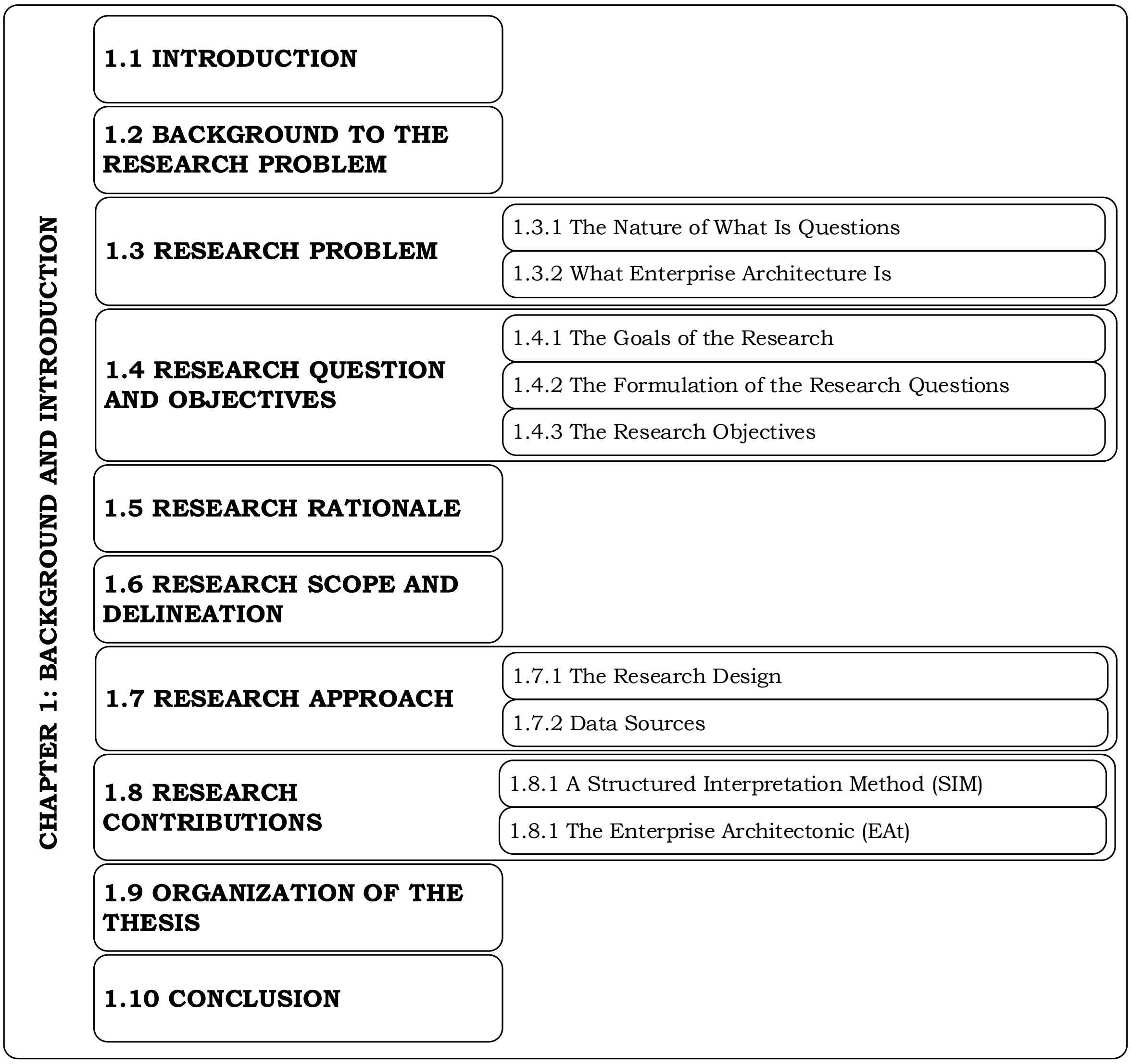
TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: BACKGROUND AND INTRODUCTION

Chapter Map



1.1 INTRODUCTION

This thesis reports on the development and demonstration of an Enterprise Architectonic (EAt). The primary aim of the EAt is to promote clarity in the fundamental understanding of the EA concept, in terms of concepts and their relationships. The EAt is a conceptual artefact designed to contain an understanding of the fundamental meaning of the EA concept. The EA understanding is achieved by the application of a structured interpretation method (SIM) to the key documents of three prominent enterprise architecture frameworks (EAF). Given the extensive use of information systems (IS) in modern business, the examination of the meaning of EA, in this thesis, is executed from an information systems research perspective.

Enterprise architecture's (EA) conceptual description is generally attributed (Boucharas et al., 2010) to the Zachman Framework for Enterprise Architecture (Zachman Framework) (Zachman, 1987; Sowa & Zachman, 1992; Zachman, 1996). The development of tools, frameworks and methods listed in reports generated by technology research companies such as Gartner Research (Wilson & Short, 2010), indicates that EA, as an industry, operates on a global scale. In practice, EA is positioned between business strategy and information technology (IT) (Ross et al., 2006), where it bears the responsibility to align the implementation of technology and the strategy of the business (Chorafas, 2001). Such a casting of EA in the role of aligning IT and the business, creates interest in the value of EA by the IT practitioner and academic researcher alike (Kappelman et al., 2008). In the context of research interest in EA, Schöenherr (2009) reports an absence of standardised terminology among researchers as well as practitioners, and calls for a common EA terminology. More recently, Simon et al. (2013b) reiterates the lack of a universally accepted EA definition and terminology.

The background to the research problem is discussed in section 1.2, followed by the description and motivated statement of the main research problem in section 1.3. The research questions are stated in section 1.4. The research rationale, scope and delineation are stated in sections 1.5 and 1.6, respectively. The research approach is summarised in section 1.7, followed by a discussion on research contributions in section 1.8. The organisation of the thesis is shown in section 1.9. The chapter concludes in section 1.10.

