INSTITUTO TECNOLOGICO Y DE ESTUDIOS SUPERIORES DE MONTERREY

UNIVERSIDAD VIRTUAL

PROGRAMA DE GRADUADOS EN INGENIERIAS Y TECNOLOGIAS

TECNOLÓGICO DE MONTERREY.

ASSESSMENT ON ENTERPRISE ARCHITECTURE AND METHODOLOGIES

TESIS PRESENTADA COMO REQUISITO PARCIAL PARA OBTENER EL GRADO ACADEMICO DE:

MAESTRO EN CIENCIAS CON ESPECIALIDAD EN SISTEMAS DE CALIDAD Y PRODUCTIVIDAD

POR:
JUAN CARLOS MENDEZ BARREIRO

MONTERREY, N. L. MAYO DEL 2008

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Los miembros del comité de tesis recomendamos que la presente tesis del Ing. Juan Carlos Méndez Barreiro sea aceptada como requisito parcial para obtener el grado académico de Maestro en Ciencias en Calidad y Productividad.

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Dedicatoria

A mi familia que me apoyó durante todo el tiempo que les deje de dedicar y me comprendieron para poder terminar la maestría y alcanzar una de mis metas en la vida.

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Executive Summary

From the beginning of my professional work as a researcher and consultant in the area of enterprise architectures I found that enterprises are facing new challenges to maintain and improve their market-share and their competitiveness. These new challenges mean that they have to respond in a more agile and precisely way to new customer requirements. These customer requirements have to be identified with no doubts by answering questions like where, when, how and what needs are needed to be satisfied in an enterprises by focusing in their expertise in order to adapt their business processes to be able to respond to the customer requirements.

According with Professor Williams (Williams, 1996) architectures can be of either two types. Type I presents a pictorial description or model of the physical organization or structure and Type II describes or models the steps of the process of development of enterprise integration. Actual research in heading to define the content and the structure of any organization, in terms of architecture structure (Type II), content, definitions and other aspects that define what is an enterprise. With the knowledge developed on Enterprise Architecture (Type II) no more questions will come from the people in charge of defining the business processes in terms of what to model and how to model in an enterprise. This knowledge is known as "Enterprise Architecture and Methodology" and is already defined as an ISO standard (ISO 15704, ISO 19439 & ISO 19440).

So this thesis is using the ISO standard to structure a serial of matrices that will help an enterprise and their stakeholders and practitioners to find out what is missing in its enterprise model. The thesis does not intent to say what aspects are better to fulfill in a specific enterprise mission, but to establish that lacks that contain the aspects that are weaknesses to obtain the enterprise performance and competitiveness.

The reader will find a complete methodology to perform an assessment and discover those weaknesses in its enterprise model. Also it will find a study case that will give an example of what to expect from the assessment proposed. But remember it is not the intention to give guidelines of what to improve to fulfill an enterprise mission, just to show the gaps in a particular enterprise model against the standard.

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GLOSSARRY

CIMOSA	Computer Integrated Manufacturing for Open System Architecture
IT	Information Technology
EA	Enterprise Architecture
GERA	Generalized Enterprise Reference Architecture
GERAM	Generalized Enterprise Reference Architecture and Methodology
IFAC	International Federation for Automation and Control
IFIP	International Federation for Information Processing
ISO	International Organization for Standardization
PERA	Purdue Enterprise-Reference Architecture
GRAI	Graphes et Résultats et Activités Interreliés
GIM	GRAI Integrated Methodology
NASCIO	National Association of States Chief Information Office
EAMM	Enterprise Architecture Maturity Model
EPAM	Enterprise Process Architecture and Methodology
PMMA	Process Maturity Model Assessment

Chapter 1 Introduction

1.1 Context

The competitiveness of industrial enterprises is increasingly governed by their flexibility and their ability to respond proactively to new customer demands, to market changes or to the rapidly evolution of the new information processing technologies. Managing these changes in a well-controlled way is one of the key challenges for any enterprise, today and even more in the near future (CIMOSA, 1996). And this flexibility demands an increased in the ability to synchronize all its business contents and work as an integrated enterprise.

Business process modeling has four main objectives: 1. Acquire explicit knowledge about the business processes of the enterprise operation, 2. Exploit this knowledge in business process re-engineering projects to optimize the enterprise operation, 3. Support the decision-making activities of the enterprise, 4. Ease interoperability of the business processes. With the advent of inter-organizational collaboration, objectives 2 and 3 depend heavily on the interoperability of business process models. Only if the business process models of collaborative networked organizations can be linked into a model of the envisioned collaborative enterprise, it will exist the possibility to create a TO-BE operation and analyze and optimize its collaborative enterprise structure (CIMOSA, 2003).

Standardization will provide the base for the very much needed interoperability. Both, the European and the international standards organizations address the subject at very different levels of abstraction, providing architectures, frameworks and explicit standards for different application areas. One of these applications is related to the technological integrations with the objective of defining the actual situation of an enterprise related to the planning and integration of existing and new enterprise technologies (Arriaga, 1996).

The thesis will provide a Process for a Maturity Model Assessment (PMMA) that will identify the maturity of any Enterprise-Reference Architecture. Maturity assessments help to identify constraints that might inhibit program success (Amo et al, 2007). For clarity

reasons PMMA was developed in the matter of matrices that identify how to accomplish next levels. Now practitioners will have a model to identify projects to move from one level to upper levels of maturity. For the Chief Information Officer Council (CIO) in USA its Architecture Alignment and Assessment Guide provides an introductory overview to the integration for enterprise architecture by focusing on the Information Technology (IT) Capital Planning Process (Holcolmb et al, 2000).

Another important aspect for an assessment as a tool guide (assisting mean) to any enterprise is to be: Simple, by means of being easy to use by an enterprise leadership, Focus on attributes, Alignment with business performance planning (goals and results), provide *Guidance* for "next steps" (gap analysis capability) and the *Ability to accommodate* both single and aligned organizations (teaming, partnerships, and suppliers) within an enterprise (Nightingale, 2005).

The Enterprise Architecture (EA) program completed a maturity assessment. Overall, the assessment showed the components of an EA program to be immature and in the formative stages of growth. The statewide self-assessment "consensus" score (i.e., 1.1 out of a possible score of 5.0) indicates both opportunities and challenges for growth and maturation of an EA program (Amo et al, 2007).

The benefits of performing an assessment vary based on the type of project involved. The larger the project, the greater the benefit derived from the assessment. At a most basic level, an assessment allows project teams to streamline implementation tasks and delivery timeframes while increasing project success rates. A second important benefit of performing an assessment is the provision of highly useful technical and functional documentation to project teams. For example, assessment generated documentation supports portfolio analysis, outsourcing plans, ongoing enhancements and improvements, and, of course, modernization projects (Ulrich, 2006).

1.2 Arriaga's Thesis Analysis (Arriaga, 1996)

A thesis developed by Arriaga in 1996 use similar methodology to capture a level of maturity to ingrate technology according to business intents conceptualized in the enterprise mission, vision and business objectives. In its thesis Arriaga (1996) found that no significant studies were found about the level of integration between strategic planning and technological integration.

There thesis objectives were the followings:

- Know actual situation of enterprises in relation to their planning and technological integration.
- Detect areas of improvement to implement strategic planning programs and technological integration according with the enterprise situation.
- Detect the enterprise level of maturity in an easily and quickly way.
- Develop a tool that could make possible all what was mention before.

The methodology was founded in GERAM Architecture because is the most complete according to the IFAC/IFIP TASK Force. Also is the same base enterprise architecture used in ISO standards. At the beginning, Arriaga (1996) defines 160 aspects to analyze but at the end was reduced to 55 aspects. This Arriaga's thesis proposal considers all the content of the three standards.

The maturity level used in Arriaga's thesis was defined as: always happened, almost every time, sometimes, almost every other time and never happened. In this thesis, the author proposes an assessment of the maturity level based on a five level scale and according to the ISO standards. Also in the Arriaga's thesis, four open questions are given to be response in order to:

- Analyze and describe in general way the enterprise business processes.
- Identify opportunity areas of improvement.
- Manage integration programs.
- Manage and integrate information systems.

In this thesis we can not give any open question because the standard is very clear and defined according to what any enterprise model have to contain in order to be mature. Also according with the first sentence in the ISO standards, the concept of "general way of business processes" has no meaning because is not depending of general, is depending of the stakeholders concerns and the level of granularity needed to fulfill or define how the functionality will accomplish in the business intents. Also the assessment has no intention to deal of how programs will be carry-out, only the maturity of the enterprise model in a particular moment.

The final differences is in the structure of both thesis, Arriaga's thesis are structured in three sections: strategic planning, technological planning and technological integration. In this thesis, the author do not define sections, the structure is given by the standards because is this thesis perspective if the sections are defined by the author the standardization efforts will be lost and the integration opportunities will be weaker.

1.3 Problem Definition

When companies want to get into enterprise modeling, one of the key issues is where to start. In some cases this situation force to do nothing because seems to be so far away and very complex to model it. But are resulted of the lack of where they are or where is their starting point. Enterprise Modeling is concerned with the explicit representation of knowledge about the enterprise into models (Vernadat, 1996).

So at this moment it is important to establish how close the actual enterprise representation is in relation to the best practices and then capture the enterprise-reality. So the big problem is to establish the gap between where the enterprise model is and the best practices that are needed to formalize their Enterprise Architecture Model. These best practices are contained in following ISO standards: ISO 15704, ISO 19439 and ISO 19440. So the problem is to have the proper model to define what is needed to be done to fulfill those ISO standards. One of the things in information technologies is that enterprise models must be capable to describe and provide the required information to analyze the different situations of the enterprise according to the model user (Arriaga, 1996).

Trying to clarify actual problems on enterprise-architecture constructions lets use the following analogy. Let imagine that we found a bridge that is strong and has been in use for many years, if an expert wants to know why this particular bridge is so well constructed he needs to understand its structural architecture. Well this situation is the same for a company, in order to understand why a particular business objective has particular results, decision-makers from the enterprise must know its enterprise-architecture in order to make better decision and guide the enterprise to a better business results.

1.4 Objective

After reviewing the actual literature on enterprise integration there is no existence of a tool to help enterprises to identify if there enterprise model accomplish the ISO international standard on Enterprise Integration. So the objective of this thesis is: "to give an enterprise a tool to identify the maturity level of its own enterprise model in order to better fulfills its own mission".

The maturity level is defined by the fulfillment of the international standard requirements of the enterprise architecture and methodology described in the ISO standards 15704, 19439 and 19440. At the end, any enterprise and its enterprise modeler will identify its gaps and define according to their business goals and mission which part of the enterprise architecture needs to be reinforce. Following the methodology, will allow the practitioners to have graphically the results so stakeholders will understand the weaknesses of the enterprise model.

1.5 Methodology

1.5.1 Research Model

The research methodology used for this thesis includes the following variables employed to construct the enterprise tool proposed. Also the model is show in Figure 1.

Independent Variables:	1. Enterprise Typology. 2. Enterprise Size. 3. Enterprise Formal Documentation.
Dependent Variables:	1. Current Enterprise Knowledge on how to formalize the Enterprise Model. 2. If they have Staff with the Knowledge on Business Process Documentation and/or Enterprise Modeling. 3. The Simplicity to answer the Assessment by the Enterprise Stakeholders. 4. The Gaps they will find by comparing its on Enterprise Model with the ISO Standard using the tool proposed in this thesis. 5. The Enterprise Mission Requirements. 6. The way to satisfy Stakeholders concerns with the tool proposed in this thesis.
Control Variables:	1. International Standards: ISO 15704, ISO 19439 and ISO 19440

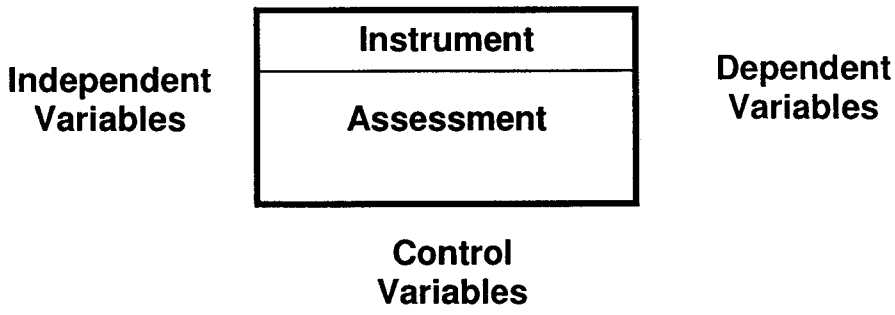

Figure 1. Research Model

1.5.2 Development

For defining the assessment parameters of an enterprise architecture standard, the following elements were studied and analyzed. The reason for using the standard is the importance of using common structures and definitions to model an enterprise. At this moment 17 countries participate in developing the ISO 15704, ISO 19439 and ISO 19440 standards and 14 more countries are observers of the results of the standardization work that is being done by ISO (Members Bodies in ISO annex).

