Theoretical perspectives of enterprise architecture

Theoretical Perspectives of Enterprise Architecture

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Abstract

The number of published Enterprise Architecture (EA) research has increased during the last few years. As a discipline, EA is still young and lacking theoretical foundation. Lately some research trying to ground EA to theory has been published, including linkage to systems theory. Enterprise Architecture can be defined as; (i) a formal description of the current and future state(s) of an organisation, and (ii) a managed change between these states to meet organisation's stakeholders' goals and to create value to the organisation. Based on this definition, this conceptual paper tries to shed light to theoretical underpinnings of EA from three theoretical perspectives; EA as a communication media, EA as an activity, and EA as an information technology system. Our conclusions are that; (i) EA can be categorised as a communication media and theoretically underpinned by ontology and semiotics, (ii) EA can be explained and theoretically underpinned by Activity Theory, and (iii) EA can be categorised as an information technology system and theoretically underpinned by General Systems Theory and Technology Acceptance Theory.

Keywords: Enterprise Architecture, Activity Theory, Acceptance Models, Semiotics

Theoretical Perspectives of Enterprise Architecture

The number of published Enterprise Architecture (EA) research has increased during the last few years. As a discipline, EA is still young and lacking theoretical foundation. Lately some research trying to ground EA to theory has been published (see for example Korhonen & Poutanen, 2013), also some arguments have been presented to link EA to systems theory (Berrisford, 2013; Hoyland, 2011). There is still need for further work on theoretical aspects.

This paper tries to shed light to theoretical underpinnings of EA by studying it from three theoretical perspectives. First we define some of the concepts related to EA to put our research into a context. Then we present three different theoretical perspectives of EA; EA as a communication media, EA as an activity, and EA as an information technology system. Finally we present conclusions and give some directions for future research.

Definition of Enterprise Architecture

Enterprise Architecture has multiple definitions in the current literature. The concept of *Enterprise Architecture* consists of two distinct terms; *enterprise* and *architecture*. Next we first introduce these concepts separately, then together, and finally conclude as a definition used in this paper.

TOGAF (2009, p. 5) defines *enterprise* as ".. any collection of organizations that has a common set of goals". In ISO/IEC/IEEE 42010:2011 standard *enterprise* is seen as a system (see *Figure 7*), which are defined as " ..man-made and may be configured with one or more of the following: hardware, software, data, humans, processes (e.g., processes for providing service to users), procedures (e.g. operator instructions), facilities, materials and naturally occurring entities" (ISO/IEC/IEEE, 2011, p. 3). PEAF defines *enterprise* as (PEAF, 2013) follows: "The word Enterprise should be interpreted as a general noun – the name of something - to refer to any

and all of these types of thing; public and private companies, government agencies, charities, universities etc. This is not an exhaustive list but illustrates the point. In addition the word Enterprise should also be interpreted to mean any name give to any of these types of Enterprises, e.g. a private company may be referred to as a Company, Business, Corporation, Conglomerate, Organisation, SME, Firm, Establishment, Group, Multinational, Venture. The word Enterprise refers to them all".

John Zachman (1997) defines *architecture* as "..that set of design artifacts, or descriptive representations, that are relevant for describing an object such that it can be produced to requirements (quality) as well as maintained over the period of its useful life (change)". ISO/IEC 42010: 2007 defines *architecture* as ''The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution''. Revised definition in ISO/IEC/IEEE 42010:2001 is "..fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution". In TOGAF (2009, p. 9), *architecture* has two meanings depending upon the context (i) "A formal description of a system, or a detailed plan of the system at component level to guide its implementation" and (ii) "The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time".

Federal Chief Information Officer Council of United States defines *Enterprise Architecture* as (CIO Council, 2001, p. 5) "..a strategic information asset base, which defines the mission, the information necessary to perform the mission and the technologies necessary to perform the mission, and the transitional processes for implementing new technologies in response to the changing mission needs. An enterprise architecture includes a baseline architecture, target

architecture, and a sequencing plan". Gartner defines *Enterprise Architecture* as (Gartner, 2013) "..a discipline for proactively and holistically leading enterprise responses to disruptive forces by identifying and analyzing the execution of change toward desired business vision and outcomes. EA delivers value by presenting business and IT leaders with signature-ready recommendations for adjusting policies and projects to achieve target business outcomes that capitalize on relevant business disruptions. EA is used to steer decision making toward the evolution of the future state architecture". GERAM (1999) defines *Enterprise Engineering* as "..the collection of those tools and methods which one can use to design and continually maintain an integrated state of the enterprise". Pulkkinen summarises *Enterprise Architecture* (2008, p. 46) as "The management of the ICT assets as enterprise resources", "Planning developments of these assets and developments enabled with them, like business models, services or processes", "Collaboration of different groups; first and foremost the business and the ICT managers in the enterprise", "Managerial activity, meaning decision making", "Recording and describing the ICT resources and evaluating them for the decisions to be made", "Scanning for new technology enablers as part of the environment information the enterprise is collecting for its strategic management", "Planning development steps both for the business and the supporting ICT, according to the strategies of the enterprise."

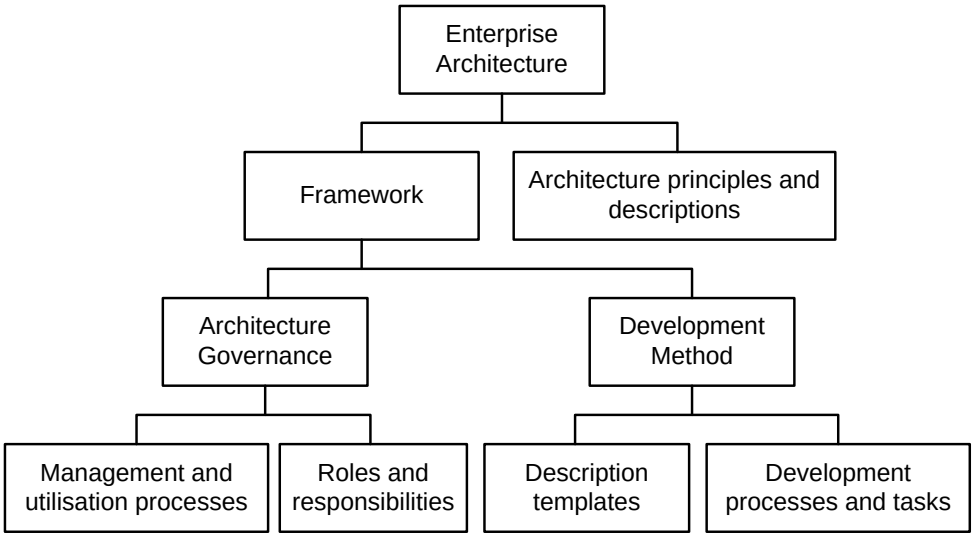

Figure 1. Taxonomy of Enterprise Architecture (adapted from ValtIT, 2007)

Finnish Ministry of Finance has compiled a taxonomy of Enterprise Architecture (ValtIT, 2007) which can be seen in Figure 1. This taxonomy can be used as a summary of previous definitions. However, not all concepts mentioned in the definitions are included, such as Gartner's statement about EA's value delivery and Pulkkinen's scanning of new technology. These can be better categorised as an examples of *purpose* of Enterprise Architecture (see *Figure 2*).

