Dragon1 Enterprise Architecture Modeling

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This article dives into the theory of the Dragon1 open EA Method, about how to model the architecture of an enterprise structure in four levels of abstraction. This new theory enables architects in organizations to design and model dynamic integral solutions for complex issues, problems and challenges that are hard to do with current available enterprise architecture modeling languages. This article aims to inform students of business administration and informatics as well as enterprise architecture practitioners, management and boardroom members about this new theory. This article will demonstrate that any architecture of any enterprise structure can be modeled using only these entities. This article tries to encourage others to also model their architecture at four distinct levels of abstraction using requirements as input. The benefit of doing that is that realizing fundamental strategic changes to the structures using integral solutions can be done more risk controlled, efficiently and effectively.

Introduction

Why a new theory on modeling enterprise architecture? Well, in many organizations today people are practicing enterprise architecture with little or no benefits with regards to enterprise transformation, that is fundamental strategic changes of the enterprise, organization, business or IT. The practice of enterprise architecture modeling often seems more like reactive high level ER-diagramming of configuration of systems where no one is actually using these diagrams to base their decisions upon: ranging from CxO to engineer.

What is Modeling? – Modeling is creating a representation of the real world in order to be able to communicate about that real world.

What is Designing? – Designing is creating a building plan, taking decisions, in order to realize a new system or change an existing system. A design always contains models, implicitly or explicitly.

One can argue very well that the current enterprise architecture modeling languages do not answer the modeling challenges well enough. Every issue or

problem you want to solve with architecture modeling requires you to extend the architecture modeling language used with extra rules, core concepts and un proven theory. That shows the languages are not fit for the job anymore. Common issues and problems in enterprise architecture we try solve by modeling but are not succeeding is:

1. It is very hard, when using the current modeling languages, to model the difference between implementation dependent and implement independent situations.
2. How to model and analyze complex changing business processes and information systems like legislative systems with multiple regimes per legislation?
3. How to model standards, rules and principles (way of working) as effective guiding boundaries for other (sub)models modeled by others in a multi modeling team and multilevel architecture (reference architecture, domain architecture and solution architecture) environment?
4. How to model the unknown or postpone/delay detailing or finalizing the type of entity in a later stadium?
5. Modeling what-if scenario's with assumptions, input and output values and business outcomes?
6. Modeling across business(function) domain and industry specific borders: a model that works both within government and commercial organizations or both within chemical industries and retail industries?
7. Modeling that is linked to building information modeling (building architecture)?

This obviously means that the Dragon1 Architecture Modeling language is only able to answer to design issues and modeling problems it was designed for to solve. Because of that the meta model will surely undergo changes the coming years to incorporate new constructs and entities. But not on every practice it is used for.

> **What is a Modeling Language?** – A Modeling Language is a rule-based artifical language to express information, knowledge or system structures and can be graphical and/or textual.

Most modeling languages within enterprise architecture do not go beyond a point where you cannot model it in PowerPoint or Visio. The number of symbols is a limited number and specific attributes, other than the name and a different color, line style or size for a symbol is not present. With these kind

of limitation modeling language discharge themselves from being capable of supporting real design challenges.

Here follow 10 cases of fundamental strategic changes the Dragon1 Architecture Modeling Languages has to be able to answer:

1. An multinational enterprise consisting of several stove pipe organized businesses in several countries need to standardize, rationalize and integrate on the information systems and IT infrastructure level so the company can collaborate more and (re)use information more efficient
2. An organization wants to drastically shorten the time-to-market for introducing a new product line and service line
3. Three completely companies or municipalities want to integrate and work with their own shared service center (operations stay decentralized), governance of the new organization must be centralized. It must be a federated model.
4. A company wants to outsource the IT operations and it has to be less complex and less costly and have a higher continuity after it is outsourced.
5. A companies wants to introduce new technology in all of their products
6. A healthcare company wants to innovate using Robotics, Virtual Reality and 3d printing. Architecture should help to redesign the business model and create situational companies.
7. A telecom company want to standardize their delivery systems into one configurable systems. And also security issue for online services and client self service dossier have to be solved using architecture.
8. The company has a gigantic gaps between business capabilities and human competence. Architecture should be used to fix it.
9. Governance, Programs and Projects are failing and architecture has to solve this
10. IT and business process are to complex. To many databases and applications are present, Single Sour of truth is not implemented. Architecture has to solve this.

As denominator, all the Fortune 500 companies and government institutions should be able to model their enterprise architecture in a detailed way using Dragon1. If that is the case, the modeling language is developed sufficiently.

As an example some companies of the Fortune 500 are listed below just to give you an idea of what should and could be modeled.