At this moment the matrices have certain level of international agreement and give to this assessment more objectives and accurate results. The base methodology of the standards is GERAM and it is the results of many years of research and agreements around the world.

The structure of the assessment has the same structure of the standards so practitioners and researchers can identify in witch part of the standard some specific aspect of the assessment is. With this in mind, they can clarify any doubts about some specific maturity level. At the end, we finish with three major sections for each standard, 13 sub-sections and 106 concepts that are the ones that define the maturity level.

The second important aspect about the assessment is how an enterprise will read the results that are using radar charts to identify their gaps. At this moment the assessment give gaps and not way or resolutions to what to improve to resolve some enterprise aspects but give stakeholders weaknesses of their enterprise model (opportunity areas for improvement).

1.5.3 Validation

To validate all definitions from each level of maturity, every aspect was evaluated by international experts from Germany and United States. The main reason for this review was to minimize as much as possible with the personal view of the author and reach a more universal view of the maturity definitions.

These matrices at the beginning were very technical, but after some interactions with some experts' descriptions they were refined and simplified to be more understandable by common enterprise stakeholders. Then at the end we came up with definitions that are easier to understand.

1.6 Scope

Enterprise architecture is part of the effort to establish a common structure to capture the enterprise knowledge. At this moment the research gives the framework of how an enterprise is structured, now the important thing is to identify what needs are needed to be done to achieve those best practices.

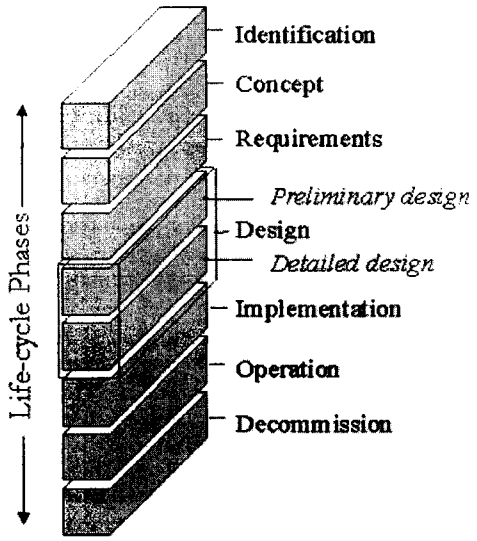

Figure 2. GERAM Enterprise Life-Cycle

The enterprise lifecycle (see Figure 2) gives a road map to develop and enterprise model, the lifecycle diagram used is the description of the lifecycle of an entity is by itself a model of the enterprise engineering methodology (ISO 15704:2000).

This thesis scope aims to develop a methodology to identify the gaps between actual enterprise architecture and the ISO family for Enterprise Architecture and Methodology, as

the starting point to any enterprise to develop its own enterprise model. With the methodology an enterprise and/or enterprise model practitioners will have a tool to define plans and intents to improve their particular enterprise business processes.

At the end this assessment, practitioners will be able to identify specific gaps in specific areas of an enterprise architecture that has some particular enterprise. It is not part of the scope of this thesis defining what gaps are needed to be cover in order to support some enterprise objectives.

1.7 Research Environment

Nowadays, enterprises are moving from an economy of scope to an economy of scale under a global economy for mass customization (Vernadat, 1996), but during much of the 20th Century, enterprises have grown organically and their design has been based on intuition, rather than theory (Bernus et al, 1996). Remember that with the globalization of national economies, enterprises are now operating as large and complex networks of autonomous units (Bernus et al, 1996), so it is very important to have a formal knowledge to manage this complexity. It is often said that in order to manage the complexity of any large organization or system, practitioners need architecture (Vernadat, 1996).

Many efforts were deployed by CIMOSA (Computer Integrated Manufacturing for Open System Architecture). The goal of CIMOSA is to help enterprises to manage change and integrate their facilities and operations to face worldwide competition and to compete on price, quality, and delivery time. The basis to achieve this is an **integrated enterprise model** (Vernadat, 1996) and this theory has been integrated in GERAM (Generalized Enterprise Reference Architecture) with another theories.

The GERAM purpose is to serve as a reference for the whole community concerned with the area of enterprise integration providing definitions of the terminology, a consistent modeling environment, a detailed methodology, promoting good engineering practice for building reusable, tested, and standard models, and providing a unifying perspective for products, processes, management, enterprise development, and strategic management

(Vernadat, 1996). International Standard ISO 15704 was prepared by Technical Committee ISO/TC 184, Industrial automation systems and integration, Subcommittee SC 5, Architecture, communications and integration frameworks.

In preparing this document, substantive contributions were received from groups involved with enterprise reference architectures such as the Purdue Enterprise-Reference Architecture (PERA), the Graphes et Résultats et Activités Interreliés GRAI Integrated Methodology (GRAI GIM), the Computer Integrated Manufacturing Open System Architecture (CIMOSA), and the Generalized Enterprise-Reference Architecture and Methodology (GERAM) to develop international standards on enterprise reference architecture and methodologies (ISO 15704:2000). The international standards developed by the ISO TC 184/SC 5 /WG 1 working groups are used as a foundation for this thesis.

The most important characteristic of enterprise architecture is that it provides a holistic view of the enterprise (Vernadat, 1996) to tackle barriers along the enterprise. So enterprise integration is originated from the need to understand and engineer processes enterprise wide. Now, a later generation of enterprise integration methods extends that utility to the support the continuous improvement practices (Bernus et al, 1996). Things to be integrated and coordinated need to be modeled. Thus, enterprise modeling is clearly a pre-requisite for enterprise integration (Vernadat, 1996).

But what is the "Architecture" in the enterprise perspective. **Architecture** is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principle guiding its design and evolution (Marc, 2005). As we said before, in order to manage changes we need to capitalize the enterprise knowledge and to have a better understanding of how the enterprise works and how to represent its operation (Vernadat, 1996).

While there are an increasing number of enterprises that are changing their business operations from a functional approach to a process oriented approach, enterprise modeling is perceived as a necessary step to perform this change (Bruno, 1997). In other words, in order to manage the business processes effectively, enterprise integration methodologies

are needed, and they rely on the lifecycle of enterprise architectures, and use modeling techniques or languages, and implementation know-how (Bernus et al, 1996).

With the importance of using an enterprise architecture and modeling techniques, it arises the importance to have an assessment of the capability to use the Enterprise Modeling Techniques to help to assess the capability of enterprise modeling techniques, and let us look at what is involved in the enterprise modeling process (Bernus et al, 1996). Also it is recommended that, when beginning to assess an enterprise modeling technique, the modeler should initially determine the required levels of capability for the modeling effort.

Practitioners must first define an assessment, this word is the noun of the verb "assess", and the definition is to judge or decide the amount, value, quality or importance of something (Cambridge-online). Assessment approaches in general propose how a given phenomenon can be described by a set of underlying components measurable in terms of certain properties. The assessment approaches consist of a set of principles and rules that combine the decomposed properties of the phenomenon, in order to perform analyses (Plazaola et al, 2006). The Architecture Assessment determines whether the documentation (i.e. functional analysis, general design, and detailed design) complies with the architecture components approved through the technical alignment. The goal is to audit the system design and analysis documentation to ensure the architecture compliance (Holcolmb, 2000).

For the assessment, in this thesis the author will use the following accomplish values or value capability assessment levels: 0 None (NO capability), 1 Weak (Bandy useful capability), 2 Good (Useful capability), 3 Strong (Significantly useful capability), and 4 Excellent (World class capability) (Bernus et al, 1996). Another proposal is Level 1 (Some awareness of this practice; sporadic improvement activities may be underway in a few areas), Level 2 (General awareness; informal approach deployed in a few areas with varying degrees of effectiveness and sustainment), Level 3 (A systematic approach/methodology deployed in varying stages, across most areas; facilitated with metrics; good sustainment), Level 4 (On-going refinement and continuous improvement across the enterprise; improvement gains are sustained), Level 5 (Exceptional, well-defined, innovative approach is fully deployed across the extended enterprise (across

internal and external value streams); recognized as best practice) Nightingale, 2005). Both proposals can be used and the significant difference is that the process does not have any effort on a specific level must be 0 and not 1, and that is why the author of this thesis uses the first proposal to identify the maturity level.

Keeping in mind what it is intended to model an enterprise, the goal of an enterprise modeling approach will be not to model the entire enterprise in all of its details, although this might be theoretically possible at various levels of abstraction. The term 'enterprise' means here a part of an enterprise which needs to be represented. Its size and scope is defined by the business users (Vernadat, 1996).

Because a business model hence describes the way economic value is created and consumed along the value chain of activities among its participants. This is important because depending on this economic value is mostly the effort to maintain the enterprise model, because a key problem with centralized enterprise models is keeping them current (Bernus et al, 1996). Thus the benefits are more significant than costs.

Thus the benefits of performing an assessment vary based on the type of project involved. The larger the project, the greater the benefit derived from the assessment. At a most basic level, an assessment allows project teams to streamline implementation tasks and delivery timeframes while increasing project success rates (Ulrich, 2006).

1.8 Thesis Structure

The research presented is this thesis is organized in six chapters described as follow:

- Chapter 1 – Introduction
- Chapter 2 – ISO enterprise-architecture and methodology.
- Chapter 3 – Methodology for enterprise-architecture maturity assessment.
- Chapter 4 – Enterprise-architecture assessment case study.
- Chapter 5 – Reports results, conclusions and further work are presented.

Chapter 2 ISO Enterprise-Architecture and Methodology

2.1 Structure

The assessment is structured according with the international standard[1] ISO15704, ISO 19439 and ISO 19440. The main reason for this is because it is not the intention to reinvent the wheel but to use international consensus of what an enterprise architecture must have and how all elements should be integrated. Then the structure is divided in three sections that completely cover all aspects of enterprise architecture and modeling. Those sections are:

2.2 Architectural Perspective

It defines the requirements for enterprise reference architectures and methodologies, as well as the requirements that such architectures and methodologies must satisfy in order to be considered as formal enterprise reference architecture and methodology.

Principles for Enterprise Reference Architecture: They provide principles to grant the capability to support those who plan, design, and implement complex enterprise integration projects.

Terms for Enterprise Architecture: For this purpose, the International Standard (ISO) was used to provide the formal terms and definitions to harmonize concepts understanding.

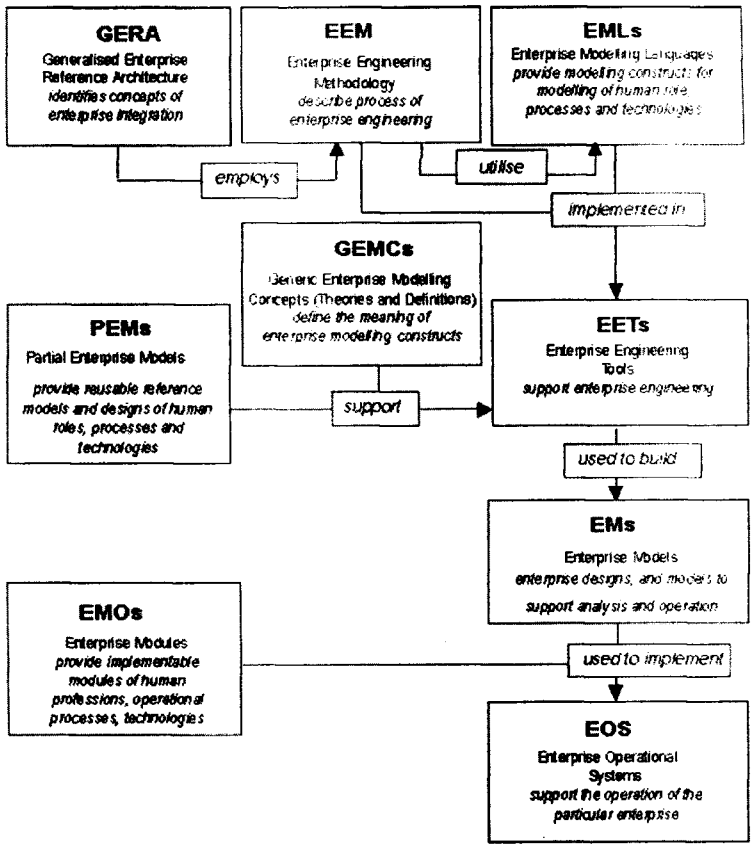

Figure 3. GERAM (Generalized Enterprise Reference Architecture and Methodology) Framework Components

Concepts of Enterprise Architecture: Enterprise reference architectures and methodologies shall be capable of assisting and structuring the description, development, operation, and organization of any conceivable enterprise entity, system, organization, product, process, and their supporting technology.

Components for Enterprise Architecture: Enterprise reference architectures and methodologies shall provide components to guide users in the structure and identification of the composition of the enterprise architecture (see Figure 3).