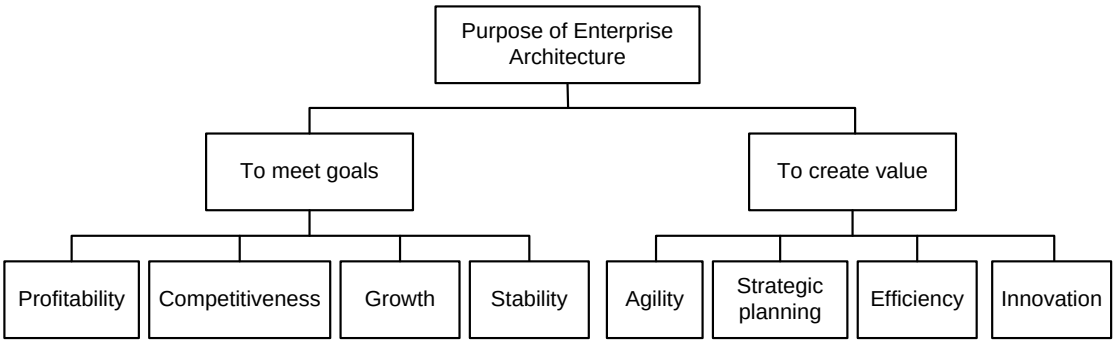

Figure 2. Taxonomy of purpose of Enterprise Architecture (Syynimaa, 2010)

Now that we've introduced several definitions of *enterprise, architecture,* and *Enterprise Architecture*, we can discuss and summarise them, and present the definition used in the paper.

Definition of *enterprise* seems to be quite constant. In the context of Enterprise Architecture, enterprise can be anything from a team to a multi-level organisation of a global corporation (ISO/IEC/IEEE, 2011; PEAF, 2013; TOGAF, 2009). Similarly, the definition of *architecture* is more or less constant; it's seen as a *formal description* of an *enterprise* at a certain time (ISO/IEC/IEEE, 2011; TOGAF, 2009; J. A. Zachman, 1997), either of the current state or one or more future states.

Definitions of *Enterprise Architecture* are more diverse, but they still have similarities. If we first look the taxonomy of EA seen in *Figure 1*, we can see that it has two main categories, *Framework* and *Architecture principles and descriptions*. The latter one doesn't bring anything new to the definition of *architecture*, but the former one is what makes the difference. Enterprise Architecture framework is what brings in concepts of *Architecture Governance* and *Development Method*. These are depending on, and related to, to the used framework such as TOGAF or PEAF, and thus are not part of EA *per se*. However, what is shared among most of the definitions is the concept of *managed change* of the *enterprise* between the current and future states for a purpose (CIO Council, 2001; Gartner, 2013; GERAM, 1999; Pulkkinen, 2008). This purpose is *to meet goals* of stakeholders and *to create value* to the enterprise (Syynimaa, 2010). As the term *enterprise* is usually used as a synonym of a business or company, later in the paper we will use the term *organisation* instead of it. *Organisation* covers both businesses and public sector and therefore, in author's opinion, suits better.

The definition of Enterprise Architecture used in the paper is as follows (see also illustration in Figure 3):

> *Enterprise Architecture is; (i) a formal description of the current and future state(s) of an organisation, and (ii) a managed change between these states to meet organisation's stakeholders' goals and to create value to the organisation.*

As a formal description, widely used and accepted way to describe the organisation is to use so called four-layer model. These layers are Business Architecture (BA), Information Architecture (IA), Systems Architecture (SA) and Technology Architecture (TA) (Pulkkinen, 2006). There are also other ways to divide the descriptions into layers or views, for instance Zachman uses a 6 x 6 matrix (see Figure 4). The four-layer model was selected due to its popularity, but also for its "simplicity" to demonstrate the complexity of organisations.

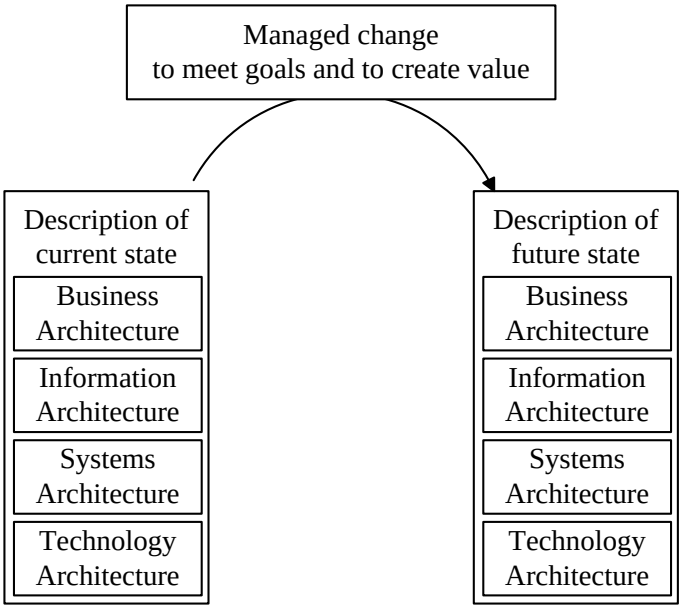

Figure 3. Definition of Enterprise Architecture

Enterprise Architecture as a communication media

In this section, we first argue that Enterprise Architecture (or the descriptions they contain) are ontologies of organisations. According to Uschold and Gruninger (1996, p. 4) *ontology* "..is the term used to refer to the shared understanding of some domain of interest.." This is also what Enterprise Architecture is; at least according to Zachman (2008), where he defines his famous Zachman Framework as ".. an ontology - a theory of the existence of a structured set of essential components of an object for which explicit expressions is necessary and perhaps even mandatory

for creating, operating, and changing the object (the object being an Enterprise, a department, a value chain, a "sliver," a solution, a project, an airplane, a building, a product, a profession or whatever or whatever)."

As such, EA frameworks, such as Zachman (see Figure 4) and TOGAF (2009) are *metamodels* of an organisation. This means that every organisation can be described in a standard, formal way using a particular EA framework. Examples of uses of ontologies are; Communications, Inter-Operability, and Systems engineering: specification, reliability and reusability (Uschold & Gruninger, 1996). As EA is ontology of the organisation, it can be used as a communication media to communicate organisation's structure, components and their relations, etc.