1. Wal-Mart stores
2. Exxon Mobil
3. Chevron
4. Berkshire Hathaway
5. Apple
6. Google
7. Microsoft
8. General Motors
9. General Electric
10. Samsung
11. IBM
12. Shell
13. Sony
14. EasyJet
15. Toyota
16. Walt Disney
17. NATO

All these companies should be able to redesign or analyze their current enterprise architecture and design their to-be architecture in detailed (governance, business, information and technology) way completely using Dragon1 enterprise architecture modeling language. With the modeling language they should be able to express all the knowledge, informative and system structures they posses or have.

Overview of current (enterprise architecture) meta models and modeling languages

- UML

- ArchiMate

- BPMN

- DEMO

- OIAM

- Enterprise/Business Motivation Model

- Building Information Model

- Event Process Change

Where does the new theory comes from?

In building architecture, construction and engineering we have many building structures that where build using architecture and there are also many, many architecture books documenting the knowledge used to design the architecture and build the structure using the architecture.

When reading those books one can re-engineer a meta model from the text with which we could (re)design, (re)model and (re)build the structure or integral solutions for the structure.

This meta model holds not only other entities but also other definitions for known entities. For instance architecture is now a special total concept and principle is about the way things work. These are very big changes when looking at current architecture modeling languages.

Import to note is that in many countries where English is not the native language people are trying to create modeling languages in English. With all respect to everyone, this still leads to a lot of problems.

The Dragon1 Core Meta Model for Architecture Modeling can be used the re-engineer the architecture of the Colosseum in Rome, The old opera in Paris, the Eiffel Tower, The Millau Bridge, The Notre Dame Church, The 360 Airbus, The Pyramid of Toetanchamon and the Temple of Heaven (China), The Google Organization, Sony, Toyota and Coca Cola. Also the name of the structure differs from the name of the total concept. For example, the Colosseum is an half open elliptic Amphitheatre.

What is (enterprise) architecture for?

Architecture is a special total concept, with coherent operative, constructive and decorative concepts, applied onto a structure. Analogue to this Enterprise Architecture is a special total concept for an enterprise structure.

> **What is Enterprise Architecture?** – Enterprise Architecture as field of study is the art and science of designing and realizing enterprise structures. Enterprise Architecture as the architecture of an enterprise structure, is the is a special total concept of an enterprise structure. An enterprise architecture is a coherent set of operative, constructive and decorative governance, business, information and technology concepts.

If one designs and realizes an (enterprise) structure without designing a total concept first more often the construction, operations and decorations will not fit the requirements of the owner-client and stakeholders as much as poss-

ible. With architecture (the total concept) the designer (i.e. architect) will use integral solutions and future proof solution for problems that are more integral, centrally, standardized and rationalized. The design and realized (enterprise) structure will have more coherence in construction itself. It will be stronger than otherwise. The operations will better fit the (enterprise) structure and later (currently unknown, unthoughtful or unforeseen) usage by user. The construction will support execution of operations better and usage of facilities and infrastructures in or at the spaces on or at the location where the structure remains.

The most important reason for architects to call what they are doing not just plain 'design' but architecture, is that they do conceptual modeling in order to design a solution answering to conflicting or contradictory requirements of stakeholders. If you do conceptual modeling you postpone or evade all kinds of implementation issues. Suppose one stakeholder wants to have a secure workplace as a solution and another stakeholder wants to have a mobile workplace as a solution, than you as architect have the challenge to design a secure mobile workplace. The thing you do as architect is to find and select secure mobile concepts and mobile secure concepts for workplace known in the industry, but you also look at other sciences and in the industry at other areas how they have combined secure and mobile concepts in one solution. Architects get their inspiration from nature what concepts and phenomena there are and how they work and produce results (the concepts principle).

What is an Enterprise Architect? – An enterprise architecture is a designer of special total concepts for enterprise structures. An enterprise architect creates a coherent set of operative, constructive and decorative governance, business, information and technology concepts, answering to the stakeholders requirements with regards to an enterprise structure.

Architects, at least on paper, can give people wings and make them fly or design a house that does not need fossil based energy anymore, and they can refine their design and in the end maybe have a workable solution. When modeling at a conceptual level it is easy to project or borrow concepts from one area to another. This is why architects do conceptual modeling and this is why total concept design by architects is and can be called architecture.

Architecture is about increasing the quality of the design and the quality of the realization of a structure. So the architecture (i.e. total concept) contains concepts on how to create a good design (like a concept as Requirements Analyses) but also contains concepts to realize a structure or integral solution for the structure in the correct way (like a concept as Work from Inside Out, or from bottom to top – First you create the systems/foundation layer, then the services layer on top of that, etc…).