2.3 Framework Perspective

Specify a framework that serves as a common basis to identify and coordinate standards development for process modeling of enterprises, emphasizing, but not restricted to, computer integrated manufacturing.

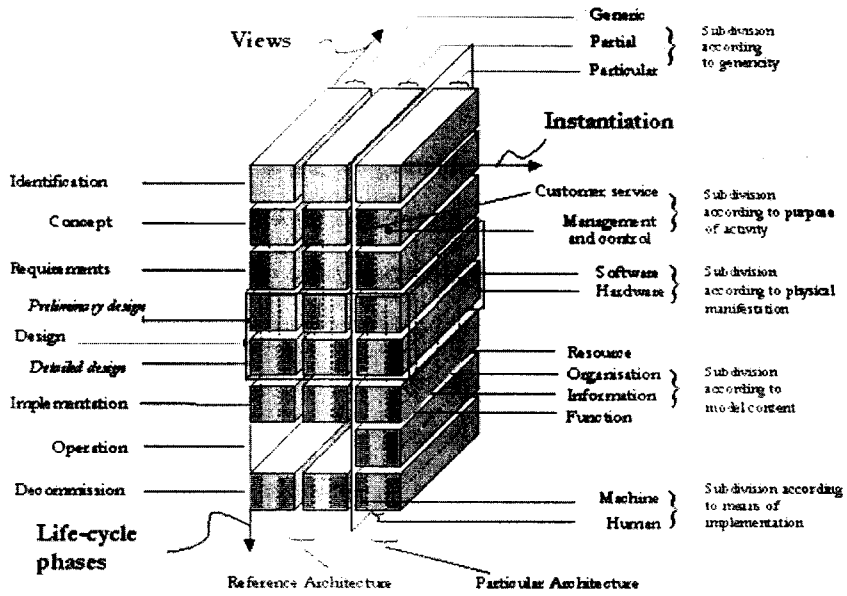

Figure 4. GERA Modeling Framework with Modeling Views

Terms for Framework in Enterprise Architecture: For the purpose of this International/European standard, the terms and definitions are given in ISO 14258:1998 and ISO 15704:2000 and the following apply. This terms and definitions harmonize the concepts understanding.

Framework for Enterprise Process Modeling: Enterprise reference architectures and methodologies that are model-based shall exhibit the capability to model entities within the conceptual space defined by the dimensions of lifecycle, genericity, and modeling views (see Figure 4).

Enterprise Architecture Model Phases - Concepts of the Model Lifecycle: Enterprise reference architectures and methodologies shall identify and represent the lifecycle phases that are pertinent during the life of any enterprise entity. Lifecycle phases encompass all activities from inception to decommissioning (or end of life) of the enterprise entity which might be characterized. There is no presumption that these phases are necessarily sequential.

Enterprise Modeling Views – The concept of Filtering: The enterprise reference architectures and methodologies that are model-based shall provide concepts for

representing different views of an enterprise model to allow it to be described as an integrated model but to be presented to the user in different subsets. Views contain a subset of facts present in the integrated model in order to concentrate on relevant questions that the respective stakeholders may wish to consider using enterprise modeling. Different views may be made available highlighting certain aspects of the model and hiding others. The concept of view is applicable to models of all entity types across their entire lifecycle.

Genericity – The Concepts of Generalization and Specialization: Those reference architectures and methodologies that are model-based shall provide the capability for representing generic-enterprise elements, partial-enterprise models, and particular enterprise models

2.4 Construct Perspective

Specifies the characteristics of the core construct the necessary for process modeling of enterprises. It focuses on, but is not restricted to, the computer integration of the information aspects of manufacturing, including the management and control technology and the requisite human tasks (see Figure 5).

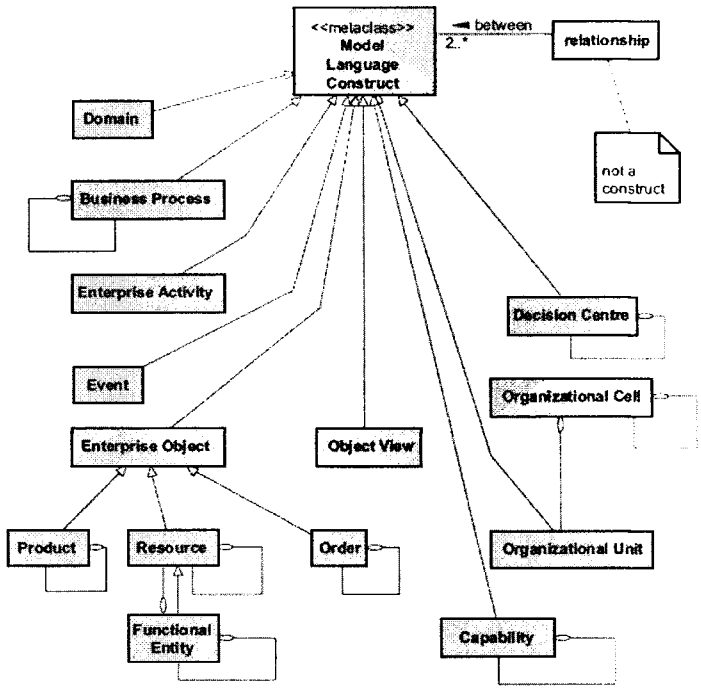

Figure 5. The Set of Constructs

Terms of Modeling Language Constructs: For the purposes of this, the International Standard (ISO) will provide the terms and definitions to harmonize the concepts understanding.

Characteristics of Modeling Language Constructs: Modeling languages that are based on a set of common generic modeling language constructs simplify the creation of enterprise models, increase modeling efficiency and improve model understanding and interoperability across organizations and even across industries

Enterprise Construct Template: These constructs form a modeling language with which a wide range of business process based enterprise models can be created. Constructs are often applicable to several views and are elaborated to different degrees at each of the modeling phases. Where the applicability of a construct, as defined in this standard, is limited to a certain view or enterprise model phase, this is noted in remarks. Each template shall include the attributes that are pre-defined to harmonize the instance characterization. Attributes are described with a combination of denotations and textual descriptions. The denotations are either self-explanatory or explained in accompanying text and are enclosed by angle brackets.

2.5 Enterprise-Integration Perspective

Specify the impact on the enterprise for the use of the enterprise architecture to enforce the competitive and to be more flexible to respond the market (customer) requirements, to integrate technology to business objectives and to attend stakeholder needs.

Chapter 3 Methodology for Enterprise Architecture Maturity Assessment

3.1 Requirements to use the Methodology

To those who want to perform this assessment must be in mind that some important requirements are needed to perform this assessment. These requirements are base on three major aspects: the knowledge on enterprise architectures and the ISO standards, the level of expertise on implanting or developing enterprise models and the level of explicitly of actual enterprise model documentation.

As is mention later in the study-case these requirements was respect in order to test this methodology. The justifications of these three requirements are:

a. Enterprise Architecture Knowledge: the practitioner must know the knowledge contained in the enterprise architecture ISO standards to be capable to identify the maturity level of a particular enterprise-model. This is the more important requirement to perform the assessment, because no matter if practitioner is internal or external to the company, the level of understanding of the standards will define how accurate is the maturity level identification of the enterprise model, and in consequence the level of confidence in the results.

b. Expertise on developing or implementing enterprise models: practitioner also must have some previous experiences on implementing enterprise model in order to understand how actual enterprise model was constructed. In many cases practitioners will found explicit model developed in different ways and structures, so it previous experience in the process of documentation or model will help understanding how the model was constructed and then identify its maturity level.

c. Explicitness of actual enterprise model: enterprise must be capable to present all its actual documentation of its enterprise-model in order to evaluate. In case of the enterprise

does not have any explicit enterprise model the conclusion by the fact is level zero for every aspect in the assessment. Because only the explicit model documentation is valid to assess it.

3.2 Methodology to Perform the Enterprise Architecture Maturity Assessment

The methodology is based on the enterprise lifecycle that is part of the ISO 15704 international standard. So it is divided in seven phases. In each phase there is a beginning condition (start event), several activities that have to be performed in order to complete the phase and also the end condition of the phase (final events). The methodology phases are:

Beginning Condition	Activities	End Condition
(ID) Identification Phase	Identification of Customer Expectations from the Assessment	
Enterprise wants to know how is its Enterprise Model.	1. Establish Domain Champion's Assessment Responsibilities. 2. Explain Assessment Methodology. 3. Understand ISO Enterprise Architecture Standard Purposes. 4. Define Domain to Assess. 5. Define customer Expectations.	Customer Expectations for the Assessment are Agreed.
(CO) Conceptualization phase	Transform Customer Expectations into a defined Objectives to the Assessment	
Customer Expectations for the Assessment are Agree.	6. Define Domain Processes to Assess. 7. Define People to respond the Assessment. 8. Define Time-frame. 9. Agreement on Assessment Rules.	Defined Scope and Time-frame for fulfill Customer Expectations.

Beginning Condition	Activities	End Condition
(RE) Requirement Definition Phase	Identify the Requirements to fulfill the Assessment Objectives.	
Defined Scope and Time-frame for fulfill Customer Expectations.	10. Define Number of Assessments. 11. Agree Basic Training Requirements. 12. Define Technological Requirements. 13. Perform the Assessment Plan.	Plan to Implement the Assessment is Performed.
(DE) Design Phase	Customize Assessment to a Particular Enterprise to fulfill Assessment Objectives.	
Plan to Implement the Assessment is Performed.	14. Customize Assessment Formats. 15. Up-load Formats to Platform. 16. Hard-copy the Formats. 17. Adequate Assessment Platform.	Customized the Assessment Formats and Adequate the Platform.
(IM) Implementation Phase	Prepare Resources to perform the Assessment.	
Customized the Assessment Formats and Adequate Platform	18. Prepare Assessment Formats. 19. Train Staff (Advisers or Users).	Assessment Formats are prepared and Staff is Trained.
(OP) Operation Phase	Perform the Assessment Controlling the Fulfillment of the Assessment Objectives.	
Assessment Formats are prepared and Staff is trained.	20. Perform Assessment. 21. Support Assessment Performers. 22. Monitor and Control the Assessment. 23. Consolidate Results. 24. Analyze Results. 25. Agree Enterprise Processes Gaps. 26. Publish Assessment Results.	Enterprise has the Gaps defined to comply with the Best Practices of Enterprise Modeling.

Beginning Condition	Activities	End Condition
(DE) Decommission Phase	Decommission the Assessment defining Task to eliminate Gaps.	
Enterprise has the Gaps defined to comply with the Best Practices of Enterprise Modeling.	27. Agree Enterprise Processes Project. 28. Formalize Assessment Decommission.	Enterprise defines its Projects to realize Gaps to Best Practices on Enterprise Modeling.

Another important consideration in the Requirement Stage is about the persons involved in the assessment. These scenarios are as follow: with all internal personal, with external evaluator but internal interviewed personal and with all external practitioners.

These three scenarios can be understood as follow:

Scenario A. Internal Personal: This scenario considers that enterprise-architecture practitioner and interviewers are all members of the company. One basic requirement to follow is practitioner can not play the role of interviewer at the same time the role of evaluator.

Scenario B. External evaluator with internal interviewed personal: This scenario is considered when the enterprise who wants to assess its enterprise-model does not have an evaluator. Because the evaluator has to be an expert on enterprise-architecture and methodologies enclosed in the ISO 15704, ISO 19439 and ISO 19440 standards.

Scenario C. All external: This scenario considers when an enterprise may considers the following intentions, it wants an external opinion, or it does not have a practitioner on enterprise-architecture and methodology in combination with personal with lack of confidence in the level of knowledge on his actual explicit enterprise-model.

Every enterprise interested in performing the assessment has to define in the stage of Requirement which scenario fits better to its particular conditions. Because of this result

obtained from the maturity assessment will affect possible decisions on its enterprise model with lack of future integration and competitiveness of the enterprise.

3.3 Maturity Levels

Enterprise Architecture Maturity Model & Assessment provides a path for architecture and procedural improvements within an enterprise. As the architecture matures, predictability, process controls and effectiveness also increase.

Enterprise Architecture Framework Development is critical because it provides the rules and definition necessary for the integration of information and services at the design level across agency boundaries. The framework combines business and environment processes and representations to allow planning and development of a blueprint.

The Enterprise Architecture Blueprint is the collection of the actual standards and specifications that define what the Business and IT Portfolios are and how they may be built. The Blueprint contains the details that are essential for allowing data to flow from agency to agency, just as water flows through the pipes and electricity flows through the wiring of a well planned home.

Enterprise Architecture Development is an ongoing process and cannot be delivered overnight. An organization must patiently work to nurture and improve upon its Enterprise Architecture Program until architectural processes and standards become second nature and the Architecture Framework and the Architecture Blueprint become self-renewing.

