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A META-MODEL FOR THE SPATIAL CAPABILITY ARCHITECTURE

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ABSTRACT

It is observed that most initiatives in the field of spatial (geospatial) information, applications and technologies are tackled without a holistic view of the enterprise and its organizational framework within which these initiatives are to be implemented, resulting in many difficulties. The solution to this problem is to utilize the routines that are common in enterprise architecture management in order to bring in the necessary level of transparency, manageability, and synergy across the complex environment of a corporation because architecting an enterprise is about understanding how things work together and how to make changes of architecture feasible and this is a prerequisite for every successful business change. For better understanding of the spatial capability one needs to realize what the architecture of the capability is and how it can be documented in order to communicate the architecture description clearly and allow one to establish a baseline for further work. The first step towards clarifying this is to describe the fundamental structure of how the capability is delivered and executed in the organization and thus the objective of this paper is to define a meta-model for the spatial capability architecture. Resources and method of meta-model development are documented as well as notation used to express the meta-model. Further work should address area of spatial capability development and definition of common spatial capabilities for reference purpose. The defined meta-model is a part of the framework which is intended to support spatial capability development.

Keywords: *Architecture, Capability, Framework, Management, Meta-model, Spatial*

1. INTRODUCTION

The fundamental part of each business is a set of capabilities which have to be available in order to execute the business. A business capability is identified based on vision, mission, corporate values, operating model, enterprise target, chosen strategy, and socio-economical context and therefore has to provide a business outcome [1]. Capability-based planning as a managerial discipline is looking for a balanced set of viable capabilities which are continuously monitored and aligned with the current needs of the enterprise to best serve its mission [2].

The capability concept [3] is not new and it is widely used in already existing enterprise architecture frameworks, but it does not usually mention explicit definition of the capability and how this concept should be used in a real case [4]. Capability is still perceived as an abstract thing that is far away from the real architecture. The clear connection to the other elements is missing and the process how to assess, design, implement and monitor capability is not formally defined [5]. This paper is intended to close the gap in this area. The author's objective is to position capability on top of the enterprise architecture framework and derive all other elements as partial contributors which all together enable the capability.

The author is working on a framework (Figure 1) for spatial architecture management and one of its components is devoted to the meta-model as an integral part of the framework.

This allows designing proper viewpoints of the framework while assuring consistency of all parts and serving as a communication tool in the course of the framework implementation. The requirements to develop the meta-model are defined from the framework perspective as follows:

- Target focused: Include enterprise target in the meta-model and show how the other concepts are related to it in order to achieve the target.

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- Capability centric: Position capability as a core concept in the meta-model to see what forms the requirements, needs and implications of the capability which is envisaged to be developed.
- Holistic oriented: Consider all important components within an enterprise which make up the capability.

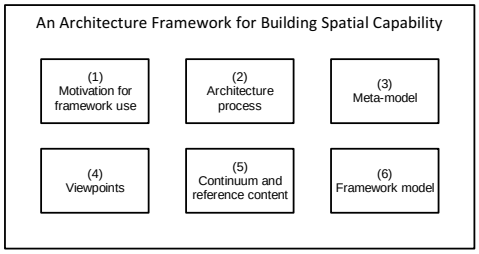

Figure 1 Content of an architecture framework for building spatial capability

A meta-model for the spatial capability architecture is a set of concepts and relationships between the concepts which together define an information scope for modeling of the spatial capability architecture. Creation of a particular model describing unique spatial capability architecture is to be based on the defined meta-model. A meta-model can be enriched with other details like attributes, cardinality, constraints and other elements with regard to the needs and level of formality which is required for the model itself.

Architecture is a physical property of a subject which provides an intended behavior which may be observed based on the subjects surroundings. In order to work with the spatial architecture it is needed to create an architecture description (model) of the architecture. Physical architecture of a capability reflects how the capability is implemented in a real environment.

Capability in the business sense means what has to be done to make a business. The architecture of the capability says how it to be done. Capability-based planning should answer why and when it should be done and to clarify the reason and implications [6]. Capability is realized by the help of a set of components which together make up the capability at some level of maturity when implemented. The process of putting the components into a viable context is a subject of architecting.

Author differentiates two main views on spatial aspect of an enterprise. First is focused on modeling spatial characteristics of businesses. This is implemented as a set of spatial information and operations per architecture building block while modeling enterprise architecture. Second view is focused on spatial capability itself which is required to support businesses. This is implemented as a particular architecture which enables the spatial capability.