	DATA *What*	FUNCTION *How*	NETWORK *Where*	PEOPLE *Who*	TIME *When*	MOTIVATION *Why*
OBJECTIVES/ SCOPE (contextual) *Planner*	List of Things Important to the Business	List of Processes the Business Performs	List of Locations in Which the Business Operates	List of Organizations Important to the Business	List of Events Significant to the Business	List of Business Goals/Strat.
ENTERPRISE MODEL (conceptual) *Owner*	e.g. Semantic Model	e.g. Business Process Model	e.g. Business Logistics System	e.g. Workflow Model	e.g. Master Schedule	e.g. Business Plan
OBJECTIVES/ SCOPE (contextual) *Planner*	e.g. Logical Data Model	e.g. Application Architecture	e.g. Distributed System Architecture	e.g. Human Interface Architecture	e.g. Processing Structure	e.g. Business Rule Model
TECHNOLOGY MODEL (physical) *Builder*	e.g. Physical Data Model	e.g. System Design	e.g. Technology Architecture	e.g. Presentation Architecture	e.g. Control Structure	e.g. Rule Design
DETAILED REPREN-TATIONS (out-of-context) *Sub-Contractor*	e.g. Data Definition	e.g. Program	e.g. Network Architecture	e.g. Security Architecture	e.g. Timing Definition	e.g. Rule Specification
FUNCTIONING ENTERPRISE	e.g. DATA	e.g. FUNCTION	e.g. NETWORK	e.g. ORGANIZATION	e.g. SCHEDULE	e.g. STRATEGY

Figure 4. Framework for Enterprise Architecture (adapted from J. A. Zachman, 1997, p. 4)

To better understand the EA as communication media, we next explain EA using theoretical lenses of *semiotics*. Semiotics is a scientific discipline of information science, Eco (1976, p. 7) defines it to be "..concerned with everything that can be taken as a sign". Oxford

Dictionaries (2010c) defines semiotics as "the study of signs and symbols and their use or interpretation". In the context of semiotics, a sign can be anything used for communication; a word, a picture, a blueprint, a gesture, or Enterprise Architecture description. Semiotics has been studied now for decades. The famous semiotics framework from Stamper can be seen in

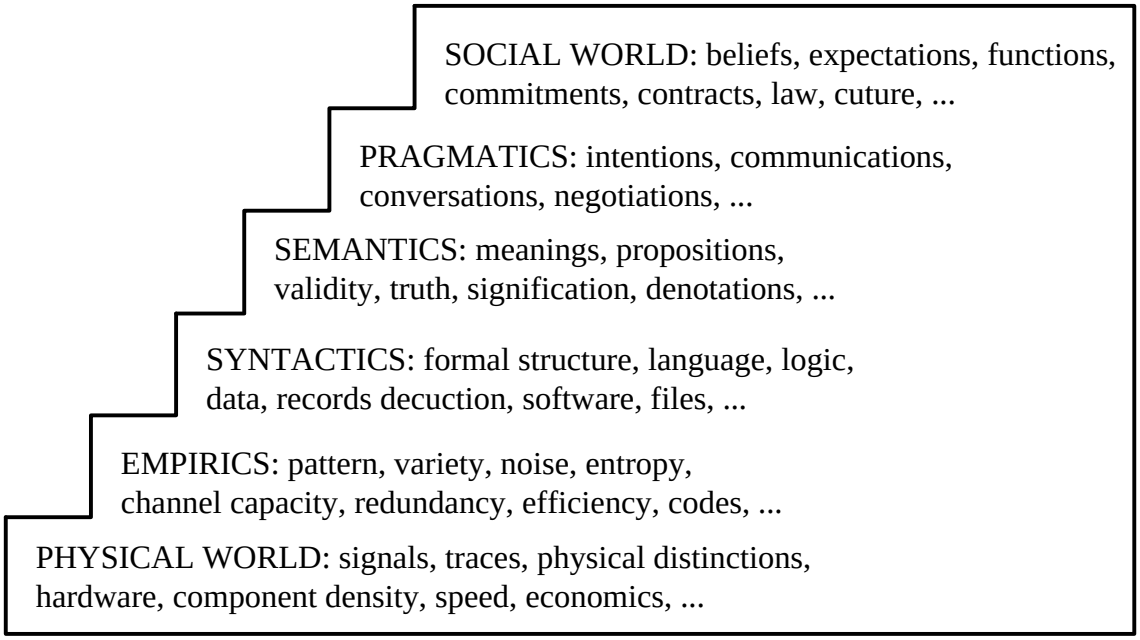

Figure *5*. Many of today's literature is based on Stamper's framework (see for example P Beynon-Davies, 2009; Liu, Clarke, Andersen, & Stamper, 2001).

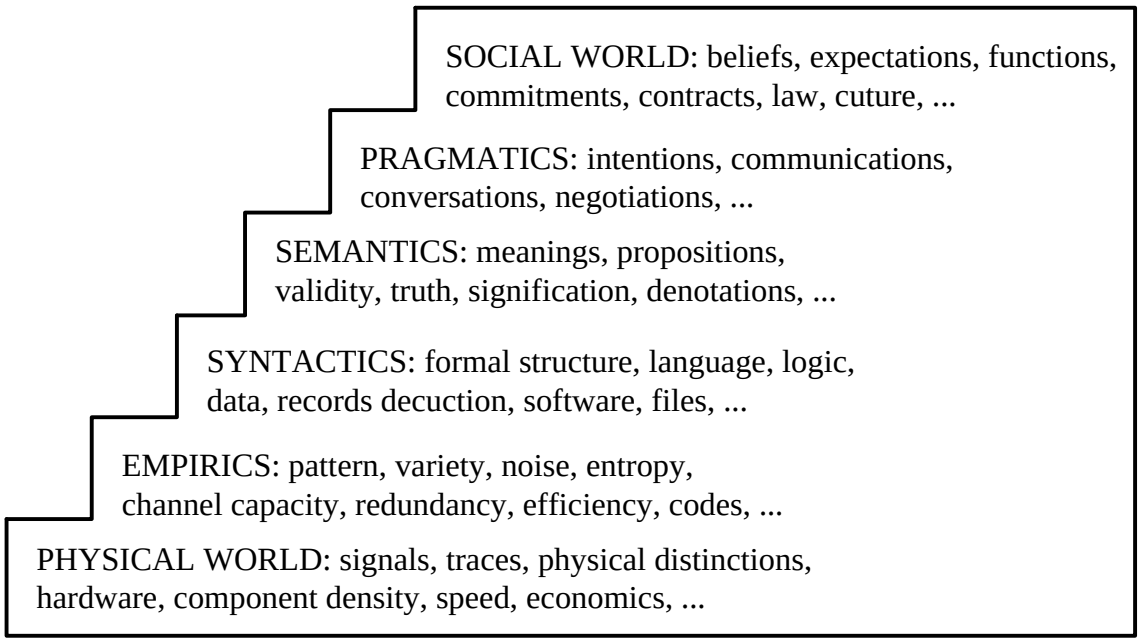

Figure 5. Adapted Stamper's (1973) Semiotic ladder (cited by Liu, 2000, p. 27)