Whatever the current stage of the enterprise architecture program, each activity undertaken also has its own lifecycle. Without continuous monitoring of the driving business and technology factors, any Enterprise Architecture Blueprint can soon become obsolete. Just as individual product and compliance components contained in the Blueprint need to go through the cyclic process of Documentation, Review, Compliance, Communication, and Vitality, the high-level Enterprise Architecture Framework and

procedures must be reviewed and updated to properly reflect environmental changes (NASCIO EAMM, 2003).

Maturity levels are divided according on how is used, how complete is implemented and how much the benefits are impacting in the lifecycle of the enterprise. The maturity path goes from 0 to 4.

Level 0 None – No capability and represent the absent of enterprise-architecture. Are enterprises that has no documented or explicit framework to represents its operation,

Level 1 Weak – Transition to Good with bandy useful capability and represent some basic structure of enterprise processes. Some enterprises start to represent in a explicit ways its operation and relation but the framework used is home designed and has no evidence of use of formal methodologies and models,

Level 2 Good – Useful capability and represent formal structure of enterprise architecture. Are enterprises that have more structured and explicated architecture and framework to capture its business-model, and y some aspect uses formal and standardized framework,

Level 3 Strong – Transition to Excellent with significantly useful capability and represent formal structure and some standardized enterprise architecture frameworks and templates. Are enterprises that are full standardized enterprises that follows international standards to structure and represents its enterprise, and

Level 4 Excellent – World class capability and represent standardized enterprise architecture and managed to be "Agile Enterprises". Consider an Agile Enterprise as an enterprise that can respond quickly to a delight customers and everyone in the organization are well integrated and coordinated.

3.4 Perform the Assessment

To perform the assessment practitioners will respond each statement according with their perception and physical proves about their actual enterprise documentation or model. Each assessment section has several matrices that cover some aspects of the Enterprise Architecture (EA).

In each matrix there are several variables that analyze the aspects of the EA. For each statement are three sentences that specify the level of statement achievement. These matrices are showed at the end of the thesis within Tables 1 to 13.

The names of those tables are according with the major areas, and are as follow:

A. Requirements for Enterprise-Reference Architecture and Methodology
   - A.I. Principles for Enterprise-Reference Architecture
   - A.II. Terms for Enterprise Process Architecture
   - A.III. Concepts of Enterprise Process Architecture
   - A.IV. Components of Enterprise Process Architecture

B. Framework for Enterprise Modeling
   - B.I. Terms of Framework for Enterprise Process Modeling
   - B.II. Framework for Enterprise Process Modeling
   - B.III. Enterprise Process Model Phase – Concepts of the Model Life Cycle
   - B.IV. Enterprise Process Modeling Views – The Concept of Filtering
   - B.V. Genericity – The Concepts of Generalization and Specialization

C. Constructs for Enterprise Modeling
   - C.I. Terms of Process Modeling Language Constructs
   - C.II. Characteristics for Process Modeling Language Constructs
   - C.III. Enterprise Construct Elements
   - C.IV. Enterprise Constructs Templates

The Enterprise-Architecture assessment main objective is to detect specific gaps and in consequence state the project that any enterprise should do in order to fulfill its particular business objectives. Thus if the enterprise at the present moment needs to solve some competitive aspects of its business, it must identify which projects are the ones that solve its urgent needs.

As any other assessment the first step to do is to define and organize all persons (practitioners or enterprise staffs) that are needed to be interviewed to perform the assessment. Second is to organize a meeting to selected people and go thru the matrices that contain the structure of any enterprise architecture. Third use a "data-sheet" (e.g. MS-Excel) to collect data from all the interviews and has it in a way that can be summarized to the analysis (see Figure 6).

Data-sheet is structured in rows and columns. Each row represents the answer of each interview to each variable. Columns represent name of the field and the name of the variable. Then the meanings of the columns are as follow;

OC Organizational - Cell of the person that correspond the row (Area, department, region or any organizational aspect that group or generalize some part of the enterprise),

OU Organizational - Unit of the person that correspond the row (position or specific part of the organization or enterprise),

Name the name of the person that responds the assessment,

Variable, it is the variable answer by the person. Each variable represent one row of each matrix.

Enterprise-process Architecture and Methodology
Data sheet

			Average of Results	2.8	3.08
			Variable ==>	Applicability to any enterprise	Enterprise identification and mission
OC	**OU**		**Name**	**A.I.1**	**A.I.2**
OC1	OU1	Name1		2	2
OC2	OU2	Name2		5	1
OC3	OU3	Name3		2	3
OC4	OU4	Name4		2	5
OC5	OU5	Name5		2	4
OC6	OU6	Name6		1	3
OC7	OU7	Name7		1	1
OC8	OU8	Name8		1	4
OC9	OU9	Name9		2	5
OC10	OU10	Name10		4	1

Figure 6. Data-sheet, used to gather the Data collected from the Assessment Interview

3.5 Illustrate the Results

The graphical representation to show results from the EA assessment is the radar chart. In the radar chart each axis represent each variable and the level of accomplish according to the international standard ISO for Enterprise Architectures.

There are another two components in the assessment to illustrate results, the Resume Sheet, and the Radar Chart. *The resume-sheet* intents to resume all data capture by the assessment, and to show the level of maturity of the enterprise on a numeric way.

Resume sheet EPAM

#	Statement	Eval
	A. Requirements for enterprise-reference architecture and methodology	**2.9085**
A.I	PRINCIPLES OF ENTERPRISE REFERENCE ARCHITECTURE	2.933333
A.I.1	Applicability to any enterprise	2.8
A.I.2	Enterprise identification and mission definition	3.08
A.I.3	Separation of mission-fulfillment functions from mission-control functions	3.12
A.I.4	Identification of process structures	2.68
A.I.5	Identification of process contents	2.84
A.I.6	Recognition of enterprise life-cycle phases	3.16
A.I.7	Evolutionary approach to enterprise integration	3.44
A.I.8	Modularity	2.96
A.I.9	Terms and definitions	2.32

Figure 7. Resume-sheet, used to resume Data from the Data-sheet

The numbers in the resume sheet are the average of all answers capture in the Data-sheet for each variable or statement. The resume can be done to all enterprise or particularized to a specific location or department (see Figure 7).

The radar chart intents to illustrate graphically the level of maturity of the enterprise or a part of it (see Figure 8).

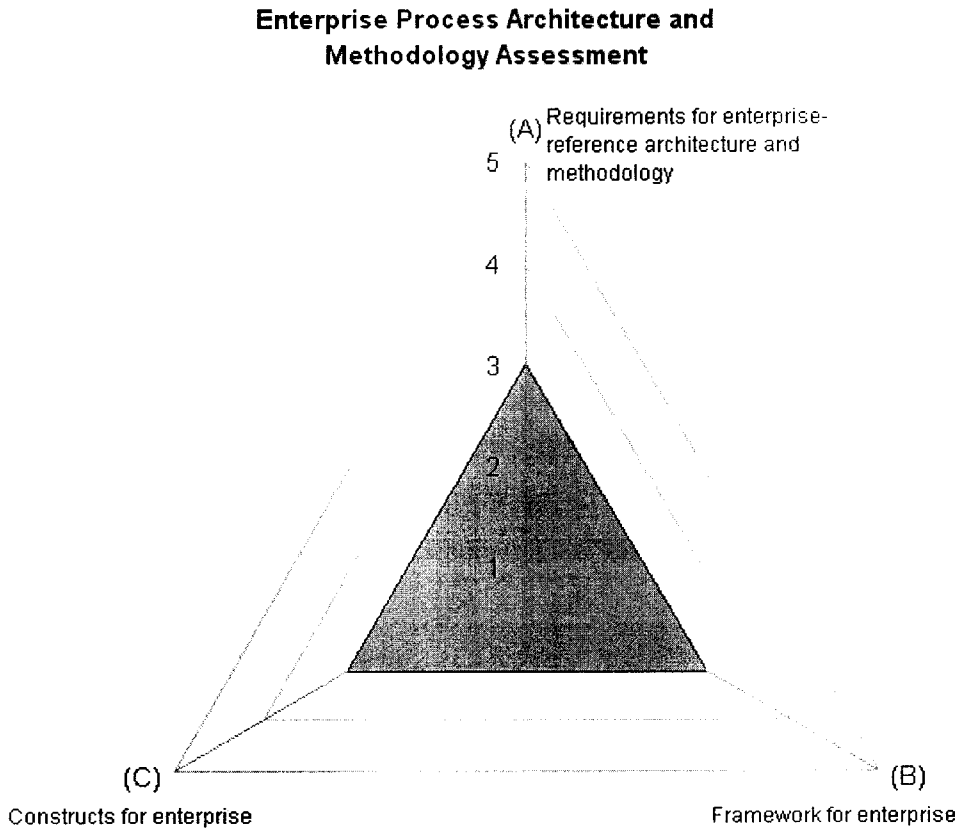

Figure 8. Radar Chart, illustrate the Maturity Level for each part of the Enterprise Architecture

In the radar chart the practitioner can analyze what part of the architecture needs more attention according with its maturity level. Remember that the maturity level shows in a graphically way the given guidelines to establish the projects that the enterprise must define to be more mature and can strength its mission fulfillment.

Chapter 4 Study Case in Real Business Environment

4.1 Introduction

The study case performed with the EPAM was conducted in a controlled environment with a controlled personal. For confidential reason requested by the enterprise assessed, the name of the company was omitted. The personal who participate was real people in a real business situation. At the moment of the assessment they were conducting a software implementation and reorganizing their logistic area. The Enterprise is in the telecommunication industry and has a solid process culture insight. The organizational structure has a Process Manager with three professionals who support all the efforts concerning to improve the processes. Also this enterprise has a tool to manage the process model; this tool is MEGA (www.mega.com). In addition the professional receive a training on the basic concepts on the ISO 15704, ISO 19439 and ISO 19440 standards.

For them, the terminology and concepts are not unfamiliar so they can respond to this questionnaire with more confidence. At the beginning, the question to answer was what are the benefits that we will receive from the assessment? This basic question will be always present in any assessment that could be performed in the future. So remember that the reason for this assessment is to identify gaps between actual enterprise-process architecture and its methodology to manage processes, and this EPAM mission must be always present to answer the basic inquiry.

Before we present to them formats was personalized to them in order to capture the answer they respond to each statement for all tables. We use MS-Excel to structure the answer data-sheet and using different worksheets the responses are summarized to a global level of accomplish.

Following the methodology we prepare the assessment and stakeholder define scope of the assessment as follow. Identify gaps in the overall process architect of the enterprise

not only for a specific process. In order to accomplish this expectation we analyze entire processes as a one domain. The assessment process took about 2 hours to finalize all statements, and the key factors of success are the level of knowledge of the customer process.

The assessment was conducted between the author of this thesis and the process owner responsible to coordinate effort heading to maintain and improve operational processes of the enterprise. This is a controlled environment because as we mention before the participants already know all this concepts and we do not need to train or explain about the enterprise architecture and methodology.

4.2 Results

The results of the assessment will be summarized with the worksheets designed to that purpose. The results are expressed in the following Maturity-sheet.