Spatial capability can be defined as a business outcome which is required to meet a specific business objective either directly or by supporting of any other capability. The outcome is achieved through utilization of spatial information or by spatial services which works with spatial data. It usually involves support of spatial applications and/or spatial technology. Samples of spatial capabilities are spatial intelligence, geomarketing, navigation and routing, spatial data visualization and publishing, localization of enterprise assets and work management, image processing.

2. META-MODEL DEVELOPMENT

The identification of concepts stated in the meta-model is translated into a simple question: What components are needed to make up a capability? To answer this, a construct was borrowed from the enterprise architecture field and applied to commonly known architecture domains in the capability area. This way concepts were identified which belong to the business, information, application and technology domains [7]. To accomplish requirements falling into more strategic areas, the concepts mentioned in Business Motivation Model [8] and standard business strategy theory [9] were considered. It led to adding two other domains focusing on influence and strategy. The last area of interest was added based on the dynamic aspect of capability development because capability is developed incrementally [3]. In enterprise architecture projects are a key tool for implementing changes and therefore project domain was added to reflect this aspect.

The meta-model was designed based on already existing meta-models [3, 8, 10, 11], based on the framework's requirements mentioned in the introduction section and author's experience with this topic.

For connecting the enterprise target the Business Motivation Model [8] was used which was beneficial in understanding motivation for business itself and to qualify impact of the environment on businesses. For connecting the capability concept the meta-model within TRAK framework [10] was utilized which explicitly defines connection

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between capability and other elements such as system, enterprise, and enterprise goal and metrics. The Architecture Content Framework as part of [3] was used for connecting common concepts in architecture domains. Improvement of ArchiMate meta-model [11] proposed by Campbell [12] was used to express an access channel.

3. META-MODEL NOTATION

The meta-model is expressed with the following constructs and rules:

- Concept
- Relationship
- Viewpoint

Concept depicts a building block which is used to build up a specific model. Concept has a name and optionally can have a description. Relationship shows how the concepts are linked together. Only unary and binary relationships are introduced. Relationship can connect two concepts - source and target. In case of unary relationship the source and target concept is identical. The relationship has a name and orientation. It is oriented from the source to target concept and expressed visually by an arrow pointing to the target concept. The reader may read the model from source concept to target. Viewpoint groups the concepts into a cohesive logical set which is named.

Implementation aspects of this meta-model in specific modeling tools are not considered here. One should assess requirements for navigability, reporting, intended viewpoints, support for ternary (n-ary) relationships and/or possibility to handle transitive relationships as well as flexibility of meta-model changes in general.

4. META-MODEL DOCUMENTATION

Meta-model (Figure 2) consists of seven viewpoints:

- Influence
- Strategy
- Business
- Information
- Application
- Technology
- Project

All the concepts are categorized into these seven viewpoints excluding the Capability concept which is positioned in the middle of the meta-model between top and bottom parts of the meta-model. The top part contains the influence and strategy viewpoints, which answers why (relationship requires) a capability should exist. The bottom part includes the business, information, application, technology and project viewpoints which says how (relationship enables) and when (relationship implements) a capability is developed. Capability concept in the middle represents what is needed to be developed and this concept does not belong to any viewpoint.

Influence viewpoint contains Driver concept which represents a result of influence assessment and is a key motivator (relationship motivates) for any business change in the organization.

Strategy viewpoint says which organization is needed to realize a particular enterprise and what is the aspiration of this enterprise represented by the target and strategy which leads to this target. Measure concept is used to track progress of target achievement.

Business viewpoint talks about key processes needed and points out knowledge and experience of individuals represented by Process role concept. Adding value to customers is represented by Product concept which can be used to model relevant product and service portfolio. Business service concept is used to establish a formal building block of functionality which has defined interface, terms and conditions.

Information viewpoint shows which information is needed to execute the process and it depicts information aspect at three abstraction levels from conceptual (Business term and Business object concept), through logical (Logical data entity concept) and finally to physical one (Physical data entity concept).

Application viewpoint delivers information about business applications needed, functional application decomposition and application functions available through application components to support processes. Physical level of application modeling is expressed by SW instance concept, which is used to model application instances.

Technology viewpoint demonstrates how technology can support the business environment. The Access channel concept emphases the method of information delivery. IT component concept shows different logical building blocks needed to

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build up a technology environment as a basis for business applications support. Physical level of modeling corresponds to physical devices.

Project viewpoint is focused on delivery of the capability increments. Projects and their work packages are supposed to close the identified gaps between the current and planned state of the capability architecture. Projects realize this by adding, changing or eliminating logical parts (Architecture building block concept) of the architecture.