1.2 BACKGROUND TO THE RESEARCH PROBLEM

Banerjee (2010) summarised a popular debate on the topic of the death of EA, by claiming that 'EA is dead' is a proposition that was widely accepted by EA practitioners. Allega (2010), in turn, emphasised that Gartner's 2010 enterprise architecture hype cycle report (Burton & Allega, 2010) indicated an increase in business interest in EA. The blog posting that sparked the debate was based on Zachman's clarification (Zachman, 2009a) of the statement that 'enterprise architecture is relative'[1]. In his clarification, Zachman expressed dissatisfaction with the arbitrary use and ownership, by practitioners,

---

[1] The response from Zachman was made to correct a misquotation by Roger Sessions on the issue.

of the EA term, by exclaiming that "this is what is killing enterprise architecture". Zachman furthermore argued that EA is absolute, in the sense that its meaning is not open to arbitrary interpretation.

The pronouncement of the demise of EA might be premature, when the activities of defining EA are considered. The Open Group (The Open Group, 2011a) and Gartner Research (Gartner, 2011) are two examples (section 2.3.2.1) of organisations initiating formal efforts to establish an EA definition. An informal EA definition effort was also initiated on the LinkedIn (LinkedIn Corporation, 2014) social network site (section 2.3.2.3). In the world of academia, researchers such as Dankova (2009), Buckl et al. (2010), Lapalme (2012), Kotzé et al. (2012), Mentz et al. (2012) and Korhonen and Poutanen (2013), have published results that relate to the effort of finding the meaning of EA (section 2.3.1).

The efficacy of these efforts to create an EA definition is affected by the number of people involved in the process. Gartner demonstrates (Lapkin, 2006; Lapkin et al., 2008), for example, that a clear EA definition can be reached in a relatively short period of time (section 2.3.2.1), whereas cases of multiple participants such as, for example, The Open Group, show the opposite state of affairs (section 2.3.2.2). Each of the EA definition initiatives generated an understanding of EA that is specific to each group. Each group's EA definition, furthermore, represents a localised understanding of EA. In the case of the LinkedIn challenge (section 2.3.2.3), for example, the EA definition is a synthesis of all the proposals from the participants who participated in the challenge.

The search for an EA definition is worthwhile, but a definition (even if universally accepted) in itself does not represent the complete set of terms needed to capture the meaning of EA. According to Shah and Kourdi (2007), an EAF provides the set of common terminology in the development of an EA. The EAF serves as a communication model (Schekkerman, 2006). The importance of an EAF to the EA researcher is emphasised by Simon et al. (2013b), who list EAFs among three key EA research streams – the other two being the design and operations of EA management, and EA conception and modelling. Numerous EAFs are available to the researcher and practitioner tasked with starting an EA practice (section 2.4.1). Schekkerman (2006) states that the practitioner can either adapt an existing EAF, according to the needs of the enterprise, or completely invent a new EAF. Liimatainen et al. (2007) report that the worldwide trend among governments is to develop new EAFs for their national EA initiatives. In the South African context, the Government-Wide Enterprise Architecture (GWEA) framework (Needham, 2010) is a case in point. The issue of selecting or adapting EAFs to facilitate the development of EA is a non-trivial problem, and of ongoing concern to EA researchers and practitioners (Cameron & McMillan, 2013).

The pliable nature of an EAF, and the realisation aspect (Namkyu et al., 2009) of the EA-EAF relationship, suggest that a localised EA definition finds its way into the EAF. Each initiative to describe enterprise architecture, or to synthesise various descriptions, leads to a situation where the understanding of enterprise architecture is local to the group that initiated the definition activity. This localised understanding leads to a knowledge silo that potentially inhibits an academic inter-framework discussion, and creates practitioner challenges for inter-framework migrations in business. In other words, the multitude of EAFs means a variation in the understanding of EA. What is unclear and implicit in EA and EAF research and practice, is the underlying foundational meaning of EA. The area that is therefore under-researched, by the academic community specifically, is the foundations of EA in terms of its conceptual meaning.

1.3 RESEARCH PROBLEM

According to Bernard (1941) defining a concept is a process that simplifies, formulates and brings precision to the description of something. A definition fulfils the formal function of scientific analysis, and serves as a tool to communicate and preserve knowledge (Timasheff, 1947). Definitions, furthermore, answer the question of what something is, and provide an answer that is concise, precise and allows for clear communication.

The multitude of EAFs and their proposed definitions, as well as the diversity in the wording of EA definitions, demand a measure of interpretation on the part of an interested practitioner or researcher (section 2.3). The pressure on the interpreter to find an EA definition, leads to the occurrence of multiple interpretations, which in turn could lead to differences in the understanding of the meaning and purpose of EA. The differences, in the interpretation of EA, may inhibit agreement, among those interested in EA, on a universal conceptual understanding of EA.

To formulate the research problem and related research questions, this thesis takes, as the starting point, the phenomenon of the implicit fundamental concepts of EA as described in section 1.2. What follows is a discussion on the background of the research problem in terms of a) the science of asking questions, and b) the conceptual understanding of EA.

1.3.1 The Nature of 'What Is' Questions

The formulation of questions serves the purpose of inquiring into the meaning or nature of the phenomenon under examination. As such, a question exhibits an intent embedded in the question itself (Bérci & Griffith, 2005), that in turn suggests the direction for a possible answer. The classification scheme proposed by Dillon (1984) identifies *what is* questions as of the *substance/definition* type, where the three aspects of *nature*, *naming* and *meaning* of a *thing* under exploration, is examined. For example, given that the entity under examination is called *P*, then the nature of *P* is explored by asking *what makes P be P?*, the naming of P is asked as *whether P names P?*, and finally, in terms of *P's* meaning, the question *what does P mean?* is asked. All of these questions are subsumed under the broader category of exploring the substance or definition of P by inquiring into *what P is*. In philosophical terms, the aspects discussed above characterise the *being* of a thing, and are described by Macdonald (2005) as the ontological study of a thing. Ontology is rooted in the philosophical domain of metaphysics.