Key concepts of semiotics and their relations can be seen in

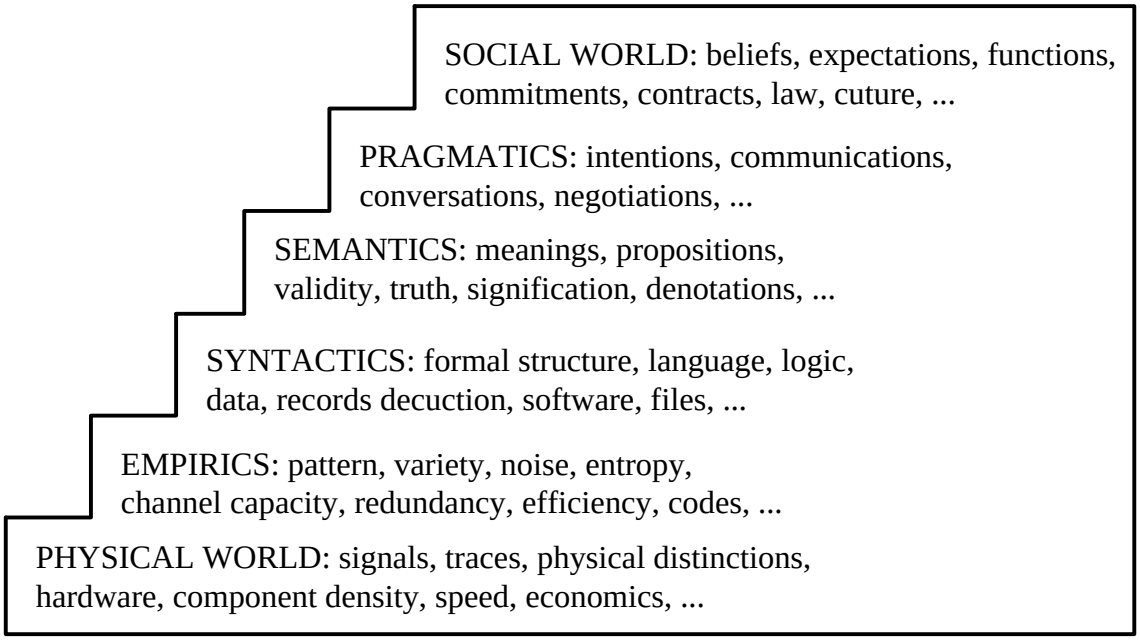

*Figure 5*and are defined as follows (Barron, Chiang, & Storey, 1999; P Beynon-Davies, 2009; Liu, 2000, pp 26-35). *Pragmatics* is about the purpose of communication; why we are communicating, what we're trying to achieve and so on. Pragmatics gives an answer to a

question: Why? *Semantics* is about meaning of things, definitions. It gives an answer to a question: What? *Syntactics* is about the structure of communication, such as grammar of a spoken language or a XML schema of HTML 5.0. Syntactics gives answer to a question: How? *Empirics* is about the medium used for communication, such as a letter, email, air pressure, and so on. These four "ladders", pragmatics, semantics, syntactics, and empirics bound together the social and physical worlds we're living in.

With this view to Enterprise Architecture, we can map semiotic "ladders" to EA as seen in Figure 6. Every organisation exists in *environment*, having one or more *stakeholders* having interests to it as seen in Figure 7. This can be mapped to *Social World* ladder. The purpose of EA is to meet goals of *stakeholders,* and to create value to organisation as seen in Figure 2. As this is the reason for "doing" EA, it can be mapped to *Pragmatics* ladder. *Business Architecture* layer contains descriptions of the organisation's "business". This layer tells us what the organisation actually does, why it exists in the first place. In this layer, also processes of the organisation are described, so it also tells us how the business is done. This is different from the "how" on the next layer. Business Architecture can thus be mapped to *Semantics* ladder. *Information Architecture* layer contains descriptions of the information itself, for example its structure, taxonomies used, and security issues. Information Architecture descriptions are thus descriptions about organisation's knowledge, and as such, tells us "how". *Information Architecture* can thus be mapped to *Syntactics* ladder. *Systems Architecture* contains descriptions about information systems and their relations. It tells us where the information is located and how it is communicated. Thus *Systems Architecture* can be mapped to *Emprics* ladder. *Technology Architecture* contains decisions related to the actual physical technology to be used, such as the

used paper type or the make and model of the server hardware. Thus *Technology Architecture* can be mapped to *Physical World* ladder.

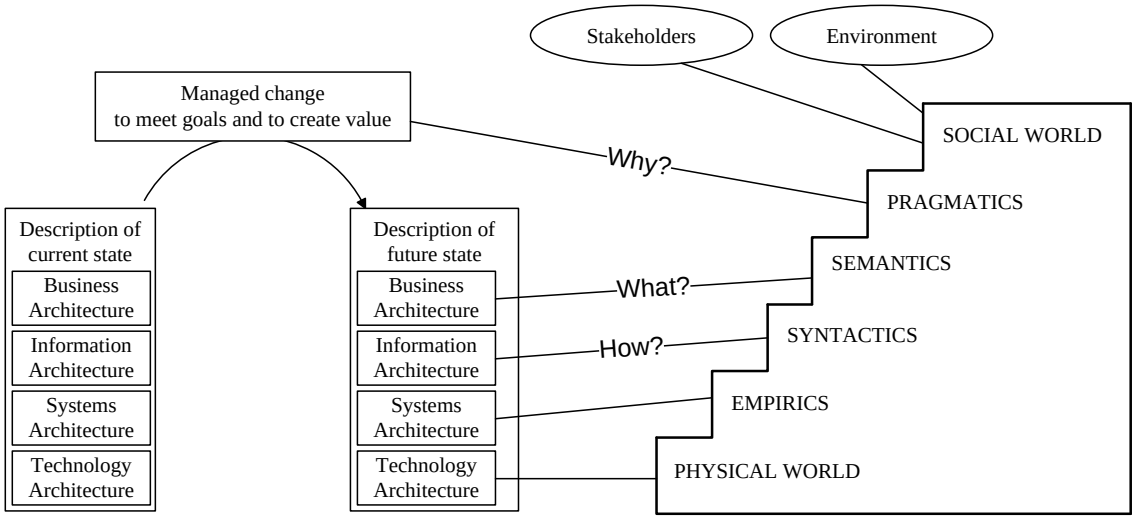

Figure 6. Mapping Enterprise Architecture with semiotics

Peirce proposed that there are three ontological categories, Firstness, Secondness and Thirdness (as cited in Peirce & Houser, 1998). First category of any ontology is the one that exist independently. Second category is what the first one relative to, and third one is a mediation which brings the first two to a relation. To put this into the context of Enterprise Architecture, let's give an example. *Architecture Description* is an example of *Firstness*, it exist independently. Even though it expresses *Architecture*, it would exist if there would not be such architecture. It is "just a piece of paper". There is a relation (*Secondness*) between *Architecture Description*, such as Business Architecture's *Process Flow Chart*, and the symbols used. For instance a diamond symbol represents a decision to be made, and what to do after that. This relation requires that there is a cognitive agent to interpret it. *Thirdness* gives this relation by mediating the purpose of *Process Flow Chart*. It tells to the interpreter how things are currently done in the particular process, or how they should be done.