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Although it has the overhand nowadays, architecture is and was not meant to be labeled on activities that deal with the design of a complex system with focus on a certain operation, like an information systems that can process any kind of legislation on any set of citizen tax data. If the design contains no constructive and/or decorative concepts, the design is NOT architecture, it is not a special Total Concept.

Below follows an example architecture diagram showing the concepts view of an enterprise structure. The name of the total concept is "Robotic Health Care Service Delivery" You see an enterprise with three businesses and their business functions and a framework with sub architectures and in it constructional, decorative and operational concepts. And per concept that needs to be implemented the main function. And per concept the core three elements it holds and per concept the principle of the concept and the results of the principle linked to requirements and goals of the enterprise.

The first steps an Enterprise Architect always takes

The first steps an enterprise architect always takes whatever the design assignment is, is he models the existing and known elements and functions of the enterprise structure and he models the needs and issues of the owner/client and stakeholder (with focus on users) with regards to that enterprise structure. Next he helps the stakeholder to utter performance and quality requirements for the functions and elements of the enterprise structure. Also for that he creates a model.

Now the action really starts when the enterprise architect begins thinking, looking and selecting concepts to answer the conflicting and contradictory requirements for the functions and elements of the enterprise structure. I say action, because he goes out there to look for concepts. A real architect does not still and googles and checks documents. A real architect visits sites, talks with people, experiments. And uses all experience from that to select, project and combine concepts from anywhere and everywhere for his total concept, his architecture for the enterprise structure.

The enterprise architect always creates various versions of a design sketch of a total concept and communicates that to the owner/client and discusses it, to have the owner/client decide for a version. It is this work that makes and enterprise architect and enterprise architect, as opposed to being a consultant, advisor, analyst, designer, director or project manager.

If there is already an existing enterprise structure, the enterprise architect will try establish the identity of the enterprise structure (what it is and what it tries to be, because these two might me different and an identity crisis might be the case). It matters a great deal if a company for instance is a bank selling

insurance products, or if a company is a supermarket, selling insurance products. Solving the same issues will require different solutions, because alone the context is completely different.

How can we break breakdown structure of a modeling language?

A modeling language is defined as:

Five parts (element) make up an architecture modeling language (as concept). The specification of the modeling language with hold these:

1. A list of named and defined entity classes
2. Shapes for the named entities
3. Meta model (the relationships between entity classes)
4. A CRUD / cross-reference matrix showing mandatory and optional relationship or connections between entities.
5. A list that details by example the issues and challenges the language was created for to solve. The details contain reference and example user models created using the meta model dealing with certain issues, challenges.

A description of the meta model

The Dragon1 meta model consist of a core with 25 entities and around that two four rings: The core is called The Structure, Ring 1 is called The Design, Ring two is called The Realization, Ring Four is called Science, Ring is called Art. This division is based on the old definition of Architecture being the art (5) & science (4) of design (2) and realization (3) of structure (1). Art and Science are extended with new concepts every day, so the art and science domain only contain the basic concepts in the Dragon1 User Models. The Design and Realization domains contain also the basic concepts. And also design and realization as science do not change that often at the moment, the basic concepts of a structure hardly change or have changed. Architecture is about building on solid foundation, so the meta model of Dragon1 also must use that wisdom.

The structure in Dragon1 can be anything having the three dimensions of construction, operation and decoration, like a church, building, house, bridge, airplane, traffic junction, bakery, human body, tree, tree house, enterprise, organization, information system and business process.

The Design domains can also be called the Analyses and Design domain. The realization domain can also be called the Realization and Maintenance domain. One could recognize a Governance and Management Domain above the structure and a Operations and Usage domain below the structure. We do not do that in this article.

For every entities we can argue why it is been made part of the model. Of course many other entities could also have been made part of the meta model, but practice shows that this is the minimal set that must be used in order to be able to re-engineer and document the architecture of a structure.

The reason that form is part of the meta model if because of that famous architect claim that it is a good practice in architecture that form follows function. Also the reason that problem is in the meta model is because of the solution that has to be designed as answer to the problem (that is the question). Unknown and assumption are present in the model because an architect does not get all answers to all questions fired off to the stakeholders.

The 13 common and generic architectures that are created using Dragon1 are:

1. Reference Architecture
2. Chain Architecture
3. Enterprise Architecture
4. Governance Architecture
5. Business Architecture
6. Organization Architecture
7. Information Architecture
8. Technical Architecture/Technology Architecture / IT Infrastructure
9. Security Architecture
10. Application Architecture
11. Data Architecture
12. Human Capital Architecture
13. Solution Architecture

Per architecture global, medium and detailed models are created of concepts, elements, components and technical products (the four layers of abstraction. For instance the business model may exist of up to 5 or 10 sub models.