Resume sheet EPAM		
#	**Statement**	**Eval**
	ENTERPRISE-ARCHITECT AND METHODOLOGY MATURITY LEVEL (0 TO 4)	**1.476**
(A)	**Requirements for enterprise-reference architecture and methodology**	**1.705**
A.I	PRINCIPLES OF ENTERPRISE-REFERENCE ARCHITECTURE	**1.556**
A.I.1	Applicability to any enterprise	2
A.I.2	Enterprise identification and mission definition	2
A.I.3	Separation of mission-fulfillment functions from mission-control functions	1
A.I.4	Identification of process structures	3
A.I.5	Identification of process contents	2
A.I.6	Recognition of enterprise life-cycle phases	1
A.I.7	Evolutionary approach to enterprise integration	0
A.I.8	Modularity	2
A.I.9	Terms and definitions	1
A.II	TERMS FOR ENTERPRISE PROCESS ARCHITECTURE	**1.000**
A.II.1	Architecture perspective	0
A.II.2	Framework perspective	2
A.II.3	Modeling perspective	1
A.III	CONCEPTS OF ENTERPRISE PROCESS ARCHITECTURE	**1.818**
A.III.1	General	2
A.III.2	Human oriented	2
A.III.3	Process oriented	3
A.III.4	Technology oriented	2
A.III.5	Mission-fulfillment oriented	0
A.III.6	Mission-control oriented	2
A.III.7	Framework for enterprise modeling	1

A.III.8	Life cycle	0
A.III.9	Life history	4
A.III.10	Modeling views	4
A.III.11	Genericity	0
A.IV	COMPONENT OF ENTERPRISE PROCESS ARCHITECTURE	**2.444**
A.IV.1	Engineering methodologies	3
A.IV.2	Modeling languages	4
A.IV.3	Generic Elements	2
A.IV.4	Partial models	2
A.IV.5	Particular models	2
A.IV.6	Tools	4
A.IV.7	Modules	1
A.IV.8	Enterprise-operational systems	2
A.IV.9	Framework dimensionality	2
(B)	**Framework for enterprise modeling**	**2.015**
B.I	TERMS OF FRAMEWORK FOR ENTERPRISE PROCESS MODELING	**2.143**
B.I.1	Architecture perspective	1
B.I.2	Framework perspective	1
B.I.3	Modeling perspective	1
B.I.4	Function view perspective	4
B.I.5	Information view perspective	2
B.I.6	Resource view perspective	2
B.I.7	Organizational view perspective	4
B.II	FRAMEWORK FOR ENTERPRISE PROCESS MODELING	**1.600**
B.II.1	Dimensionality of the model	1
B.II.2	The model identify enterprise model phases	2
B.II.3	The model has view to filter it.	4
B.II.4	Genericity of the model	0
B.II.5	Enterprise Model Consistency and Completeness	1
B.III	ENTERPRISE PROCESS MODEL PHASE – CONCEPTS OF THE MODEL LIFE CYCLE	**1.000**
B.III.1	Domain identification	0
B.III.2	Concept definition	0
B.III.3	Requirement definition	0
B.III.4	Design specification	3
B.III.5	Implementation description	2
B.III.6	Domain operation	2
B.III.7	Decommission definition	0
B.IV	ENTERPRISE PROCESS MODELING VIEWS – THE CONCEPT OF FILTERING	**4.000**
B.IV.1	Function View	4
B.IV.2	Information View	4
B.IV.3	Resource view	4
B.IV.4	Organization view	4
B.V	GENERICITY – THE CONCEPT OF GENERALIZATION AND SPECIALIZATION	**1.333**
B.V.1	Generic view	2
B.V.2	Partial view	2
B.V.3	Particular view	0
(C)	**Constructs for enterprise modeling**	**0.708**
C.I	TERMS OF PROCESS MODELING LENGUAGE CONSTRUCTS	**1.000**

C.I.1	Architecture perspective	0
C.I.2	Framework perspective	1
C.I.3	Modeling perspective	0
C.I.4	Function view perspective	2
C.I.5	Information view perspective	1
C.I.6	Resource view perspective	1
C.I.7	Organizational view perspective	2
C.II	CHARACTERISTICS OF PROCESS MODELING LENGUAGE CONSTRUCTS	**0.000**
C.II.1	Range of representation	0
C.II.2	Common structure and template	0
C.II.3	Representation of construct attributes	0
C.II.4	Construct specializations	0
C.II.5	Relationship	0
C.II.6	Roles	0
C.II.7	Purpose and applicability of constructs	0
C.III	ENTERPRISE CONSTRUCT ELEMENTS	**1.833**
C.III.1	Domain	0
C.III.2	Business process	2
C.III.3	Behavioral rules	4
C.III.4	Enterprise activity	4
C.III.5	Functional operation	3
C.III.6	Event	4
C.III.7	Enterprise object	1
C.III.8	Enterprise object view	4
C.III.9	Product	0
C.III.10	Order	0
C.III.11	Resource	3
C.III.12	Capability	0
C.III.13	Functional entity	0
C.III.14	Organizational Unit	4
C.III.15	Decision Center	4
C.III.16	Person profile	0
C.III.17	Organizational Role	0
C.III.18	Operational Role	0
C.IV	ENTERPRISE CONSTRUCT TEMPLATES	**0.000**
C.IV.1	Template for Domain with standardized attributes	0
C.IV.2	Template for Business Process with standardized attributes	0
C.IV.3	Template for Enterprise Activity with standardized attributes	0
C.IV.4	Template for Event with standardized attributes	0
C.IV.5	Template for Enterprise Object with standardized attributes	0
C.IV.6	Template for Object View with standardized attributes	0
C.IV.7	Template for Product with standardized attributes	0
C.IV.8	Template for Order with standardized attributes	0
C.IV.9	Template for Resource with standardized attributes	0
C.IV.10	Template for Capability with standardized attributes	0
C.IV.11	Template for Functional Entity with standardized attributes	0
C.IV.12	Template for Organizational Unit with standardized attributes	0
C.IV.13	Template for Decision Center with standardized attributes	0
C.IV.14	Template for Person Profile with standardized attributes	0
C.IV.15	Template for Organizational Role with standardized attributes	0
C.IV.16	Template for Operational Role with standardized attributes	0

Making the graph for this result we can appreciate visually gaps between what the ISO standards request to have and the level of accomplish in this enterprise.

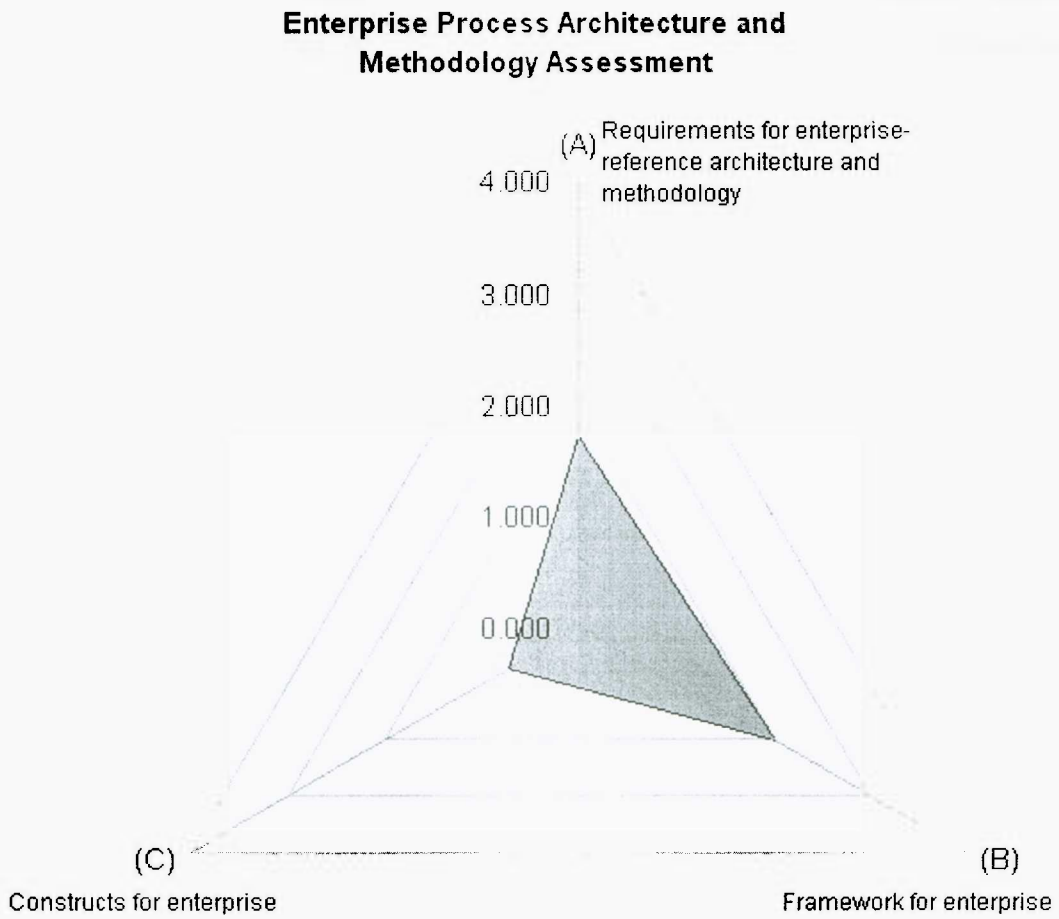

Figure 9. Radar Chart showing results from the Study Case.

The overall level of maturity of this study case is 1.476. So this particular enterprise architecture is weak to good in its maturity level. In order to improve the maturity level the enterprise has to improve the weak aspects of the assessment (see Figure 9).

4.3 Interpretation

Now let's analyze these three axes, A. Requirements for enterprise reference architecture and methodology, B. Framework for enterprise modeling and C. Constructs for enterprise modeling.

For the axes A the level of maturity is 1.705 means that is almost good with useful capabilities and represents formal structure of enterprise architecture, with the weak aspect is in the use of standardized term and definition with just 1.000 of maturity.

For the axes B the level of maturity is 2.015 means that is good with useful capability and represent formal structure of enterprise architecture, the strongest aspect comes from the use of the concept of filtering or enterprise views.

For the axes C the level of maturity is 0.708 means that is weak with bandy useful capability and represents some basic structures for enterprise processes. The limitation comes from Characteristics of process modeling language constructs and enterprise construct templates with 0.000 level of maturity.

The next step important in the methodology is the interpretation of the results from the assessment. Using the major results at the highest level, that means A. Requirements for enterprise-reference architecture and methodology, B. Framework for enterprise modeling, and C. Constructs for enterprise modeling, we can say the enterprise obtains 1.476 of 4.000. Saying in other words the enterprise model accomplishes the 36.901% of the standard requirements for an enterprise process architecture and methodology.

Now depending on the goals and objectives of the enterprise the practitioners will define projects, plans, resources and any other aspect needed to improve its enterprise model. As mentioned before now the gaps arise from the gray areas of the model and they are identified, then stakeholders of the enterprise must identify their concerns and define the viewpoint needed in order satisfy their concerns.

Final Comments

At the end of the assessment we perform a questionnaire to the people participant in the assessment to receive his comments. The questions and the answers are listed below.

1. Clarity of the questionnaire, the statements used in these assessments are clear enough to know what to answer.
2. Levels are explicit, yes
3. Difficult to identify where the enterprise architect is, simple because was no confuse where we are and what is our level.
4. Resume sheet and radar chart show with enough clarity where you are, yes, because the graphs visually show our position according with standards, and resume give us a number that qualify our level.
5. Final comments, it is very interesting see in a simple way where we are and what are our weaknesses. With this we can decide where to go from this and identify benefits to achieve. At the end is a starting point to define some kind of master plan to improve our business operation.

Finally the assessment gives the position of the enterprise process architect and gaps to cover in order to get closer to the standard requirements. Remember the assessment give the position of the enterprise not what to do for a specific business requirement.

Chapter 5 Conclusions and Further Work

5.1 Conclusion

According with the results of the thesis obtained in the study case, the objective was accomplished. An enterprise-architecture assessment identifies its maturity level in relation with the international standard and from there define some specific improvements in its enterprise model to better accomplish its enterprise mission.

Another important aspect founded was about the level of knowledge of the responsible of the process management. He must have some knowledge on enterprise-architecture to be able to respond to this assessment, and the most important thing is to have a practitioner on enterprise-architecture as a responsible to guide thru the assessment.

When I performed the assessment some maturity levels needed to be explain it to responsible of the business process modeling, so the level can be better understand and respond obtained be more accurately.

Another aspect comes from the scope of the assessment. Let's say we want to perform the assessment in general, or for a particular division or department of the enterprise. Then the scope must identify and the results and objectives must focus on that scope. This is important because the accuracy of the assessment will be lost and the results will be useless to the enterprise. Remember the objective of this enterprise-architecture and methodology assessment is to give tools to the responsible of the process management to strength business processes in order to better fulfill the enterprise mission and its business objectives.

A final conclusion is the importance of continuing enforces this diagnostic tool to simplify it and make it more universal according to the level of knowledge needed to perform it. So everyone involved in improving the enterprise skills is responsible to know about enterprise-architecture and methodology and spread it to everyone in charge of improving enterprise processes.

5.2 *Further Work*

The next work need to be focus on which gaps solve some particular enterprise problems. Because some enterprise mission requests some specific variable to fortify and some other than not really impact or have some significant results. Further work should focus on the relevance of each variable to increase the value of specific enterprise mission.

Let make some examples, suppose an enterprise needs to have a common understanding inside the enterprise so maybe the most important aspect is to have a harmonized definitions and terms in order to improve the communication of the people involved. Maybe another enterprise needs to use their documentation for different locations in order to train its people so they should enforce the use of the constructs.

The major future research should be focus on the impact on the enterprise value to have or not have some structural elements of the enterprise-architecture; nevertheless it is also relevant to explore another diagnostic mechanism to determine the maturity level of any enterprise.