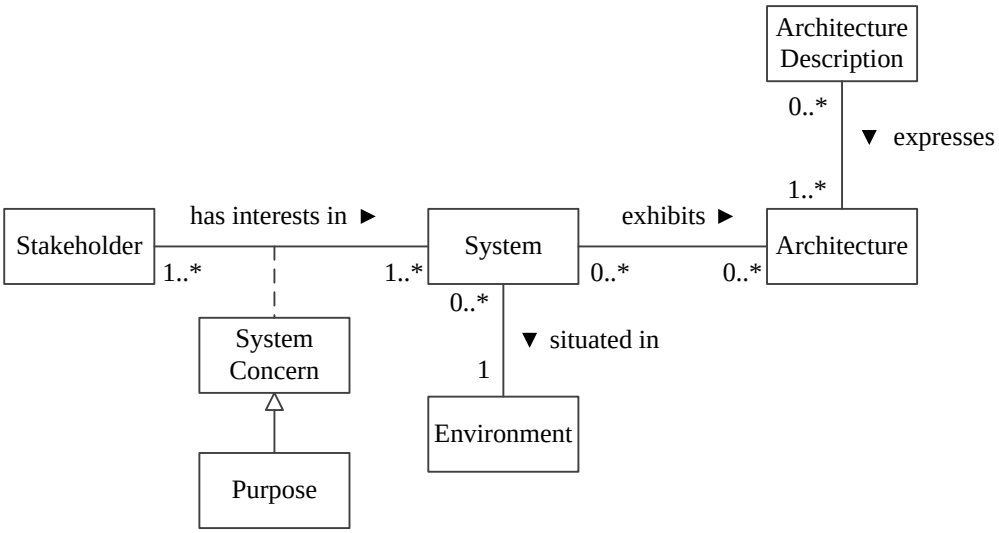

Figure 7. Context of architecture description (adapted from ISO/IEC/IEEE, 2011, p. 3). Note: figure uses class diagram notation from ISO/IEC 19501.

As a conclusion, Enterprise Architecture can be categorised as a communication media and theoretically underpinned by ontology and semiotics. As ontology, EA can be used to describe and communicate organisation's current and future state(s). Semiotics could be used as methodology when analysing and researching Enterprise Architecture as a communication media in organisations.

Enterprise Architecture as an activity

Besides Enterprise Architecture descriptions, there are also a number of activities related to Enterprise Architecture. If we look in our definition of Enterprise Architecture, we can recognise at least three processes. The process of *describing the current state* of the organisation, the process of *describing one or more future states* of the organisation, and the *managed change* between these states. There is also a process of initial adoption of Enterprise Architecture tools, methods, etc., which is later called *implementation*. We will analyse these activities using *Activity Theory*.

Oxford Dictionaries (2010b) defines *process* as "a series of actions or steps taken in order to achieve a particular end". Moreover, *activity* is defined as "a thing that a person or group does or has done" (Oxford Dictionaries, 2010a). In Activity Theory these definitions are more complex and under debate. Engeström (1999) introduces six dichotomies related to Activity Theory; (i) Psychic process versus object-related activity, (ii) Goal-oriented action versus object-related activity, (iii) Instrumental tool-mediated production versus expressive sign-mediated communication, (iv) Relativism versus historicity, (v) Internalisation versus creation and externalisation, and (vi) Principle of explanation versus object of study. Moreover, Engeström summarised these dichotomies into three critical questions (1999, p. 28):

> *First, how can we depict the cell of activity theory or, more specifically, what would be a viable way of modelling the structure and dynamic relations of an activity system?*
> *Second, how can we incorporate historicity and developmental judgment into activity-theoretical analyses, yet take fully into account the diversity and multiplicity inherent in human activities?*
> *And third, what kind of methodology is appropriate for activity-theoretical research – one that could bridge the gaps between the basic and applied, between conceptualization and intervention?*

As a solution to previous questions, Engeström's model of activity system can be seen in Figure 8.

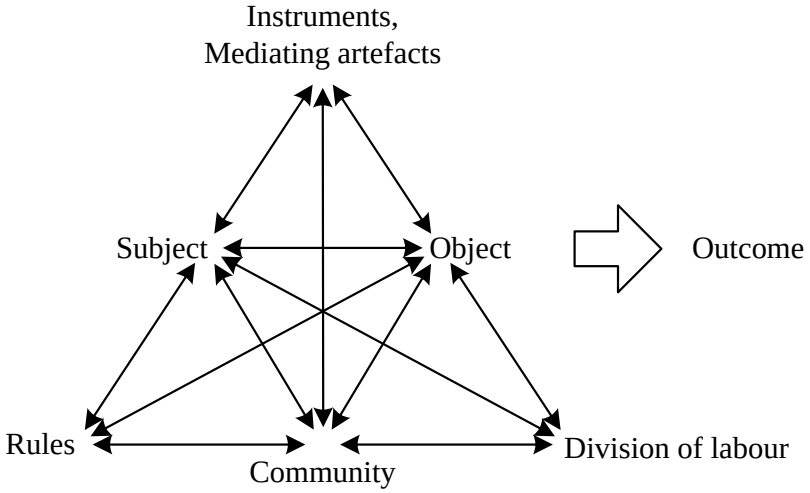

Figure 8. A complex model of an activity system (adapted from Engeström, 1987, 1999, 2000)

Basic idea of the model is that every activity has three main components; *Subject*, *Object,* and *Community*. These are in a relation to each other thru mediation. Subject-object relation is mediated by *Instruments* (or "tools" as in Kuutti, 1996), object-community by *Division of labour*, and community-subject by *Rules*. These mediating elements should be regarded in a broad sense; "A "tool" can be anything which is used in the transformation process, including both material tools and tools for thinking; "rules" cover both explicit and implicit norms, conventions and social relations within a community; "division of labour" refers to the explicit and implicit organization of a community as related to the transformation process of the object into the outcome.." (Kuutti, 1996, p. 6). Engeström's model has been used for example to analyse Human-Computer Interaction (Kuutti, 1996), and to analyse and redesign work (Engeström, 2000). Next we analyse the processes related to Enterprise Architecture using Activity Theory and Engeström's model.

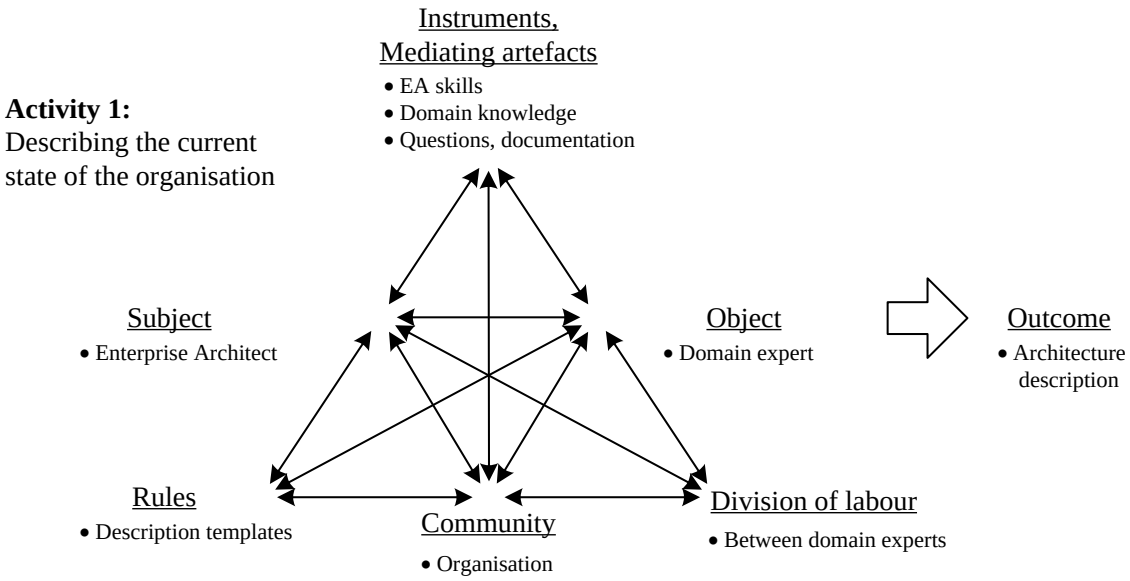

Figure 9. Activity 1: Describing the current state of the organisation

In Figure 9, we can see the process of describing the current state of the organisation as an activity system. Subject, the one who is creating descriptions, is called *Enterprise Architect*. This

