and considered from the *Endogenous Elements'* perspective of one kind of CNO.

At the same time, the subjects contained in all the cells within a single row, such as the life cycle stage of "evolution" will provide a complete description of the CNO from that perspective. Similarly, each column in each of the two sub-spaces (e.g. the behavioral dimension of the *Endogenous Elements'* sub-space, or the constituency dimension of the *Exogenous Interactions'* subspace) captures the CNO subject for that particular dimension through the entire life cycle stages of the CNO.

For any kind of CNO, e.g. **VBE, VO, PVC**, etc., and with the model intent of **General Representation (GR)**, through the definition/representation of each *individual subject* related to all cells in this layer of its ARCON modeling framework, its *comprehensive definition*, and thus its **reference model**, can be achieved.

Furthermore, for each individual subject defined in every cell of the GR layer (e.g. the cell representing the evolution stage of the constituency Exo-I element in Figure 10) of a CNO's ARCON matrix, a number of specific models can be formalized for it, and represented at its **Specific Modeling (SM)** layer. And in the same way, if desired, one or more architectural models can be defined for any *specific model* (defined within a cell in the SM layer of the ARCON matrix, e.g. the evolution stage of the constituency Exo-I element in Figure 4.10) that will be then represented in its corresponding cell within the **Implementation Modeling (IM)** layer of the CNO's ARCON matrix.

Fig. 10 depicts the inter-relationships among the three layers of modeling intent, in relation to different models that represent the same subjects.

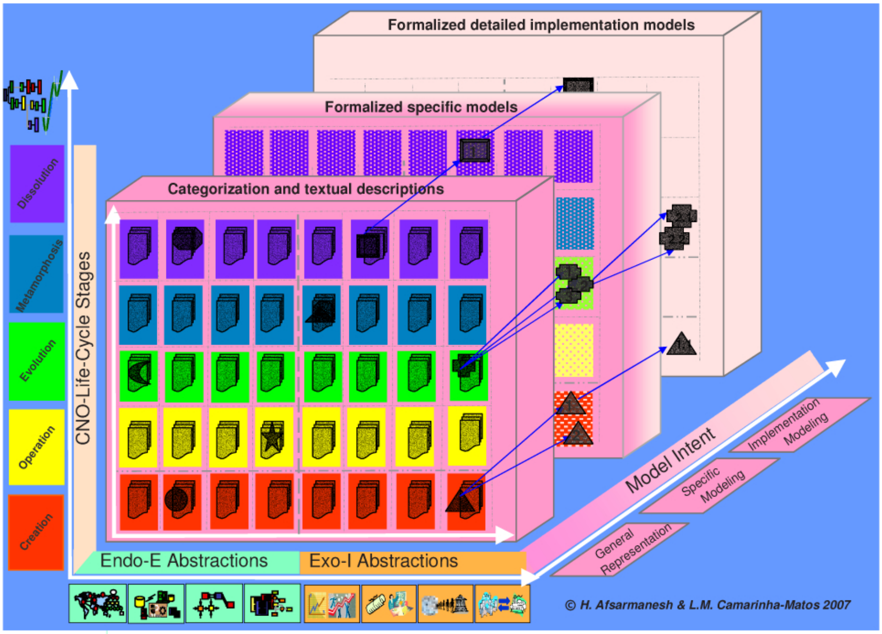


Figure 10 – Three Model intent layers and their inter-relationships

Given the base definition of reference models presented earlier, the scope of a CNO's reference model covers mainly the "General Representation" layer and it can as examples also represent some elements from the "Specific Modeling" layer. In other words, at the current stage of development of the CNO area, the first priority for a reference model for CNOs is to consolidate its most general aspects that are common to all types of CNOs. With further progress in this area of research, CNOs are better defined gradually. Therefore, it is important to also support the "maintenance of the reference model for CNOs", such that in time it can progressively and incrementally consolidate more and more specific models, as each major class of CNOs will become well developed. Chapter 2.7 of this book addresses this issue further.

In terms of representation, and considering the arguments presented above and earlier in this chapter, for the definition of the **CNO reference model** at its General Representation layer, the most **neutral** means of **textual representation** is chosen for ARCON to represent its detailed elements. Nevertheless, a structured object is further defined for each dimension, e.g. for the dimensions in the Endo-E subspace, the structured object includes: Active entity, Passive entity, Action, and Concept, as addressed in details in Chapter 2.6 of this book), where further details about the elements of CNO reference model will be textually defined.