A.I. PRINCIPLES ENTERPRISE-REFERENCE ARCHITECTURE

	0	1	2	3	4
1. Applicability to any enterprise	Enterprise architecture of the enterprise is develop only to a specific aspect of the business	Transition stage	Enterprise architecture can be used to the purpose of the enterprise that was developed. Apply to several aspects of the business but not to any aspect of the business	Transition stage	enterprise architecture apply to any enterprise, regardless of its size and mission or any other such attributes involved and to all aspects of the enterprise
2. Enterprise identification and mission definition	Enterprise do not has its mission defined and in consequence the enterprise architecture does not has it as it essential part	Transition stage	Enterprise has a mission and its used to guide the business strategy but is not an essential part of the enterprise architecture	Transition stage	enterprise has its identification and mission definition as an essential parts of any enterprise architecture
3. Separation of mission-fulfillment functions from mission-control functions	Enterprise model do not identify how the mission is fulfill. Neither it separate the mission-controlling from the mission-fulfillment	Transition stage	The model only identifies one mission-fulfillment aspect. This aspect can be physical or information.	Transition stage	Comprises functions involved in fulfilling the mission (physical) and functions involved that manage and control the mission-fulfillment (information)

	0	1	2	3	4
4. Identification of process structures	The model does not have any distinctions that can information, material on the other aspect of the formal process structure.	Transition stage	The enterprise model identified at least one transformation aspect, either for information or for material.	Transition stage	Identification of two distinct transformations classes: one for information and the other for material and energy. These transformations will be carried out by many separate activities that can be executed both concurrently and sequentially to constitute processes of an equivalent class
5. Identification of process contents	There is no way of showing where how the human fits in the enterprise. Enterprise model only shows The procedure to perform an activity	Transition stage	The model shows certain aspects of the human but more than machine aspects. Some aspects of the model can distinguish between human and machine participation	Transition stage	To have a simple way of showing where and how the human fits in the enterprise and how the distribution of functions between humans and machines is accomplished
6. Recognition of enterprise life-cycle phases	In the model we can not recognize any life cycle phases, only the function behavior	Transition stage	Enterprise model can only identify some phases of the life-cycle. However these phases are not well structured in the model	Transition stage	All enterprises, of whatever type, follow a life cycle from their initial concept in the mind of an entrepreneur through a series of stages comprising their identification, conceptualization, requirement, design, implementation, operation and decomposition.

	0	1	2	3	4
7. Evolutionary approach to enterprise integration	There is not a master plan to build the enterprise model in the enterprise. The model o documentation is made it informally	Transition stage	The process practitioners follow a plan o program to document the processes but this plan is not clearly in order to identify how all or part are integrated	Transition stage	The integration of all of the informational and customer-product and service functions of an enterprise may be a part of a master plan.
8. Modularity	The documentation developed is not in a modular way, so the documentation in one process can not be interchange to another similar process	Transition stage	Some aspects of the process are documented or modeled in a modular fashion, therefore these models can be reused or interchanged in other processes	Transition stage	all functionality must be defined in a modular fashion, along with their required interconnections, so they may later be interchanged with other processes that carry out similar functions but in a different manner
9. Terms and definitions	The model use terms that are not harmonized in the enterprise. Some or all terms have different meaning to process practitioners	Transition stage	Some terms are harmonized and some of those are conformed to some international standard. The process practitioners are harmonized to those terms	Transition stage	Enterprise architecture has and use harmonized terms along the enterprise life-cycle. This term complies to international standards.
	None		Medium		High

A.II. TERMS FOR ENTERPRISE PROCESS ARCHITECTURE

	0	1	2	3	4
1. Architecture perspective	The practitioners do not have any defined high level terms to define or identify the process architect	Transition stage	Some terms are defined to understand the architectural perspective of the process, and some of those are part of this international standard.	Transition stage	The enterprise's enterprise architecture has the following terms: architecture, enterprise, enterprise engineering, framework, methodology, structure and system
2. Framework perspective	The practitioners do not have any defined high level terms to define or identify the framework perspective	Transition stage	Some terms are defined to understand the framework perspective of the process, and some of those are part of this international standard.	Transition stage	The enterprise architecture has the following terms: activity, attribute, behavior, business process, life cycle, organization and resource
3. Modeling perspective	The practitioners do not have any defined high level terms to define or identify the modeling perspective	Transition stage	Some terms are defined to understand the modeling perspective of the process, and some of those are part of this international standard.	Transition stage	The enterprise architecture has the following terms: enterprise model, genericity, life history, master plan, mission and model
	None		Medium		High

A.III. CONCEPTS OF ENTERPRISE PROCESS ARCHITECTURE

	0	1	2	3	4
1. General	Enterprise-reference knowledge does not clearly address role of humans or processes and the supporting technologies. Neither the enterprise life cycle concepts.	Transition stage	Knowledge and methodology used to model the enterprise processes express some of the following: human roles, process description and supporting technologies. Nevertheless enterprise life-cycle in not well identified	Transition stage	The enterprise-reference architectures and methodologies shall address the role of humans, the description of processes (function and behavior) and the representation of all supporting technologies throughout the life cycle of the enterprise.
2. Human oriented	The architectural-reference methodology does not identify how human aspects are going to exhibit.	Transition stage	The architectural-reference methodology used to document or model the processes exhibit some human aspects but do not comply to any international standard	Transition stage	It shall exhibit the capability to represent human aspects, such as organizational and operational roles, capabilities, skills, know-how, competencies, responsibilities, authorization, and relations to the organization.
3. Process oriented	The model does not exhibit the operation, but represent components of the operation as activities or processes	Transition stage	The model exhibits some process behavior and some functionality. This representation do not cover all operational aspects so behavior and functionality is not complete	Transition stage	It shall exhibit the capability to represent the enterprise operation. Such representations shall cover both the functionality and behavior of the operation
4. Technology oriented	The model does not represent the technologies that are used in the enterprise.	Transition stage	For some viewpoints there is a representation of how the technologies are employed in the operation	Transition stage	It shall exhibit the capability of representing all technologies employed in the enterprise operation

	0	1	2	3	4
5. Mission-fulfillment oriented	There is no explicit relation of how process fulfill the mission and how key processes are affected if the mission is affected	Transition stage	There is an explicit explanation on how the process fulfills the mission and some processes are aligned to the mission.	Transition stage	It shall exhibit the capability to represent any process and its constituent activities involved in performing the established mission of the enterprise in terms of providing the enterprise products and services to its customers
6. Mission-control oriented	The process and its activities have no mechanism to control and manage the process to assure the mission fulfillment	Transition stage	Some processes exhibit some basic capabilities to manage and control the processes in order to fulfill the mission	Transition stage	It shall exhibit the capability to represent any process and its constituent activities of the accomplishment of the management and control of the established mission of the enterprise according to the criteria established by enterprise management
7. Framework for enterprise modeling	The model does not show the capability to see the concepts of the dimensions expressed in this standard	Transition stage	The model exhibits the capability to see some dimensions defined by the enterprise-architecture standard.	Transition stage	It shall exhibit the capability to model entities within the conceptual space defined by the dimensions of life cycle, genericity, and modeling views
8. Life cycle	The life-cycle phases can not be identified in the model and in the life of enterprise	Transition stage	Some phases of the life-cycle can be identify in the construction of the model to express all stages during the life of the enterprise	Transition stage	It shall identify and represent the life-cycle phases that are pertinent during the life of any enterprise entity.

	0	1	2	3	4
9. Life history	The model does not represent the life history of the enterprise and in consequence do not represent in time how the activities are performed	Transition stage	The model is capable to represent some aspect of the life history. Some parts of the model can represent in time the activities carrying out	Transition stage	It shall be capable of representing the life history of any enterprise entity; that is, the representation in time of activities carried out on any enterprise entity.
10. Modeling views	The model or procedures do not show different view. The methodology used also does not promote different views.	Transition stage	There is some view that represents different perspectives of the enterprise, but those views can or cannot be part of this standard	Transition stage	It shall provide concepts for representing different views of an enterprise model to allow it to be described as an integrated model but to be presented to the user in different subsets. Recognize function, data, resource and organization.
11. Genericity	The model does not provide the capability for represent different levels of particularizations	Transition stage	In the model can identify the level of particularization of the enterprise-model, but is confusing which part is generic or partial or particular	Transition stage	It shall provide the capability for representing generic-enterprise elements, partial-enterprise models, and particular-enterprise models
	None		Medium		High

A.IV. COMPONENT OF ENTERPRISE PROCESS ARCHITECTURE

	0	1	2	3	4
1. Engineering methodologies	The enterprise does not have any methodology to carry out the management plan and maintenance of the enterprise- model	Transition stage	The methodology used to carry out enterprise-model is partially developed or partially used	Transition stage	Enterprise-reference architectures and methodologies shall provide enterprise-engineering methodologies that guide the user in the process of management of change and provide methods of progression for every type of life-cycle activity for any enterprise-entity type.
2. Modeling languages	Enterprise- process architecture and methodology not use any formal language to describe their operation	Transition stage	The enterprise architecture and the methodology, use some formal modeling languages or constructs. To be formal it needs to be based on formal sources (bibliographically supported)	Transition stage	Enterprise-reference architectures and methodologies that are model-based shall identify enterprise modeling languages or modeling constructs that allow the enterprise operation to be described.
3. Generic Elements	The model do not have a meta-model or high glossary or theories that give a common theory in the construction	Transition stage	Enterprise-reference architecture and methodologies are based on some generic elements. These generic elements have incomplete glossaries, or partial meta-models, or some ontological theories.	Transition stage	Enterprise-reference architectures and methodologies shall be based on generic elements of enterprise design and modeling. Such generic elements are, in increasing order of formality, glossaries, meta-models, and ontological theories.

	0	1	2	3	4
4. Partial models	The methodology is only for developing documentation but do not give the capability to have a reusable models	Transition stage	The enterprise model has some partial aspects, but it is difficult to reuse (reusable models)	Transition stage	It shall support the concept of partial-enterprise models (reusable reference models).
5. Particular models	The methodology used in the enterprise do not identify the particular model of the enterprise	Transition stage	It supports the creation of particular-enterprise model for some of the views. These views can be function, information, resources or organization	Transition stage	It shall support the creation of particular-enterprise models that describe part or all of any enterprise entity.
6. Tools	The enterprise does not have a technological tool that support the modeling efforts	Transition stage	Our methodology can be supported by computer based tools. However those tools only support some aspects of the enterprise model or were not designed to that specific purpose	Transition stage	It shall be supported by computer based tools that aid the user in enterprise engineering and integration projects. Such tools shall be based on enterprise-engineering methodologies and may have implemented modeling languages.
7. Modules	The methodology used in the enterprise does not provide the capability to make modules that can be used in different part of the enterprise-model	Transition stage	Enterprise-reference architecture provides the capability to reuse some parts of the enterprise-model but not as modules. An process-engineer need to create the new one base on the reference enterprise-model	Transition stage	It shall provide the capability for representing the concept of enterprise modules or implemented building blocks or systems (products, or families of products) that are utilized as common resources in enterprise engineering and enterprise integration

	0	1	2	3	4
8. Enterprise-operational systems	The enterprise-model or documentation does not identify the hardware, software and humanware needed to fulfill the objectives and goals	Transition stage	Enterprise model contains some aspects like: hardware, software or humanware but is not clear that those will fulfill the enterprise objectives.	Transition stage	It shall consist of the hardware, software and humanware needed to fulfill the enterprise objectives and goals
9. Framework dimensionality	The enterprise framework does not provide guidelines to structure the three main dimension for modeling	Transition stage	Enterprise framework is structured with some of the following dimensions: model phase, model view or Genericity	Transition stage	The framework is structured in terms of three dimensions. The dimensions are: enterprise model phase, enterprise model view and genericity
	None		Medium		High

B.I. TERMS OF FRAMEWORK FOR ENTERPRISE PROCESS MODELING

	0	1	2	3	4
1. Architecture perspective	The practitioners do not has any defined modeling terms to define or identify different architecture perspectives	Transition stage	The enterprise architecture has at least 50% of the terms for the architecture perspective.	Transition stage	The enterprise architecture has the following terms: component, decomposition, detailing, enactment, enterprise, enterprise engineering, enterprise integration, entity, environment, framework, generalization, generic, methodology, particularization, specialization, stakeholder, and system.
2. Framework perspective	The practitioners do not have any defined modeling terms to define or identify the framework perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the framework perspective.	Transition stage	The enterprise architecture has the following terms: concept definition, decommission definition, design specification, domain identification, domain operation, enterprise model phase, enterprise model view, enterprise, operation, generic level, implementation description, life cycle, life cycle phase, partial level, partial model, particular level, particular model, and requirements definition.