5. CONCLUSION

The solution to the identified business problem lies in the necessity to look at spatial capabilities in the same way as one would look at any other enterprise capabilities. The concept of enterprise capabilities and its contribution to the achievement of business targets is introduced. The first step towards understanding of the spatial capability is to define the meta-model for its architecture. Resources and methods that enabled the author in creating the meta-model are described. Capability has been identified to be built from key enterprise components. The work resulted in defining 26 concepts categorized into 7 viewpoints and connected to each other by 42 relationships. Further work should address spatial capability development and a definition of common spatial capabilities as a reference model. The defined meta-model is considered to be part of the framework which is intended to support spatial capability development.

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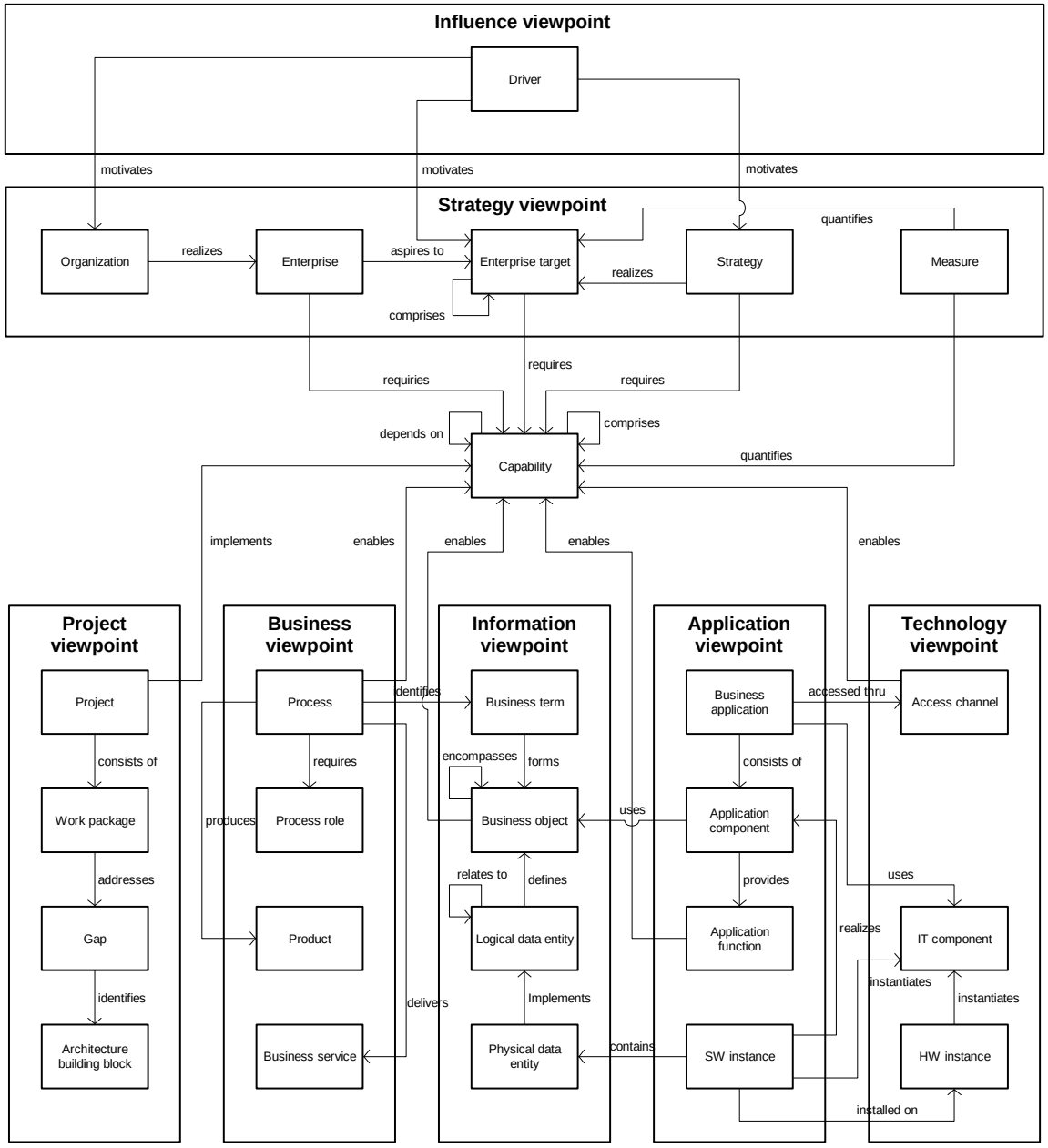

Figure 2 A meta-model for the spatial capability architecture