should be understood as role, not a single person in the organisation (although that can be a case too). Object of activity is *Domain expert*, a role of any person having knowledge of a particular domain, such as business, process, or technology. Instruments of the activity are Enterprise Architecture skills, domain knowledge, and questions and documentation. Documentation refers to all available documentation used in the activity, such as web-pages, quality handbook, income statement, etc. The community, where the activity takes place, is the organisation itself. Rules that apply in this activity are *Description templates* of the used Enterprise Architecture framework, because they define for instance which notation is used. There are division of labour between *Domain experts*, each expert takes part to the activity related to his/hers own domain. Outcome of the activity is architecture description(s) of the current state of the organisation.

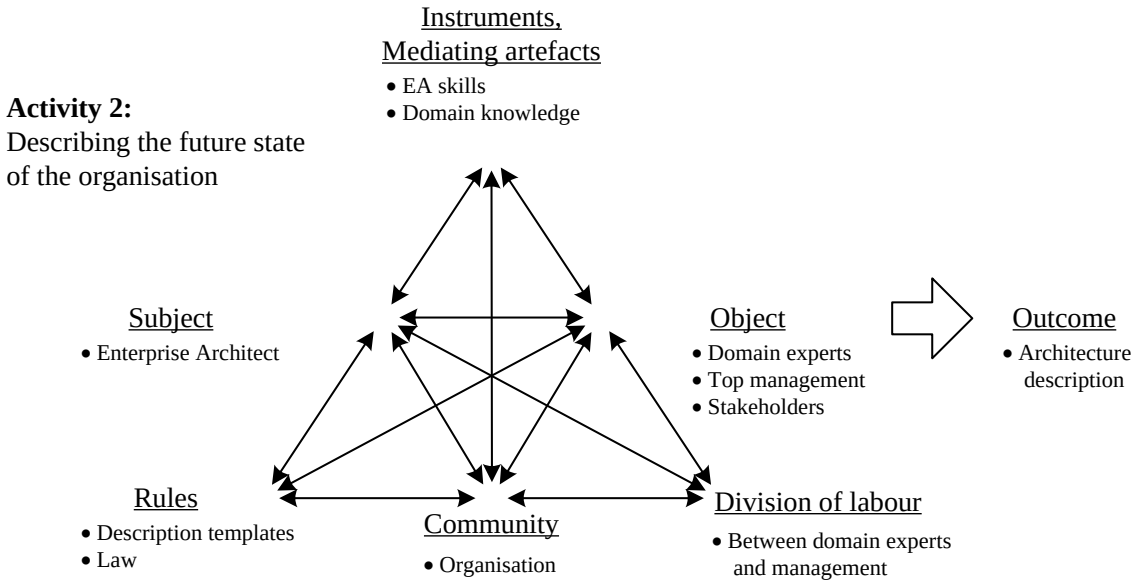

Figure 10. Activity 2: Describing the future state of the organisation

Activity model of the process of describing the future state of the organisation seen in Figure 10 has a number of common elements with the previous one. However, there are some fundamental differences. As this activity is describing future, the element of planning exists in the activity. Object contains also *Top management* and *Stakeholders*, as these are the parties that

have interests about (and are responsible for) the future of the organisation. Domain experts are still objects too, because they have knowledge about what is possible, for instance in the technology domain. There is a division of labour between domain experts and management. If for instance there are changes in organisation structure, domain expert are not necessarily involved in the planning as they might have conflicting interests with the management. Also rules are a bit different; as the future is involved, for instance law may restrict or mandate future changes. Outcome is same than in the previous activity, an architecture description.

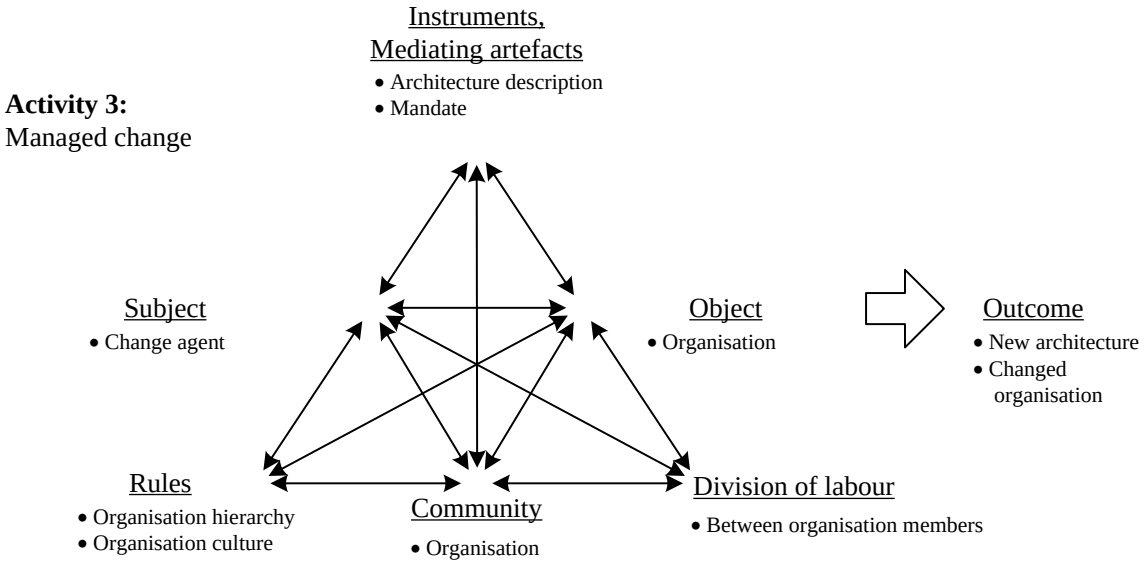

Figure 11. Activity 3: Managed change

Figure 11 shows us an activity system of the process of managed change. Subject of the activity is *Change agent* and object *Organisation*. Organisation in a sense that it depends on the "target" architecture, what is to be changed. So it can be any part of the organisation, its processes, technology, and so on. Instruments of the change are *Architecture description(s)* and *Mandate* to conduct the change. As in previous activities, community is *Organisation* itself. Rules are *Organisation hierarchy* and *Organisation culture*. Hierarchy in a sense that division of power is usually embodied to the hierarchy or the structure of the organisation. Outcome of this

activity system is a new architecture, which should be similar to the architecture description(s), and a changed organisation.