	0	1	2	3	4
3. Modeling perspective	The practitioners do not has any defined modeling terms to define or identify the modeling perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the modeling perspective.	Transition stage	The enterprise architecture has the following terms: abstraction, aggregation, enterprise model, enterprise modeling, genericity, instantiation, mission, model, model development process, and modeling language construct
4. Function view perspective	The practitioners do not have any defined modeling terms to define or identify the function view perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the function view perspective.	Transition stage	The enterprise architecture has the following terms: behavior, business process, constraint, domain, enterprise activity, function view, objective, and operational, and process
5. Information view perspective	The practitioners do not have any defined modeling terms to define or identify the information view perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the information view perspective.	Transition stage	The enterprise architecture has the following terms: attribute, enterprise object, information technology component, information view, and manufacturing technology component
6. Resource view perspective	The practitioners do not have any defined modeling terms to define or identify the resource view perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the resource view perspective.	Transition stage	The enterprise architecture has the following terms: capability, resource, and resource view

	0	1	2	3	4
7. Organizational view perspective	The practitioners do not have any defined modeling terms to define or identify the organizational view perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the organizational view perspective.	Transition stage	The enterprise architecture has the following terms: decision, decisional, and organization view
	None		Medium		High

B.II. FRAMEWORK FOR ENTERPRISE PROCESS MODELING

	0	1	2	3	4
1. Dimensionality of the model	Current enterprise framework does not describe three dimensions for the enterprise-model structure	Transition stage	The framework describes its structure in some of the following dimensions: model phase, model view, or genericity.	Transition stage	The framework described is structured in terms of three dimensions. The dimensions are: enterprise model phase, enterprise model view, and genericity
2. The model identify enterprise model phases	There is no formal methodology to build the model. In consequence no phases can be distinguishing	Transition stage	The model can identify at least three phases in the life cycle of the model.	Transition stage	Enterprise models have a life cycle that is related to the life cycle of the entity being modeled. The model phases that shall be distinguished by different extents of decomposition and detailing are: domain identification, concept definition, requirements definition, design specification, implementation description, domain operation, and decommission definition.

	0	1	2	3	4
3. The model has view to filter it.	In the model it is not possible to distinguish views to filter the world main aspect	Transition stage	Modeler and enterprise model user filter the real world in the model with two of the formal views. Those formal views are: function, information, resource and organization.	Transition stage	The enterprise model view dimension enables the enterprise modeler and enterprise model user to filter their observations of the real world by emphasizing those aspects that are relevant to their particular interests and context. They are: function view, information view, resource view, and organization view.
4. Genericity of the model	Actual model or documentation in the enterprise it is not possible to identify the particularization or the generalization of the concepts. It's not possible to identify if the model is on particular or general level.	Transition stage	The frameworks the enterprise use to create enterprise-models only characterize some of the following levels: generic, partial or particular	Transition stage	Generalization is the progression from one or more particular concepts to a more general concept that represents their shared characteristics or essential qualities. Specialization is the reverse procedure, defines three levels of genericity. They are: generic level, partial level, and particular level.

	0	1	2	3	4
5. Enterprise Model Consistency and Completeness	Terms and concepts used in the model have different connotation and semantic. This also means that practitioners use different concepts to identify the same modeling content.	Transition stage	The consistency and completeness is provided for some modeling contents. The consistency is partially identified in the enterprise-model. However the consistency and completeness has to be found in at least half of the enterprise-model.	Transition stage	The modeling language shall provide a unification (common semantics) of the modeling contents and the menu-driven user interface shall assure model consistency in terms of valid in context references to enterprise objects provided the underlying enterprise knowledge base (the set of enterprise objects and sub-objects) is consistent in itself.
	None		Medium		High

B.III. ENTERPRISE PROCESS MODEL PHASE – CONCEPTS OF THE MODEL LIFE CYCLE

	0	1	2	3	4
1. Domain identification	In the model is not possible to identify the top level of the enterprise representation. Also is not possible to identify if the top level was defined in the perspective of the end user. Also is not defined all the inputs and outputs.	Transition stage	In the model it is possible to identify the domain with its business objectives and its inputs and outputs, and shall be described by end-users	Transition stage	It shall identify the domain to be modeled in terms of its business objectives, its inputs and outputs, their respective sources and sinks, and the basic functionality and capabilities. It is described by the end-users
2. Concept definition	The model or documentation does not have a relation between the domain identification and the concept definition. Either the conceptualization that is characterized on the business objectives does not cover all the basic functionalities and capabilities.	Transition stage	The enterprise-model can define concepts that enable the realization of the domain identification. The concepts shall be at least mission, vision, and strategies necessary to achieve the basic functionality and capability of the domain	Transition stage	It shall define the business concepts that enable the realization of the business objectives and the domain operation, including the mission, vision, values, strategies, policies, business plans and so forth, necessary to achieve the basic functionalities and capabilities of the domain

	0	1	2	3	4
3. Requirement definition	The enterprise-model or documentation does not describe the business functionality. Also is not possible to identify if the requirements was a consequence of the concept definition.	Transition stage	Enterprise-model identifies the business needs but is not derived from the concept definition. Also the model defines only some parts of the business process, enterprise activities or their input and outputs.	Transition stage	It shall describe the business functionality of an enterprise domain in term of business process, enterprise activities and their inputs and outputs. The requirements definition model is derived from the concept definition model and shall identify the business needs of the enterprise domain.
4. Design specification	In any part of the enterprise-model or documentation perceives in a detailed manner the enterprise operations. Means that are all in some partial or general level, also they do not satisfy any formal requirements.	Transition stage	Enterprise-model is designed in detailed manner but is not derived from the requirement definition. Or the enterprise-model is not clear enough about the detail needed to satisfy the requirement definition.	Transition stage	It shall specify in detailed manner in which the enterprise operations are performed. It is derived from the requirement definition and shall capture the specification of domain processes with all their components to satisfy the requirements.
5. Implementation description	There is no evidence that the enterprise documentation or model described is the final documentation. It is ambiguous or not defined.	Transition stage	Enterprise-model is designed but do not include the processes and information that describe the final implementation of the domain operational model.	Transition stage	It shall capture all the information and functionality that describe the final implementation of the domain operational model.

	0	1	2	3	4
6. Domain operation	Our operational system or procedures do not specify how the operation is controlled or monitored. The procedures just mention aspects of the operations without specifying controlling aspects.	Transition stage	Enterprise-model control and/or monitor some aspects of the model. However the model does not control the operation in an integrated manner to ensure the fulfillment of the domain mission.	Transition stage	It constitutes the operational usage of the model that represents the operation of the enterprise domain. It shall be capable of enabling monitoring and controlling of the domain operation as well as supporting any kind of decision-making activities.
7. Decommission definition	Documentation does not have any aspect of the final disposal or state for the operational system. Because of this when the process, domain or enterprise finalizes its life time the model cannot specify what is its final destination.	Transition stage	Enterprise model only identify some aspects of decommission definition in the enterprise-model. These aspects could be for hardware, software, or humanware.	Transition stage	It shall define the final state of the operational system for a particular enterprise domain at the end of its useful life. It shall identify the different tasks include redesign, recycling, preservation, transfer, disbanding, disassembly, or disposal for all or part of the operational system at the end of its useful life.
	None		Medium		High

B.IV. ENTERPRISE PROCESS MODELING VIEWS – THE CONCEPT OF FILTERING

	0	1	2	3	4
1. Function View	The model does not specify any functional aspects, the behavior of the processes, and any other kind-of to explain the enterprise functionality.	Transition stage	It is possible to identify in the model functional aspects but the logical connections and interdependencies are not clear enough or well documented	Transition stage	It shall describe a concatenation of single processing steps as a collection of processes structured as a network of activities reflecting their logical connection and interdependencies
2. Information View	The model does not specify any informational aspect, meaning objects that describe the attribute for information and materials used in the curse of enterprise operations.	Transition stage	The model specifies informational aspects but in some cases for data and other for material. But in the model is not clear enough to understand how this information is produce or their attributes are not well defined.	Transition stage	It shall describe the information-related enterprise objects (both material and information) of the enterprise as they are used and produced in the curse of enterprise operations
3. Resource view	The model or documentation does not specify any aspect of the resources that give the capabilities of the enterprise.	Transition stage	Enterprise-model describes some of the resource assets. This could be for human, physical or technological.	Transition stage	It shall describe resource assets of the enterprise (human, physical, and technological) as they are used in the curse of enterprise operations
4. Organization view	The enterprise model or documentation does not describe the responsibilities for decisional activities; also do not describe the authorities in the domain.	Transition stage	Enterprise-model has an organizational structure but the responsibilities and authorities are not complete. Also to be in this level some of other organizational aspects must be defined like geographical.	Transition stage	It shall describe the responsibilities and authorities within the enterprise domain. It shall also provide for representation of responsibilities for decisional activities into a decisional structure

B.V. GENERICITY – THE CONCEPT OF GENERALIZATION AND SPECIALIZATION

	0	1	2	3	4
1. Generic view	The actual model or documentation does not have re-usable generic processes. This concept is not part of the actual documentation.	Transition stage	The model has some generic components that can be re-used in other parts, but are not complete to build partial or particular models.	Transition stage	It is a collections of modeling languages that can be re-used to build partial models and particular models
2. Partial view	The actual model or documentation does not have partial processes that can be used as a reference to develop particular models.	Transition stage	The model has some partial models but is not clear if those can be re-used or only are an incomplete models.	Transition stage	It contains sets of partial models, each one being applicable to a specific kind of enterprise segment or industrial activity
3. Particular view	Documentation does not specify if the processes documented is solely used for one particular domain.	Transition stage	Enterprise model has a particular models but it is not possible to identify which parts only apply to this particular domain	Transition stage	It is solely with one particular enterprise domain
	None		Medium		High

C.I. TERMS OF PROCESS MODELING LENGUAGE CONSTRUCTS

	0	1	2	3	4
1. Architecture perspective	The practitioners do not have any defined construct terms to define or identify the architectural perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the architecture perspective.	Transition stage	The enterprise architecture has the following terms: classification, component, component, entity, generalization, integrate, occurrence, particularization, relationship, specialization, system, and universe of discourse
2. Framework perspective	The practitioners do not have any defined construct terms to define or identify the framework perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the framework perspective.	Transition stage	The enterprise architecture has the following terms: concept definition, decommission definition, domain identification, domain operation, enterprise model phase, enterprise model view, generic level, implementation description, life cycle, life cycle phase, partial model, particular level, and requirements definition.

	0	1	2	3	4
3. Modeling perspective	The practitioners do not have any defined construct terms to define or identify the modeling perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the modeling perspective.	Transition stage	The enterprise architecture has the following terms: construct-based modeling language, construct label, construct template, derivation, design specification, enterprise model, instantiation model, modeling language construct, partial level, and processable model
4. Function view perspective	The practitioners do not have any defined construct terms to define or identify the functional perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the function view perspective.	Transition stage	The enterprise architecture has the following terms: behavioral rule, constraint, declarative rule, enterprise activity, enterprise domain, enterprise function, function view, functional category, functional operation, objective, performance indicator, business process, domain, enterprise activity, event, and functional entity

	0	1	2	3	4
5. Information view perspective	The practitioners do not have any defined construct terms to define or identify the informational perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the information view perspective.	Transition stage	The enterprise architecture has the following terms: attribute, class, data type, information technology component, information view, integrity rule, manufacturing technology component, enterprise object, enterprise object view, order, and product
6. Resource view perspective	The practitioners do not have any defined construct terms to define or identify the resource perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the resource view perspective.	Transition stage	The enterprise architecture has the following terms: capability, capability element, resource, resource view, capability, and resource
7. Organizational view perspective	The practitioners do not have any defined construct terms to define or identify the organizational perspective	Transition stage	The enterprise architecture has at least 50% of the terms for the organizational view perspective.	Transition stage	The enterprise architecture has the following terms: organization view, decision centre, operational role, organizational role, organizational unit, and person profile
	None		Medium		High

C.II. CHARACTERISTICS OF PROCESS MODELING LENGUAGE CONSTRUCTS

	0	1	2	3	4
1. Range of representation	The constructs used to document are not applicable to human-understandable and machine-readable.	Transition stage	Modeling language construct shall represent only human-understandable or machine-readable. This mean that model only can be use for human purposes or only for machine purposes	Transition stage	Modeling language constructs shall be represented in both a human-understandable and a machine-readable form. This means there is the need for both visual (graphical, iconic representation of structures) for use by model builders and business users, and a structured representation for information capturing for which this standard uses templates.
2. Common structure and template	The construct used to document or model the enterprise do not provide a common structure that provide a consistent properties and/or attributes.	Transition stage	Documentation's structure and templates are common defined but was defined locally by the users or practitioners	Transition stage	This standard uses a common structure that provides a consistent minimal assignment of properties and attributes to each construct. shall have two constituents: textual description and construct template
3. Representation of construct attributes	Enterprise constructs do not have a predefined attributes. Every practitioner who made a procedure defines its own data type.	Transition stage	The attributes of the templates are not formal defined but at least the identification code, name, design authority, description and objective	Transition stage	Each attribute shall be defined by its name and predefined data type (numbers, literals, structures, etc.)

	0	1	2	3	4
4. Construct specializations	Actual constructs do not have the capability to specialize a new construct from them.	Transition stage	Constructs used in the model have the capability to specialize some specialization aspects or only for half of the constructs used in the model.	Transition stage	Capability for specializations of the constructs already defined in this standard. i.e. of specializations are: Enterprise Object construct (Product, Order, Resource) and Person Profile (Organizational Role, Operational Role)
5. Relationship	The constructs or documentation do not have a relationship with other constructs used in the enterprise-model	Transition stage	The relation with every construct or model element are defined for function elements and information elements	Transition stage	Construct shall have relationships to model time-varying and other associations between run-time instances of modeling language constructs. i.e. relationship between Domain and Process
6. Roles	Actual documentation or constructs do not provide the capability for the representation of the resource roles (human, machinery and IT)	Transition stage	The modeling language constructs defines representation for human roles at least and IT resources	Transition stage	The modeling language constructs defined in this standard provide for the representation of the roles of human resources, machinery and IT resources.