1.3.2 What Enterprise Architecture Is

Approaching the question of *what is EA* from the background of the discussion so far, an ontologically oriented research question can be derived. The application of the framework for scientific questioning

(Dillon, 1984) to the question of the *being* of EA, results in an expression that reads as follows: in order to answer *what enterprise architecture is*, it must be explored in terms of its nature (*what makes enterprise architecture, be enterprise architecture?*), its name (*does the term enterprise architecture name enterprise architecture?*) and, finally, its meaning (*what does enterprise architecture mean?*). The assumptions underlying Dillon's scheme is that EA is a kind of thing that is a) a substance of some sort, or b) something that can be defined. Section 1.3.2.1 explores EA as something that is defined as a concept, rather than as a substance.

1.3.2.1 The Nature of Enterprise Architecture

The nature of a thing speaks of its qualities and attributes (Crowther, 1989) and is expressed as descriptions in the form of statements. The LinkedIn definition (section 2.3.2.3), for example, describes EA as a kind of thing that *enables* the enterprise to *do* something – for example, to realise the enterprise's vision. Gartner (section 2.3.2.1) supports this idea by calling EA a process that *translates vision into change* and includes in its scope *people, processes, information and technology* (Lapkin, 2006). Dankova's definition (section 2.3.1), on the other hand, suggests that EA *represents, describes, defines and synchronises* various aspects of the enterprise (Dankova, 2009). The Open Group Architecture Framework (TOGAF) (section 2.3.2.2) describes architecture as a *description of the structural organisation of the enterprise* (The Open Group, 2009b) and proposes the Architecture Development Method (ADM) (The Open Group, 2009b) as a means to create an EA. The nature of EA can therefore be described as a type of thing that is an activity that *enables, represents, describes, defines and synchronises* aspects of the enterprise.

The active nature of EA is focused on the creation of artefacts such as *models, processes* and *tools,* as suggested by the LinkedIn definition (section 2.3.2.3). TOGAF is more explicit, in stating that the *objects* of architecture consist of a repository of documentation that results from the execution of the ADM (The Open Group, 2009b). EA, therefore, is not the kind of thing that holds substance like a physical object, but, by way of activities, creates artefacts such as models, descriptions and documents.

1.3.2.2 The Term 'Enterprise Architecture'

Definitions in themselves are insufficient to explore whether the term in question (EA) adequately describes the foundations of the concept that it defines (EA). This difficulty arises when the underlying conceptual foundations of EA are assumed (or taken as implicit) during the process of defining EA as a term. The value of the EA definition is therefore uncertain, in that a clear answer cannot be given to the question of what the meaning of the term EA is. At face value, the two words *enterprise* and *architecture* suggest that the established understanding of each word (for example, architecture as used in software engineering, computer science and the built environment) plays a part in the definition of the EA term. Furthermore, the term *architecture* should have a universal meaning across its domains of usage, so that the EA term can simply be understood in the light of an *enterprise* that relates to *architecture*. If this was the case, then the issue of defining the term EA should be more easily settled. The discussion in section 1.2, though, points towards a diversity rather than a unity.

1.3.2.3 The Meaning of Enterprise Architecture

Each definition of EA, when considered separately, exhibits a specific meaning of EA (section 2.3). In the case of the LinkedIn definition effort (section 2.3.2.3), the meaning of EA is that it *enables the enterprise to achieve various aspects of being an enterprise* (Smith, 2010b). For Gartner (section 2.3.2.1), EA is a *vision-to-change translation process* (Lapkin, 2006; Lapkin et al., 2008). TOGAF (section 2.3.2.2) emphasises the creation of sub-architectures to *describe the organisation of the elements* of an enterprise. Similarly, Dankova's (section 2.3.1) definition indicates the meaning of EA as *representing, describing, defining and synchronising various aspects of the enterprise* (Dankova, 2009). All of these definitions, in combination, strongly suggest that EA is an *activity*, with its focus on the *structure and behaviour of the enterprise*.

The issue of meaning, however, is problematic, since meaning itself depends on an interpretation of what is under consideration. Such an interpretation in turn depends on the viewpoint and conceptual foundations of the interpreter. The efforts to define the meaning of EA (section 2.3) do not explicitly state either the viewpoint or conceptual foundations of the interpreter. The lack of clarity in defining EA has a direct impact on the universal acceptance of a shared understanding of the conceptual meaning of EA.

1.3.2.4 Discussion Summary

The discussion so far could create the impression that the definitions of EA in themselves make little contribution to the knowledge of EA as a research field. The reality, though, is that EA is individually understood by the group or organisation engaged in its definition. The results of each definition initiative represent a local understanding by the creators of the definition, and are captured in an EAF associated with that group. That the question of definition (section 2.3) is still raised, is evidence of an active interest in refining the understanding of those interested in making use of EA. What is lacking in the definitions is a clearly stated basis on which EA must stand, to continue to enjoy such active research interest.

The lack of a universally agreed theoretical basis makes it difficult for practitioners and researchers to engage in inter-framework discussions, since the understanding of EA is treated as belonging to the EAF enlisted for EA work. For example, if an organisation aims to make use of TOGAF (The Open Group, 2009b) for its EA development, then the basis of understanding EA is The Open Group's. If the same enterprise wants to change its EA to another framework at a later stage – for example, by using Gartner's consultants, then it would mean not only a change of framework, but also a change in the very understanding of EA.

What the preceding examination shows is that the theoretical and philosophical basis of EA is not explicit in the definitions proposed. The absence of an explicit foundation makes a cross-framework discussion hard to follow, or even begin. Furthermore, EA's implicit foundations creates the problem of EAF selection (section 2.5.1). Stating the case in another way, it means that the history of EA shows that the exploration and explanation of EA definitions manifest as a localised understanding by the creators of definitions and frameworks. The aspect that remains unexplored is the foundational meaning of EA – the problem being that the universal understanding of EA, in terms of its foundations, is assumed, and not yet explored in a scientific manner, as illustrated Figure 1.1.