Next per concept or element architecture are created like: Process Architecture, Service Architecture etc…

Dragon1

Dragon1 Core Meta Model Entities Domains
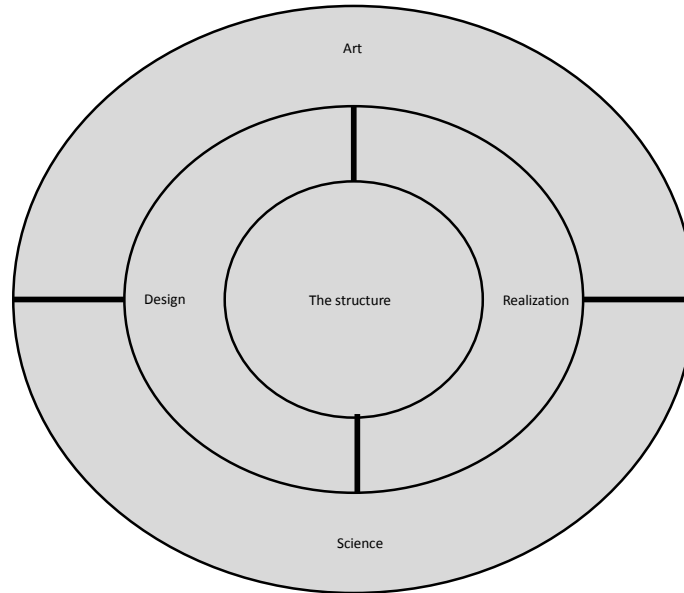
The 100+ core entities in the meta model of Dragon1 are the following:

1. Unknown
2. System
3. Entity
4. Entity Class
5. Entity Type
6. Entity Sort
7. Entity Instance
8. Structure
9. Construction
10. Operations
11. Decoration
12. Total concept
13. Architecture
14. Plateau
15. Concept
16. Element
17. Component
18. Object
19. Technical Product
20. Meta Model

21.   User Model
22.   Instance Model
23.   Rule
24.   Guideline
25.   Design
26.   Realization
27.   (architecture decision) Decision
28.   Rationale
29.   Artifact
30.   Principle
31.   Owner-Client
32.   Stakeholder
33.   Need
34.   Requirement
35.   Fragment
36.   Building Block
37.   Solution
38.   Domain
39.   Pattern
40.   User
41.   Infrastructure
42.   Facility
43.   View
44.   Viewpoint
45.   Viewer
46.   Owner/Client
47.   Designer
48.   Architect
49.   Contractor
50.   Engineer
51.   Function
52.   Annotation line
53.   Capability
54.   Ability
55.   Disability
56.   (technical) Form
57.   Situation
58.   Location
59.   Space
60.   Time
61.   Layer
62.   (Time)Frame
63.   Scenario

64. Budget
65. Cost
66. Quality
67. Performance
68. Sketch
69. Drawing
70. Diagram
71. Impression
72. Framework
73. Visualization
74. Environment
75. Socio-ecosystem
76. Attribute
77. Relationship
78. Connection
79. Phenomenon
80. Event
81. Trigger
82. Action
83. Interaction
84. Dynamics
85. Change
86. Project
87. Resource
88. Money
89. Document
90. Book
91. Milestone
92. Deliverable
93. Phase
94. Stage
95. Literature
96. Issue
97. Concern
98. Benefit
99. Problem
100. Question
101. Answer
102. Assumption
103. Status
104. Ownership
105. Information
106. Data

Next to these architecture concepts, dragon1 also defines 400+ generic enterprise/business elements like product, service, process, onto computer, machine, technology, material and robot. These are concepts themselves but often in the context of Enterprise Architecture elements of the concepts and concept principles we define. And also dragon1 defines 100 generic enterprise architecture concepts like: Process Orientation, Customer Centric Approach, Leadership, Knowledge, Sales and Marketing. In fact all of the known business functions are global generic concepts. And today in enterprise architecture we look for specialized detailed concepts like eBusiness, eProcurement, robotized service delivery, etc..

We know that in time new concepts, elements, components and technical products will arise new requirements will appear and technology will be invented. What stays is that enterprises, businesses, organizations and companies have to deliver products and services to humans and other organizations and fulfill their changes needs by being adaptive or reinvent/redesign themselves. And that is what Dragon1 Enterprise Architecture Modeling Languages is focused on supporting and enabling.