	0	1	2	3	4
7. Purpose and applicability of constructs	The constructs used to model do not provide templates to define and describe different aspect of the enterprise. These templates shall include pre-defined attribute that guarantee relationships between them.	Transition stage	The constructs used in the documentations or enterprise model provide generic language constructs at least for functions and information	Transition stage	Constructs defines, describes and provides templates for generic modeling language constructs. These constructs form a modeling language with which a wide range of Business Process based enterprise models can be created. Each template shall include the attributes that are pre-defined in this standard
	None		Medium		High

C.III. ENTERPRISE CONSTRUCT ELEMENTS

	0	1	2	3	4
1. Domain	The model does not have a high-level element and their relationships with their environment.	Transition stage	Enterprise model construct for domain is defined for the meta-function or domain. However this definition it not conform to the standard. The relations with the environment are not formal defined.	Transition stage	It shall describe the parts of the enterprise to be modeled and their relationships with the external environment from the high-level management-oriented point of view
2. Business process	Model does not have an element that is part or decompose from the domain, and express the functionalities of the domain.	Transition stage	Documentation named the process but does not observe the international standard definition	Transition stage	It shall represent all or parts of the domain functionalities and its dynamic behavior named as business process
3. Behavioral rules	Model does not have rules to describe the logical sequencing of processes. i. e. the relationship can exist but the rule is not named.	Transition stage	Documentation has defines the name of behavioral rule but does not observe the international standard definition	Transition stage	It shall identify the start of the main business process and describe the logical sequencing relationships of constituents functionality
4. Enterprise activity	The model does not have defined an elementary part of the functionality; there is more than one different kind.	Transition stage	Documentation has defines the name of enterprise activity but does not observe the international standard definition	Transition stage	It shall represent the elemental part of the functionality that is needed to realize a basic task within a business process of an enterprise domain.
5. Functional operation	The procedure in the documentation or the model does not define a basic functionality that is part of an enterprise activity.	Transition stage	Documentation has defines the name of functional operation but does not observe the international standard definition	Transition stage	It shall represent a part of the functionality of an enterprise activity, which has been decomposed into a number of ordered transformation functions

	0	1	2	3	4
6. Event	The model does not define the element of event that represent the initiation or final stage of functionality.	Transition stage	Documentation has defines the name of Event but does not observe the international standard definition	Transition stage	It shall represent the initiation of a state change in the enterprise or its environment
7. Enterprise object	The model does not define an element that represent an information viewpoint mean it exist during its lifetime	Transition stage	Documentation has defines the name of enterprise object but does not observe the international standard definition	Transition stage	It shall represent the common characteristics from an information viewpoint of a thing as it exist during its lifetime
8. Enterprise object view	The model does not have an element that can describe a specific subset of attributes of an enterprise information object.	Transition stage	Documentation has defines the name of enterprise object view but does not observe the international standard definition	Transition stage	It shall represent a subset of the descriptive attributes of an enterprise object. Enable the identification of relevant attributes from a particular enterprise object.
9. Product	The model does not have an element that represents the products as a specialization of an enterprise object.	Transition stage	Documentation has defines the name of product but does not observe the international standard definition	Transition stage	It shall represent the products and specializations thereof, whose fabrication and sale is the aim of the enterprise. It is a specialization of the enterprise object
10. Order	The model does not have an element that represents the orders as a specialization of an enterprise object.	Transition stage	Documentation has defines the name of order but does not observe the international standard definition	Transition stage	It shall represent and instruction from one authority to another one for performance an operation. It is a specialization of the enterprise object
11. Resource	The model does not have a representation for a device, tool or means that produce the goods and services.	Transition stage	Documentation has defines the name of resource but does not observe the international standard definition	Transition stage	It shall represent any device, tool or means that provide some or all the capabilities for an enterprise activity

	0	1	2	3	4
12. Capability	The model does not have an element that describes the quality of being able to perform a given activity.	Transition stage	Documentation has defines the name of capability but does not observe the international standard definition	Transition stage	It shall represent the elements of both the capabilities required by an enterprise activity and those provided by a resource.
13. Functional entity	The model does not have an element that describes a resource that executes a specific functional operation.	Transition stage	Documentation has defines the name of functional entity but does not observe the international standard definition	Transition stage	It shall a special type of resource, which is capable of executing one or more functional operations
14. Organizational Unit	The model does not have an element that describes a hierarchical structure for an enterprise organization.	Transition stage	Documentation has defines the name of organizational unit but does not observe the international standard definition	Transition stage	It shall represent the formal, hierarchical, and/or administrative structure of an enterprise
15. Decision Center	The model does not have an element that describes a decisional structure of an enterprise that describe how and who makes it.	Transition stage	Documentation has defines the name of decision center but does not observe the international standard definition	Transition stage	It shall represent the decisional structure of an enterprise. It shall be determined by a set of decisions and their associated decision frames
16. Person profile	The model does not have an element that describes the human skills that a person shall have to fulfill required abilities in the organizational unit and enterprise activity.	Transition stage	Documentation has defines the name of person profile but does not observe the international standard definition	Transition stage	It shall represent the provided human skills that are required to perform the tasks defined by organizational units and enterprise activity

	0	1	2	3	4
17. Organizational Role	The model does not have an element that describes the organizationally relevant human skills and responsibilities in the organization.	Transition stage	Documentation has defines the name of organizational role but does not observe the international standard definition	Transition stage	It shall represent, within a given hierarchical structure of an enterprise, the organizationally relevant human skills and responsibilities required to perform those organizational tasks
18. Operational Role	The model does not have an element that describes the relevant human skills and responsibilities to perform an organizational task.	Transition stage	Documentation has defines the name of operational role but does not observe the international standard definition	Transition stage	It shall represent the relevant human skills and responsibilities required to perform the organizational tasks that are assigned to the particular operational role
	None		Medium		High

C.IV. ENTERPRISE CONSTRUCT TEMPLATES

	0	1	2	3	4
1. Template for Domain with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Domain	Transition stage	Enterprise documentation or model construct for domain has attributes at least for identifier, name, design authority, domain description, process description, objectives and constraints	Transition stage	Exist a standardized template with at least the following attributes: construct label with DM, identifier, name, design authority, domain description, process description, objectives, constraints, object view inputs, event input, object view outputs, event outputs, domain characterization, domain operation, decision function, decision level, performance indicators, business processes, operation responsibility and operation authority

	0	1	2	3	4
2. Template for Business Process with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Business Process	Transition stage	Enterprise documentation or model construct for business process has attributes at least for identifier, name, design authority, description, objectives, constraints and performance indicators	Transition stage	Exist a standardized template with at least the following attributes: construct label with BP, identifier, name, design authority, description, objectives, constraints, performance indicators, declarative rules, object view inputs, event input, object view outputs, event outputs, process behavior, priority, where_used, part_of, consist_of, operation responsibility and operation authority

	0	1	2	3	4
3. Template for Enterprise Activity with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Enterprise Activity	Transition stage	Enterprise documentation or model construct for enterprise activities has attributes at least for identifier, name, design authority, description, behavior, objectives, constraints and performance indicators	Transition stage	Exist a standardized template with at least the following attributes: construct label with EA, identifier, name, design authority, description, behavior, objectives, constraints, performance indicators, function inputs, control inputs, required capabilities, function outputs, control outputs, input events, output events, person profile inputs, person profile outputs, resource inputs, resource outputs, ending statuses, duration, where_used, consist_of, operation responsibility and operation authority
4. Template for Event with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Event	Transition stage	Enterprise documentation or model construct for event has attributes at least for, identifier, name, design authority and description	Transition stage	Exist a standardized template with at least the following attributes: construct label with EV, identifier, name, design authority, description, object views, timestamp, priority, generated_by, initiates, operation responsibility and operation authority

	0	1	2	3	4
5. Template for Enterprise Object with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Enterprise Object	Transition stage	Enterprise documentation or model construct for enterprise object has attributes at least for, identifier, name, design authority, description, nature, attributes and constraints	Transition stage	Exist a standardized template with at least the following attributes: construct label with EO, identifier, name, design authority, description, nature, attributes, constraints, integrity rules, specialization_of, part_of, consists_of, related_to, operation responsibility and operation authority
6. Template for Object View with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Object View	Transition stage	Enterprise documentation or model construct for object view has attributes at least for, identifier, name, design authority, description, attributes, constraints and events	Transition stage	Exist a standardized template with at least the following attributes: construct label with EO, identifier, name, design authority, description, attributes, constraints, events, integrity rules, enterprise object, operation responsibility and operation authority

	0	1	2	3	4
7. Template for Product with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Product	Transition stage	Enterprise documentation or model construct for product has attributes at least for, identifier, name, design authority, description, nature, attributes and constraints	Transition stage	Exist a standardized template with at least the following attributes: construct label with PR, identifier, name, design authority, description, nature, attributes, constraints, integrity rules, specialization_of, part_of, consists_of, related_to, operation responsibility and operation authority
8. Template for Order with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Order	Transition stage	Enterprise documentation or model construct for order has attributes at least for, identifier, name, design authority, description, nature, attributes and constraints	Transition stage	Exist a standardized template with at least the following attributes: construct label with OR, identifier, name, design authority, description, nature, attributes, constraints, integrity rules, specialization_of, part_of, consists_of, related_to, operation responsibility and operation authority

	0	1	2	3	4
9. Template for Resource with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Resource	Transition stage	Enterprise documentation or model construct for resource has attributes at least for, identifier, name, design authority, operator roles and description, nature	Transition stage	Exist a standardized template with at least the following attributes: construct label with RE, identifier, name, design authority, operator roles, description, nature, operator profile, attributes, constraints, integrity rules, specialization_of, part_of, consists_of, related_to, operation responsibility and operation authority
10. Template for Capability with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Capability	Transition stage	Enterprise documentation or model construct for capability has attributes at least for, identifier, name, design authority, description and included capabilities	Transition stage	Exist a standardized template with at least the following attributes: construct label with CS, identifier, name, design authority, description, included capabilities, function related, entity related, constraints, integrity rules, performance related, operation related, where_used operation responsibility and operation authority

	0	1	2	3	4
11. Template for Functional Entity with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Functional Entity	Transition stage	Enterprise documentation or model construct for entity has attributes at least for identifier, name, design authority, operator roles, description, nature, operator profile, capabilities, attributes and operation set	Transition stage	Exist a standardized template with at least the following attributes: construct label with FE, identifier, name, design authority, operator roles, description, nature, operator profile, capabilities, attributes, operation set, constraints, integrity rules, specialization_of, part_of, consists_of, related_to, operation responsibility and operation authority
12. Template for Organizational Unit with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Organizational Unit	Transition stage	Enterprise documentation or model construct for organizational unit has attributes at least for identifier, name, design authority and description	Transition stage	Exist a standardized template with at least the following attributes: construct label with OU, identifier, name, design authority, description, assigned to OR, process-related, information-related, resource-related, organizational level, assigned OR, and assigned OU.

	0	1	2	3	4
13. Template for Decision Center with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Decision Center	Transition stage	Enterprise documentation or model construct for decision center has attributes at least for identifier, name, design authority, description, objectives, variables and decision category	Transition stage	Exist a standardized template with at least the following attributes: construct label with DC, identifier, name, design authority, description, objectives, variables, constraints, decision category, decision level, process applicability, information applicability, resource applicability, organizational level, assigned decision centers, and assigned to decision centers.
14. Template for Person Profile with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Person Profile	Transition stage	Enterprise documentation or model construct for person profile has attributes at least for identifier, name, design authority and organization related	Transition stage	Exist a standardized template with at least the following attributes: construct label with PPR, identifier, name, design authority, organization related, operation related, role job description, owner of job, and assigned to OU

	0	1	2	3	4
15. Template for Organizational Role with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Organizational Role	Transition stage	Enterprise documentation or model construct for organizational role has attributes at least for identifier, name, design authority and role job description	Transition stage	Exist a standardized template with at least the following attributes: construct label with ORR, identifier, name, design authority, role job description, organizational skill profiles, responsibilities, authorities, specialization_of, and assigned to OU
16. Template for Operational Role with standardized attributes	Enterprise does not have a construct template with pre-defined and standardized attributes for Operational Role	Transition stage	Enterprise documentation or model construct for operational role has attributes at least for identifier, name, design authority and role job description	Transition stage	Exist a standardized template with at least the following attributes: construct label with OPR, identifier, name, design authority, role job description, operational skill profiles, specialization_of, assigned to OU, and assigned to EA
	None		Medium		High

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