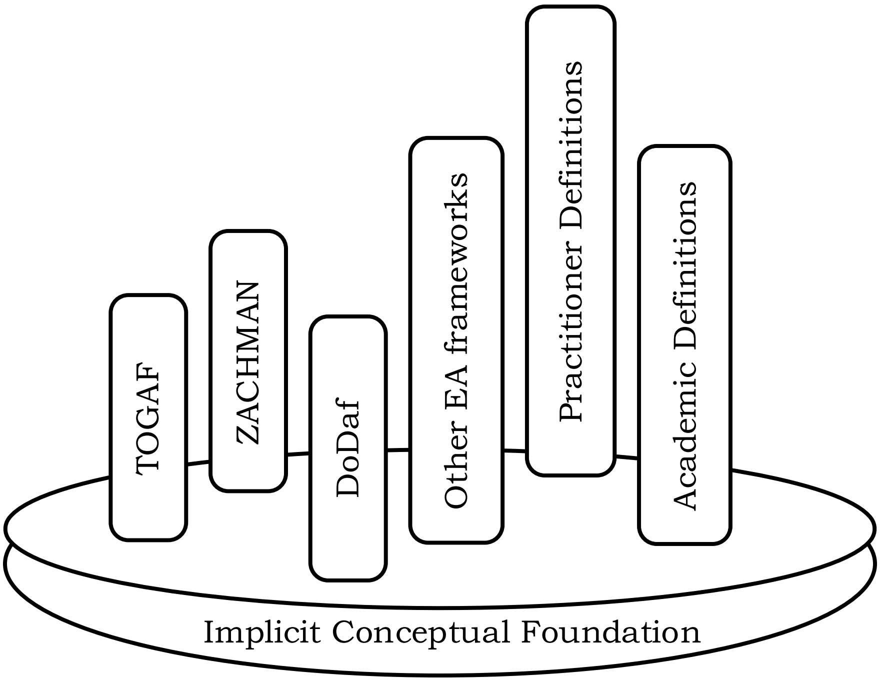


Figure 1.1: The Research Problem: Implicit Conceptual Foundation

The vertical blocks in the figure represent different understandings of EA, as reflected either by an effort at definition or as encapsulated by an EAF. Each of these understandings of EA rests or stands on a conceptual foundation that serves to unite aspects of the understanding of EA. This conceptual foundation is assumed, due to the fact that the thing that binds the various understandings together is the term EA itself. A conceptual ground that is left implicit is open to assumption, which leads to the phenomenon of a localised (that is, inside the community, represented by a vertical rectangle in the figure) understanding of what EA is. The problem, therefore, that is addressed in this research, is the lack of clarity on the conceptual foundation of EA thinking and practice. The research problem is formally expressed as follows:

> *The implicit conceptual foundation of enterprise architecture thinking and practice leads to a lack of universal agreement on EA terms and definitions.*

1.4 THE RESEARCH QUESTION AND OBJECTIVES

The absence of an explicitly described theoretical and conceptual foundation for EA, enables the formulation of a research question that explores the meaning of EA as what it is – not only as a conceptual term, but also in an ontological sense. The framework for scientific inquiry as developed by Dillon (1984), serves as a point of departure for this formal formulation. As indicated in section 1.3.1, the intent of the *what is* question is to understand what EA is in terms of its *nature*, *name* and *meaning*. These aspects will guide the process of creating a primary research question, answerable by resolving a set of sub-questions. The temptation of simply wording the question as *what is enterprise architecture?* is tempered by the reality of the scope of such an endeavour. What is more, such a wording, from the perspective of doctoral research, holds little interest, since it has already been answered (section 2.3). A formal refinement and understanding of a research question on the academic level of doctoral research, is needed. To facilitate this refinement, two elements are required, namely –

- A plainly stated set of goals for the research as a whole.
- An approach to the formulation of research questions.

1.4.1 The Goals of the Research

The analyses in section 1.3.2.4 concluded that the theoretical basis for making claims about what EA is, remains implicit in the EA debate on definitions and terms. In order to change from an implicit EA conceptual foundation to an explicit EA conceptual foundation, the theoretical underpinnings of EA have to be explored, to uncover its foundational conceptual basis. The result of such an exploration provides an understanding of EA that contributes to the process of synthesising the meaning of EA. An EAF realizes the EA and therefore presents a source of data for the exploration of the meaning of EA. And architectonic on the other hand provides a conceptual structuring mechanism to organize the fundamental EA concepts and their realtionships.

The goals of the research as it relates to the research problem, are therefore threefold:

1. Describe the theoretical background of EA research in terms of EA definition efforts and the difficulties with EAF selection.
2. Determine the meaning of EA by interpreting the key works of three prominent EAFs.
3. Construct an enterprise architectonic (EAt) to structure the core concepts of EA, in terms of fundamental concepts and their relationships.

In order to achieve these goals, the research approach (section 1.7) focuses attention on the inquiry into the understanding of EA. The quest for understanding the concept of EA falls within the social domain, as it takes into account that the EA concept is a product of human thought and action. In particular, the enterprise, as it is founded in the world of business, is a unique human expression of co-operation towards a shared goal. Likewise, architecture, as a product of human creativity, is regarded as part of the sciences of the artificial (Simon, 1996). Due to the social nature of these aims, and the focus on meaning, a qualitative approach to the research is taken (Denzin & Lincoln, 2005).

1.4.2 The Formulation of the Research Question

Mantzoukas (2008) defines the characteristics and elements of a well-formed qualitative research question in terms of *content, coherence and structure*. The content of a qualitative research question reveals the researcher's area of interest. The question's coherence brings together the research's theoretical and philosophical underpinnings. Finally, the structure of a qualitative research question conveys information about the topic, participants, context, timing and method of the study. Following these guidelines, the research question for the thesis is developed in Table 1.1:

Table 1.1: Characteristics of a Qualitative Research Question

Characteristics of a qualitative research question		**Aspect of research problem**
Content (area of interest)		Conceptual meaning of EA
Coherence (theoretical and philosophical underpinnings)		Ontological understanding and phenomenological interpretation
Structure	topic	Construction of an architectonic
	participants	EA authors and EAF texts
	context	The enterprise
	timing	n/a
	method	Interpretation

The research question, according to Cormack and Benton (2000), can be in the form of a declarative or an interrogative statement. The interrogative format of a research question identifies a knowledge gap in the field of study, while the declarative format defines the purpose of the study. In the interests of scientific clarity, the purpose of this study is indicated by the declarative statement as follows:

> *The purpose of this research is to explore the meaning of enterprise architecture by using the results of a structured interpretation method (SIM) to construct an enterprise architectonic (EAt) to organise the foundational understanding of enterprise architecture in terms of concepts and relationships.*

The interrogative format of this statement shows the knowledge gap addressed in this thesis, and is worded as follows:

> *In what way can architectonics contribute to a foundational understanding of enterprise architecture?*

1.4.3 The Research Objectives

In order to guide the execution of the research process, a set of research objectives is established to indicate how each of the three research goals (section 1.4.1) is met. The objectives of this research serve to focus the activities of the research execution, and, as such, are associated with the main research question:

- Research Objective 1: Describe the theoretical background of EA research, in terms of EA definition efforts as well as issues in EAF selection.
- Research Objective 2: Determine the meaning of EA by interpreting the key works of three prominent EAFs.
- Research Objective 3: Organise the concepts derived from the interpreted meaning of EA, in an EAt.