For the other two levels of the ARCON modeling intent, depending on the specific subject/feature (e.g. within each of the cells) that need to be represented, and depending on the nature and complexity of the subject/feature, other suitable modeling tools/systems/theories shall be chosen for such representations. For example, depending on the subject/feature, the set theory, graph theory, Petri nets, deontic logic, complexity theories, multi-agent systems, federated systems, etc., can be suitable for representation of its Specific Modeling level. Similarly for the Implementation Modeling level of a subject/feature, the UML, Flowcharts, workflows, etc. can be considered.

7. COMPARISON WITH OTHER FRAMEWORKS

When attempting to establish a reference model, it is fundamental to consider the potential inputs and partial contributions from previous related works to reference modeling (Noran 2003). In the investigation and definition of the proposed modeling framework for ARCON, several relevant previous approaches introduced by other initiatives were considered. Although most related work in this area fall within the enterprise-centric stream, e.g. Zachman (Zachman 1987), VERAM (Tolle, Bernus, 2003) – that includes elements from PERA (Williams 1994), CIMOSA (Vernadat, Kosanke, 1992), and GERAM (IFIP-IFAC TFAEI, GERAM, 2003) – there are also works in this area that fall within the network-centric stream, e.g. the FEA (FEA 2005) and EGA (EGA 2005), and with SCOR (Huan 2004), (Stewart 1997), located somewhere in between, since it mostly addresses the value chain.

However, our conclusion of this study showed that for the purpose of CNO reference modeling, although the related previous works have provided valuable contributions to the understanding of several aspects of this area, they are limited when a holistic modeling is pursued. As an illustration, Table 1 summarizes the results of our analysis of the main relevant initiatives, in comparison with the needs identified for the ARCON reference modeling framework, as represented by: positive coverage (**+**), moderate coverage (**~**) and negative coverage (**-**) .

Table 1 – Brief summary analysis of other modeling frameworks

Model \ ARCON-Purpose	**Modeling Target**	**Modeling Framework**	**Modeling Scope**
Zachman Framework	**-** Single enterprise (not CNOs)	**+** Good set of "dimensions" **~** different emphasis (e.g. location) **~** not clear, Endo-E / Exo-I are mixed **-** Confusing rows (levels, life cycle, actors)	**+** Most needed modeling dimensions **-** Little focus on behavior within Endo-E of CNO **-** Little focus on Exo-I of CNO (some aspects in "Purpose")
SCOR	**~** Only supply chain (no other CNOs)	**+** Simple composition (client-supplier) and multi-abstraction level **-** Limited in terms of generality	**-** Can cover only process sub-dimension & performance indicators in Endo-E of CNO. **-** Not addressing Exo-I of CNO

Model \ ARCON-Purpose	Modeling Target	Modeling Framework	Modeling Scope
VERAM[1]	~ Manufacturing CNOs (no PVC and other CNOs)	+ Good set of dimensions and abstraction levels ~ Limited in life cycle - Confusing / complex generality	+ Most modeling dimensions - Little focus on behavior within Endo-E of CNO - Little focus on Exo-I of CNO
EGA	- Grid enterprise infrastructure focus	+ Inclusion of glossary ~ Multiple levels of abstraction - Very limited in terms of generality	- Only part of the functional dimension within Endo-E of CNO - Not addressing the Exo-I of CNO
FEA	~ Governmental organizations focus	+ Inclusion of glossary + Customer orientation - Limited in terms of generality	+ Some aspects of Exo-I of CNO - Only process sub-dimension within Endo-E of CNO

8. CONCLUSIONS

Definition of a comprehensive modeling framework for CNOs is a first step in the development of a reference model for collaboration networks - ARCON. As such the ARCON modeling Framework acts as the base for consolidation of existing knowledge in this area, as well as the facilitator for its consistent further progress. This chapter offers a contribution to this purpose, by introducing a multi-perspective modeling framework for CNOs. The necessity of each of the three perspective, i.e. the environment characteristics, the life cycle stages, and the modeling intents are addressed and when applicable contrasted with other modeling frameworks. Detailed elements of each perspective are further described and exemplified. Furthermore, the visual presentation of the three dimensional ARCON reference modeling framework is illustrated and its usage for the definition of reference models for different kinds of CNOS, e.g. VBE, PVC, VO, etc. are briefly addressed. Finally, to benefit from the knowledge generated by other related research in this area, the most relevant other modeling frameworks are mentioned, and a summary of their analysis is presented, when addressing the important features required for the purpose of ARCHON modeling framework.

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[1] VERAM includes elements from PERA, CIMOSA and GERAM.

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