Main concepts in Dragon1 are: Work(ing), Collaboration, Production, Living, Procurement/Buying, Sales/Selling, Research, Procurement, Marketing (product Launch), Logistics, Finance (Bookkeeping), HRM. All the basic elements and components part of Dragon1 arise from these concepts. With that a generic 4 layered architecture reference model for enterprise can be created. If a new concepts is thought of or invented, the constructs in the language like entity class, attribute etc., can be used to create and add the new concepts, its elements, objects, components and technical products to the meta model and then create user models with it.

Parts of Dragon1 are not only Business Concept and Information Concept, etc.. but the elements in the core met model come from Analysis and Design Concepts and Realization or Engineering Concepts. Normally Principles of Design and Project Management Principles are part of Dragon1.

Creating User Models using the meta model

Organization have their products, services, processes, activities and applications. They have their customers, clients, contract, employees, computers, robots, process oriented approach, 360 degree customer view, big data, nano technology, smartphone, iPad, cross selling, up selling, MS Word, Google Browser, 3d printer, Amazon Cloud etc.. All these things can be viewed as concepts, elements, components and technical products. At user model level organizations define their concepts, elements, objects, component and tech-

nical products. Often using reference models for that or best practices. Important to note is that you can (and in the future will) design organizations without services, processes, employees. So these concepts or elements might better not be part of the meta model of your modeling language.

Dragon1 has a set of 100 concepts, patterns and principles (market & client, governance, business, information/application/data, it infrastructure / technology and security concepts) and about 1000 generic elements, components and objects that are enterprise or organization generic. But these concepts, elements and components should not

How to do architecture modeling using the meta model

With this meta model one can design architecture. With architecture one can bridge the gap from strategy to business change and in fact enable business changes.

If in an organization the strategy requires is a series of business changes realized through business and IT projects, it a good practice to design or model the AS-IS and TO-BE enterprise architecture and for the strategy to design a solution architecture. With these architecture the projects will have a design of a total concept. The core meta model contains that much project and realization related entities because if at execution of the project it is unclear how the architecture should be used or have impact, you might as well have not created the architecture at all.

[here is the dragon1 version of the ArchiMate meta model or business motivation model]

Extending the meta model

If you are in an certain industry or market you may find in a certain modeling situation that the Dragon1 core meta model is missing a certain construct, or that at user model level you are missing a certain industry specific concept, element, object or component. For instance **Care Path** within Health Care or **Grade** within Education. You are then enabled with the ability to extend the core model with your concept, element, object, component or other construct.

Projection of Concepts and Principles onto landscapes and blueprint

Of every concept a principle detail diagram can be created. The theoretic generic version or your organization specific version can be created. But next it should be projected onto the organizations current and future situation. In that way you how wel it is already implemented or what needs to be done still. Below is an example principle detail diagram of a concept and an example projection of it on a landscape.

Enterprise Architecture Design in four stages

Dragon1 defines an enterprise architecture design in four stages: Concept Architecture Design, Preliminary Architecture Design, Definitive Architecture Design, Detailed Architecture Design. In every stag the architect proposes concepts, elements, components and technical products as answer to requirements from the owner-client and stakeholders. The owner client every stage decides to choose what vision or version of the design and proposals, design decisions he goes along with. The owner client may install a steering committee mandated with that authority to take architecture design decisions.

Example Visualizations of View of Models

Below we give an enterprise model in four different levels of abstraction and one composed/integration model with all levels of abstraction in one. The conceptual model is diagrammed and sketched (with metaphorical symbols) as a design sketch of a total concept, the logical model is diagrammed but also drawn, the physical model is diagrammed and the implementation model is diagrammed and also pictured as an example Artist Impression (A management Overview). All of these visualizations of views of model where create using this meta model carefully.

Further Study

Enterprises and organizations are, just like churches, castle and bridge not static system structures. They are dynamic. The change (decay), interact with their environment.

It would be good to see if on universities around students would try to document the architecture of structure in order to test, evaluate and enable us to refine the Dragon1 meta model. Also in organizations we encourage to re-

engineer and document the AS-IS enterprise architecture of the organization and the TO-BE solution architecture in any project. This will make people document the knowledge of the organization on various topics and also will lead to knowledge and additions to the Dragon1 Wiki that is built around the meta model.

Outside of the field of enterprise architecture in many other sciences, like traffic and medicine, the meta model can be tested for added value to reformulate and visualize for instance the architecture principles and make them more effective.

In business administration and information science the text books can be improved by writing down the principles of concepts more in terms of the Dragon1 Meta model.

Literature

Dragon1 open EA Method Wiki. http://wiki.dragon1.org – Specification of the Dragon1 Enterprise Architecture Modeling Language.