These research objectives are achieved by reaching a set of sub-objectives associated with each objective. Research Objective 1 is the first step in the research process, as it describes the theoretical background for the study as a whole, and achieves the thesis's first goal – namely to provide a theoretical background to EA. The sub-objectives associated with Research Objective 1 are as follows:

- Describe the historical development of EA.
- Discuss the attempts that have been made to clarify the EA concept.
- Identify the three prominent EAFs cited in the academic literature.

The data sources utilised to achieve Research Objective 1 are the following:

- Peer reviewed conference and journal papers on EA and EAF theory.
- Reports on EAF comparison studies.
- Peer reviewed conference and journal literature review on EA.
- EAF official literature such as manuals and guides.
- Reports on attempts to define EA.

The research method utilised to reach Research Objective 1 is a review of the literature, reported in Chapter 2.

Research Objective 2 aims to determine an understanding of EA as proposed by the authors of three prominent EAFs. This objective addresses the second goal of the thesis, and is achieved by employing hermeneutics in the design of a structured interpretation method (SIM), to get access to an understanding of EA. The sub-objectives associated with Research Objective 2 are as follows:

- Design and implement an interpretation method to establish an understanding of EA.
- Record the results of applying an interpretation method to three prominent EAFs.

The data sources utilised to achieve Research Objective 2 are as follows:

- Hermeneutic theory literature.
- Primary literature of three prominent EAFs.

The research method employed to achieve Research Objective 2, is based on the Design Science Research (DSR) model described by Vaishnavi and Kuechler (2013). The results of Research Objective 2 are reported in Chapter 4.

Research Objective 3 addresses the third goal of the thesis, in that it organises the EA understanding, which is the result of the application of the SIM in terms of concepts and their relationships. The sub-objectives associated with Research Objective 3 are as follows:

- Describe the meaning of architectonics, and discuss its role in the structuring of the conceptual understanding of EA.
- Derive the core concepts of EA in such a way that the concepts can be arranged in an architectonic.
- Describe the context of the modern enterprise and its relationship to IT/IS and complexity.

The data sources utilised to achieve Research Objective 3 are as follows:

- Heidegger's equipment analysis, as described in Being and Time (Heidegger, 2000).
- Literature sources that discuss and explain architectonic theory as a knowledge structuring concept.
- Literature that discusses the nature of the enterprise, in terms of the role of IT/IS in enterprise complexity.

The research method employed to achieve Research Objective 3, is based on the Design Science Research (DSR) model described by Vaishnavi and Kuechler (2013). The results of Research Objective 3 are reported in Chapter 5.

1.5 RESEARCH RATIONALE

As was pointed out in the background to this chapter (section 1.2), universal agreement on the meaning of EA has not been achieved. The evidence contained in various attempts at EA definition, and the commercial interest EA enjoys, support the claim that EA enjoys attention from both practitioners and researchers. The knowledge gap lies in the conceptual level, where the abundance of EAFs produce a number of definitions that describe potentially unrelated concepts. In a sense, EA is whatever its practitioners say it is. This conceptually relative situation is indicative of a lack of a universally agreed-on theoretical foundation. Likewise, the doing of EA work is at risk of the same conceptual relativism, which hinders its development as a discipline.

The conceptual relativism is overcome by examining the understanding of EA as expressed by its key authors. The aspects of agreement among these authors' understanding of EA forms the basis of a general description of EA fundamental concepts. The set of fundamental concepts arranged in an architectonic answers the *what is EA* question, and serves as its explicit theoretical foundation. Where there is agreement on what EA is, manifold definitions are welcomed, since they represent the varied perspectives of EA practitioners. The rationale for this research is, therefore, to establish a theoretical basis for EA by interpreting its main texts for an understanding of what it is. In other words, this research is an attempt to find the concepts that bind EA together on the fundamental level.

1.6 RESEARCH SCOPE AND DELINEATION

The scope of the research is determined by the way the main research purpose is fulfilled. The main purpose of this research is to reach a foundational understanding of EA as a concept. The methods used to achieve this purpose are on the conceptual level, backed by an interpretive philosophical foundation. In order to ensure that the research is completed within a reasonable time frame, the research design must, of necessity, be well organized, structured, and executed in a systematic way. The scope of the research is therefore limited to the following aspects:

- An interpretation of EA as proposed by the authors of three prominent EAFs. The interpretation is conducted by way of a SIM that is developed according to a DSR model. The design of the SIM incorporates hermeneutics as a science of understanding.
- The EAFs used in this study are selected on the basis of their academic importance, as well as their practical use by enterprise architects. The list includes the Zachman Enterprise Architecture Framework (Zachman Framework) (Zachman, 1987; Sowa & Zachman, 1992; Zachman, 2002), The Open Group Architecture Framework Version 9.1 (TOGAF) (The Open Group, 2011c), and the Department of Defence Architecture Framework Version 2.02 (DoDAF) (DoD Chief Information Officer, 2009). Section 2.4.1 describes the section process of the three EAFs.
- An examination of EA as a phenomenon in its own right – in other words, as it describes itself. This excludes approaching EA from another discipline, such as, for example, systems thinking and enterprise engineering.