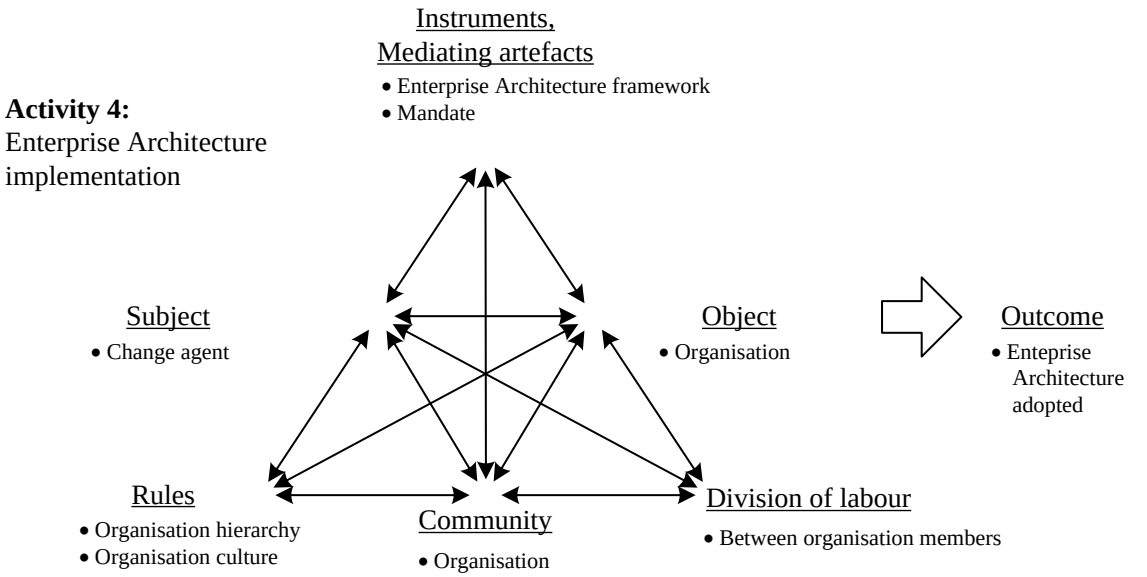

Figure 12. Activity 4: Enterprise Architecture implementation

Activity system of Enterprise Architecture implementation seen in *Figure 12* shares many elements with the previous one. This actually quite natural, because Enterprise Architecture implementation can be an instance of managed change, if it is planned by using Enterprise Architecture itself. Instruments used in the activity are *Mandate* and some *Enterprise Architecture framework*. Rest of the elements is same to the previous activity except for the outcome. Outcome of the implementation activity is *an organisation with Enterprise Architecture adopted* in some degree.

As a conclusion, Enterprise Architecture can be explained and theoretically underpinned by Activity Theory. Activity Theory can thus be used as a methodology to research Enterprise Architecture related processes in organisations.

Enterprise Architecture as an information technology system

In Oxford Dictionaries (2010d), *system* is defined as "a set of things working together as parts of a mechanism or an interconnecting network; a complex whole" and "a set of principles or procedures according to which something is done; an organized scheme or method". According to organisational semiotics, "An organisation, and therefore an information system, is essentially a system of social norms." (Ronald Stamper, Liu, Hafkamp, & Ades, 2000, p. 2). According to General Systems Theory (GST), "a system is the organized collection of men, machines and material required to accomplish a specific purpose and tied together by communication links" (Skyttner, 1996, p. 17). Thus, any organisation can be seen as a system. Same way as an organisation, Enterprise Architecture can be seen as a system. Both systems have a set of defined rules and processes to be followed.

In the other hand, information systems are systems that consist of information and communication technology (ICT) and of people utilising ICT (Paul Beynon-Davies, 2009). In this sense, ICT can be understood as any physical artefact used for storing or for communicating information (P Beynon-Davies, 2009). Thus Enterprise Architecture can also be regarded as *information communication technology*. As discussed in previous sections, EA stores information about the organisation and it can be used to communicate this information.

These two concepts, *system* and *information communication technology*, put together results to the introduction of the concept of *information technology system*. Enterprise Architecture can be seen as a system (activities) to handle information technology (architecture descriptions). Next we give an example of Enterprise Architecture as information technology system.

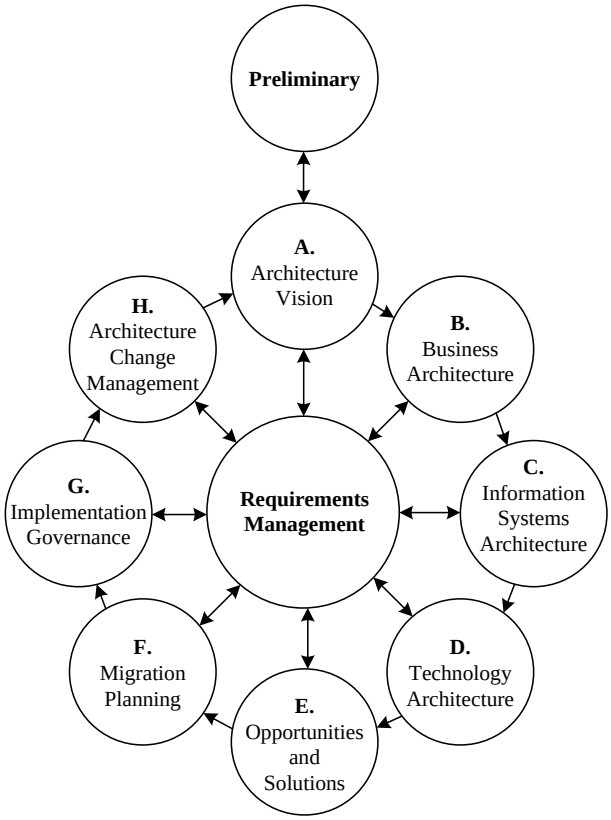

Figure 13. Architecture Development Cycle (adopted from TOGAF, 2009, p. 54)

Typically Enterprise Architecture is planned and described by using top-down approach, where higher level output is input for level below it (Pulkkinen, 2006; TOGAF, 2009). Some Enterprise Architecture frameworks, such as TOGAF and PEAF, have methods and processes for describing and maintaining architecture descriptions. The development cycle of TOGAF's Architecture Development Method (ADM) can be seen in Figure 13. ADM phases from A through H follow each other iteratively. Each phase has a defined set of minimum inputs and outputs, for instance in phase B, Business Architecture, some required inputs are (TOGAF, 2009):

- Organizational Model for Enterprise Architecture
- Tailored Architecture Framework
- Approved Statement of Architecture Work
- Architecture Vision
- Draft Architecture Definition Document, including (when in scope)

  - Baseline Business Architecture, Version 0.1
  - Baseline Technology Architecture, Version 0.1
  - Baseline Data Architecture, Version 0.1
  - Baseline Application Architecture, Version 0.1
  - Target Business Architecture, Version 0.1
  - Target Technology Architecture, Version 0.1
  - Target Data Architecture, Version 0.1
  - Target Application Architecture, Version 0.1

Main objectives of the phase B are to describe the Baseline Business Architecture, to develop a Target Business Architecture, and to analyse the gaps between the Baseline and Target Business Architectures. Some of the phase B outputs are (TOGAF, 2009):

- Draft Architecture Definition Document, including:
  - Baseline Business Architecture, Version 1.0 (detailed), if appropriate
  - Target Business Architecture, Version 1.0 (detailed), including:
    - Organization structure - identifying business locations and relating them to organizational units
    - Business goals and objectives - for the enterprise and each organizational unit
    - Business functions - a detailed, recursive step involving successive decomposition of major functional areas into sub-functions
    - Business services - the services that the enterprise and each enterprise unit provides to its customers, both internally and externally
    - Business processes, including measures and deliverables
    - Business roles, including development and modification of skills requirements
    - Business data model
    - Correlation of organization and functions - relate business functions to organizational units in the form of a matrix report