The main purpose of this research is to develop an EA theory by organising the conceptual understanding of EA fundamentals in an architectonic. The scope of this purpose is expressed as follows:

- Adopt the meaning of architectonics as described in the field of architecture (built environment) research.
- Apply Heidegger’s analysis of Dasein’s everyday use of equipment (Heidegger, 2000) to the results from the interpretation of the EAFs.

In summary, the scope of the research is described as the design, implementation and demonstration of an EAt, to organise the understanding that results from a structured interpretation of the phenomenon of EA as revealed by the descriptions of three prominent EAFs.

1.7 RESEARCH APPROACH

To facilitate the achievement of the research objectives (section 1.4.3), a design science research approach (Figure 1.2) is selected. The artificial nature of EA (section 1.3.2.4) places particular emphasis on its non-physical existence. This artificiality (in other words, made by human beings) of EA guides the research approach in that it is appropriate to study the research object (EA) by making use of theories and methods created for the study of artificial things. The kind of knowledge that results from these theories and methods is characterised as *knowing by making* (Vaishnavi & Kuechler, 2013), and is rooted in the qualitative tradition of scientific research.

The qualitative research tradition includes interpretive research methods that are used to systematically engage in the interpretation of text-based data sources. The task of qualitative methods in this engagement is to identify the nature of data, the identification of data sources, and the means to interpret the data towards a meaningful result. The contribution of this research is to structure the interpretation of the meaning of EA in an architectonic, in such a way as to be the starting point for further research in the fundamental understanding of EA.

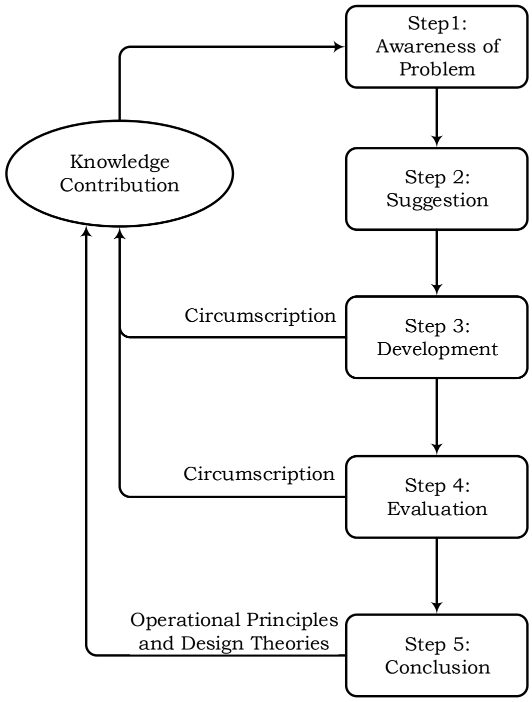


Figure 1.2: Design Science Research Model

1.7.1 The Research Design

The research design is based on a subtle realist paradigm, and applies the design science research (DSR) model described by Vaishnavi and Kuechler (2013), (section 3.3). The DSR model is applied in the development of two key artefacts, namely:

- A Structured Interpretation Method (SIM), which provides an interpreted understanding of EA fundamental concepts in the form of an EA claim and a set of EA propositions (Table 4.11).
- An Enterprise Architectonic (EAt) that is designed to reflect the fundamental understanding of EA in terms of concepts and their relationships (Figure 5.11).

The research design is illustrated in Figure 1.3.

1.7.2 Data Sources

The data sources are drawn from the work of authors who are regarded as the founders and main contributors to the body of knowledge of EA. The main criteria for the selection of authors on such a list is dependent on the frequency, over time, of their work being cited in research, as well as the accessibility of their work to the academic community. The nature of the data is textual, in that the original writings of the authors on the list will be analysed.

1.8 RESEARCH CONTRIBUTIONS

The results of the research contribute to the domain of EA research, as well as that of IS research. The research contributions are described in Chapter 6, but for introductory purposes will be overviewed here.

1.8.1 A Structured Interpretation Method (SIM)

Hermeneutics provides a way to understand written text (or text equivalent) by managing the interpretation process (Barrett et al., 2011). Hermeneutics has its origins in the interpretation of difficult-to-understand religious texts, and has developed into a science of understanding (Demeterio, 2001). A key feature of this science is the hermeneutic circle, which is a way to describe the basic nature of understanding any text. In making sense of a text, each word must be understood for the text to make sense, but the words only have meaning in the context of the whole text. There is thus a movement from words to the text, and from the text to words. This movement in the hermeneutic circle is not a method of understanding, but rather the essential feature of how humans interpret the written word as well as phenomena in the world. Science provides formal methods that identify, gather and interpret data associated with phenomena. By combining the principles of hermeneutics and the formality of a scientific method, an interpretation method is formulated that is used to understand the phenomenon of enterprise architecture.