Similarly phase C has input requirements (TOGAF, 2009). Some differences to requirements of phase B are (outputs from phase B in bold):

- Draft Architecture Definition Document, including:
  - **Baseline Business Architecture, Version 1.0 (detailed), if appropriate**
  - **Target Business Architecture, Version 1.0 (detailed)**
  - Baseline Data Architecture, Version 0.1
  - Target Data Architecture, Version 0.1
  - Baseline Application Architecture, Version 0.1
  - Target Application Architecture, Version 0.1

Input/output lists presented above demonstrate which kind of requirements an Enterprise Architecture framework typically brings to organisations. All organisations are already managed and lead, software is developed, and hardware is bought. Organisations are using some *information technology system* to do that. In Enterprise Architecture implementation, as described earlier, an organisation adopts Enterprise Architecture rules, processes, tools, etc. If these "things" to be adopted, such as requirements presented above, are different from those currently used in the organisation, challenges may be faced. This phenomenon is very common when for instance developing new software; sometimes end-users are not willing to use the new piece of software. In Information System sciences this phenomena is known as a *technology acceptance* (see for example Fred D Davis, 1986; 1993; Venkatesh & Davis, 2000). Since its introduction (Fred D Davis, 1986), Technology Acceptance Model (TAM) has been used in many published researches (see for example Lee, Kozar, & Larsen, 2003).

Unified Theory of Acceptance and Use of Technology (UTAUT), based various acceptance models, can be seen in Figure 14. In the UTAUT, there are three constructs influencing *Behavioral Intention*, and two constructs influencing *Use Behavior*. Former three constructs influence *Use Behavior* indirectly vie *Behavioral Intention. Performance Expectancy* is defined as "..the degree to which an individual believes that using the system will help him or her to attain gains in job performance." (Venkatesh, Morris, Davis, & Davis, 2003, p. 447). *Effort Expectancy* is defined as "..the degree of ease associated with the use of the system." (Venkatesh, et al., 2003, p. 450). *Social Influence* is defined as "..the degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh, et al., 2003, p. 451). *Facilitating Conditions* is defined as "..the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system." (Venkatesh, et al.,

2003, p. 453). These influences are moderated by *Gender*, *Age*, *Experience*, and *Voluntariness of Use*, as seen in Figure 14.

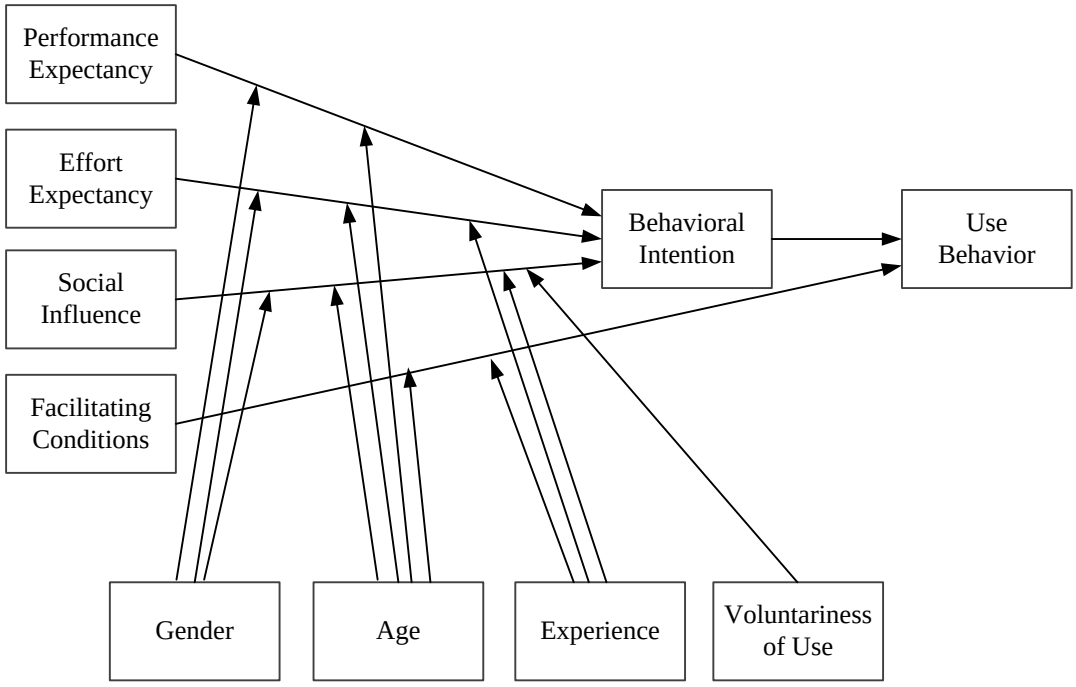

Figure 14. UTAUT, Unified Theory of Acceptance and Use of Technology (adopted from Venkatesh, et al., 2003, p. 447)

In the context of Enterprise Architecture implementation, *Performance Expectancy* can be defined as the degree how individual feels Enterprise Architecture would help he/she to perform in his/her job. Same way *Effort Expectancy* can be defined as the degree of efforts an individual feels Enterprise Architecture would require to take. *Social Influence* can be defined as the perceived degree of importance of using Enterprise Architecture others do, and *Facilitating Condition* as the degree how individual feels organisation being ready to support usage of Enterprise Architecture.

As a conclusion, Enterprise Architecture can be categorised as an information technology system. As such, it can be theoretically underpinned by General Systems Theory and Technology

Acceptance Theory. As organisations are also systems, Technology Acceptance Models can be used as theoretical view point to understand Enterprise Architecture implementation process.

Conclusions

In this paper we presented definitions of Enterprise Architecture (EA) from the current literature and the definition used in this paper. We also viewed EA from three different theoretical perspectives. Firstly, EA can be seen as a communication media used to describe both the current and future states of an organisation. In other words, EA is the ontology of the organisation and thus underpinned by ontology theory. Semiotics can be used as a research methodology to research EA as a communication media. Secondly, EA can be seen as an activity system, underpinned by Activity Theory and having four high-level activities; (i) describing the current state of the organisation, (ii) describing the future state(s) of the organisation, (iii) managed change between the current and future states, and (iv) the EA implementation. Thirdly, EA can be seen as an information technology system, possibly restricting or changing ways how organisation works. As such, it is underpinned by General Systems Theory and Technology Acceptance Theory. Technology acceptance models may be used as theoretical view point on understanding the EA implementation process.

It is acknowledged that this research does not present an exclusive set of theoretical perspectives of Enterprise Architecture, but introduces three perspectives as a foundation for future discussion. Also, as an implication to future Enterprise Architecture research, three theoretical perspectives introduced gives theoretical basis for other researchers to be used.

Future research built on the introduced perspectives could include for instance practical solutions; (i) development of method for analysing and communicating organisational change, (ii) development of a conceptually ideal EA activities and a tool to compare them to

organisation's current activities, and (iii) development of an Enterprise Architecture Acceptance Model.

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