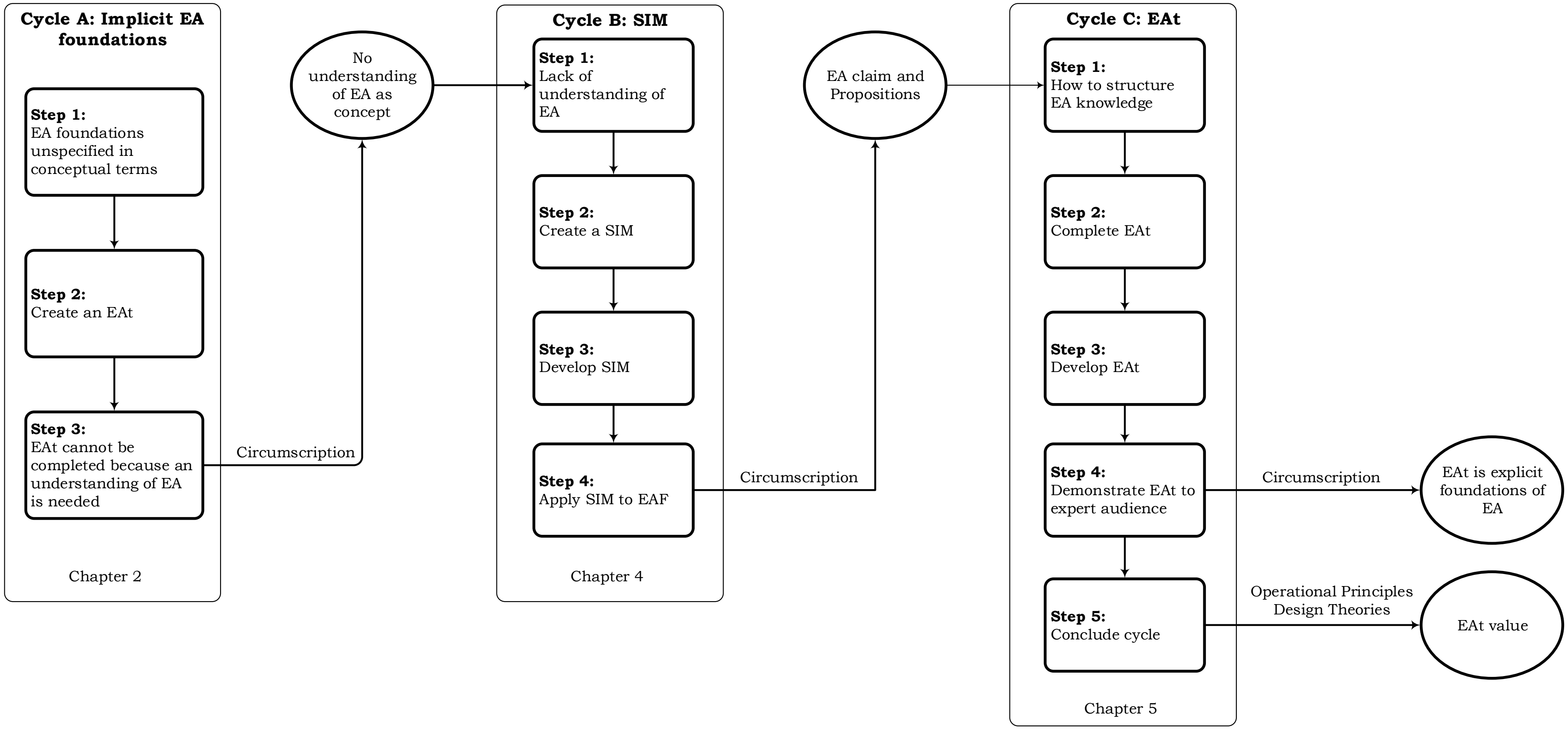


Figure 1.3: Research Design

1.8.2 The Enterprise Architectonic (EAt)

An architectonic is described as a structure that organises scientific knowledge (The American Heritage Dictionary, 2009). Manchester (2003) describes Lambert's work on architectonics as creating a purposeful whole out of a mere inventory of concepts. During the historical development of EA, many concepts have been proposed, and taken into the body of knowledge; however, after almost thirty years of activity, there is still no agreement on issues as basic and fundamental as definitions. EA is representative of such an inventory of concepts with no defined relationship between them. The execution of the interpretation method described in section 1.8.1 will add to the understanding of EA, but unless it is organised in an architectonic, this knowledge, too, will simply become part of the inventory of concepts.

1.9 ORGANISATION OF THE THESIS

The rest of the thesis is laid out as follows:

- Chapter 1 – Background and Introduction:
  This chapter provides the background to the research, as well as a description of the research problem, the research question and research approach.
- Chapter 2 – The Problem with Understanding Enterprise Architecture:
  This chapter provides the theoretical background to the thesis, and culminates in the establishment of an awareness of the design problem addressed in this thesis.
- Chapter 3 – Research Design:
  The details of the research strategy are discussed in Chapter 3. The research approach is qualitative in design, based on a subtle realist philosophical paradigm. The research strategy employs a design science research model, described by Vaishnavi and Kuechler (2013), to design, implement and demonstrate two key artefacts – namely a Structured Interpretation Method (SIM) and an Enterprise Architectonic (EAt).
- Chapter 4 – A Structured Interpretation Method (SIM):
  This chapter discusses the detail of the development and evaluation of the SIM. The chapter is structured according to the main phases of the design science research model. Firstly, the problem and proposed solution are reviewed. Secondly, the theory employed in the development of the SIM is discussed. Thirdly, the SIM's development is described in detail. Finally, the evaluation of the SIM is expressed in terms of an EA understanding. The EA understanding consists of an EA claim supported by a set of six EA propositions.
- Chapter 5 – An Enterprise Architectonic (EAt):
  This chapter discusses the detail of the development and demonstration of the EAt. The chapter is also structured according to the main phases of the design science research model. The problem and proposed solution are reviewed, followed by a discussion of the theory employed in the development of the EAt. The theoretical discussion emphasises the context of EA in

terms of the role of IT/IS in the complexity of the enterprise, as well as an overview of architectonic theory. The development of the EAt is described in terms of Heidegger's equipment analysis applied to the EA understanding, in order to determine the architectonic elements and their relationships. Finally, the demonstration of the EAt is discussed.

- Chapter 6 – The Research Contributions:
  This chapter provides a reflection on the contributions of the research results reported in this thesis. The contributions are structured according to the contributions to theory of qualitative IS research as well as EA theory. The contributions of the research are analysed in accordance with the stated research problem and research objectives.
- Chapter 7 – Conclusion and Further Work:
  The thesis concludes with a summary of the main research results and their link to the research objectives. The final answer to the research question is discussed. A critical reflection highlights the potential weaknesses and shortcomings of the research, and further research is also discussed.

Figure 1.4 shows a graphical illustration of the layout of the thesis.

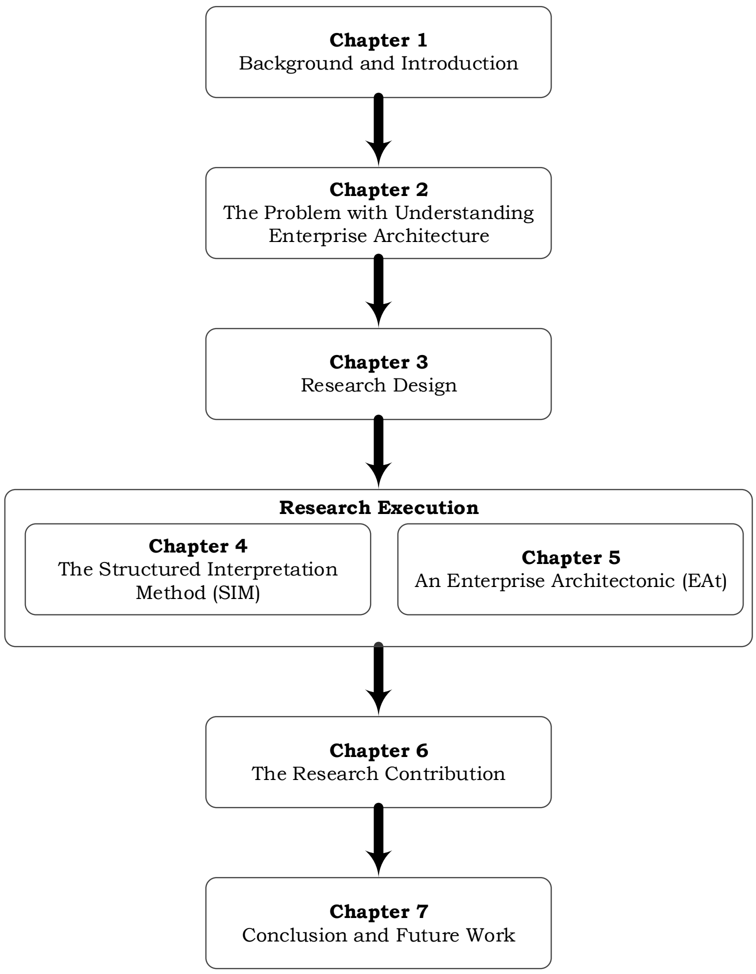


Figure 1.4: Thesis Layout

1.10 CONCLUSION

The importance of researching the foundations of EA should not be underestimated. For the practitioner, EA has developed into a multibillion dollar industry, with multiple frameworks, tools and consulting organisations. The researcher responds to the problems faced by this EA industry, and also provides intellectual leadership in shaping its body of knowledge. The argument presented in Section 1.2, and the evidence discussed in Chapter 2, prove that there is something that binds EA together in such a way that an EA debate or conversation is possible. There is therefore clearly an EA conceptual foundation. The current implicit nature of this foundation makes productive conversation and debate hard to determine.

According to Simon et al. (2013b), TOGAF is the most popular EAF in academic research, and the Zachman Framework is still regarded as the first formal EAF. The IEEE 42010 (IEEE, 2011) standard provides the potential for bringing about a standard way to describe the architectural aspect of the enterprise. Associated fields such as EA management (Simon et al., 2013a; Wißotzki & Sonnenberger, 2012) and enterprise engineering (Hoogervorst, 2009) depend on EA's conceptual existence, but also depend on the clarity of the meaning of EA. The continual absence of an explicit formulation of the conceptual foundations of EA will leave it open to interpretation, and potentially hinder its academic development in the future. In the spirit of a DSR research approach, the next chapter establishes an awareness of the problem with EA, after which the thesis will report on the proposal, design and demonstration of a solution in the form of a conceptual artefact called an enterprise architectonic (EAt). The main aim is to explicitly state the fundamental concepts and relationships of EA, so that the foundational and perhaps universal understanding of EA might become possible.

CHAPTER 2: THE PROBLEM WITH UNDERSTANDING ENTERPRISE ARCHITECTURE

Chapter Map

CHAPTER 2: THE PROBLEM WITH UNDERSTANDING ENTERPRISE ARCHITECTURE

- **2.1 INTRODUCTION**
- **2.2 A REVIEW OF ENTERPRISE ARCHITECTURE LITERATURE**
  - 2.2.1 Data Sources
  - 2.2.2 Data Analysis and Synthesis of Results
  - 2.2.3 Summary and Discussion
- **2.3 A REVIEW OF REPORTED EFFORTS TO DEFINE ENTERPRISE ARCHITECTURE**
  - 2.3.1 Academic Approaches
  - 2.3.2 Practitioner Approaches
- **2.4 OVERVIEW OF ENTERPRISE ARCHITECTURE FRAMEWORKS**
  - 2.4.1 Popular Enterprise Architecture Framework Selection
  - 2.4.2 The Zachman Framework for Enterprise Architecture (Zachman Framework)
  - 2.4.3 Department of Defense Architecture Framework (DoDAF)
  - 2.4.4 The Open Group Architecture Framework (TOGAF)
  - 2.4.5 Summary and Discussion
- **2.5 DESIGN SCIENCE RESEARCH MODEL**
  - 2.5.1 Awareness of the Problem
  - 2.5.2 Suggested Solution
  - 2.5.3 Solution Development
- **2.6 CONCLUSION**

2.1 INTRODUCTION

The problem that the EA practitioner faces (section 1.3) relates directly to the choice and application of an EAF appropriate to the needs of the EA initiative in a specific context. The choice is complicated, since the EA practitioner must decide in favour of a specific EAF among many options, and is then faced with the issue of adapting the chosen EAF to a planned EA project. The complexity is amplified by the absence of a universally adopted and accepted EA definition and terminology – an absence that leads to multiple answers to the question: *what is EA?*

The researcher, by applying the DSR model (Figure 2.7), creates an awareness of the EAF selection problem, and then proposes an artefact as a solution. The main purpose of this chapter, in support of creating problem awareness, is to examine the literature for solutions to the problem of EAF choice. The chapter's purpose is achieved by reaching a number of objectives. The first objective is to provide an integrated review of the EA literature as it pertains to the issue of definition and terms (section 2.3 and 2.4); the second objective is to make a selection of prominent EAFs by analysing the literature for the most referenced EAFs – once selected, these are summarised (section 2.5); the third objective is to create awareness of the design problem (section 2.6); and, the fourth objective is to propose a solution (section 2.7) to the problem.

2.2 A REVIEW OF ENTERPRISE ARCHITECTURE LITERATURE

The purpose of a literature review is defined as the creation of a firm foundation for advancing knowledge (Webster & Watson, 2002) by treating the literature as evidence for the argument of a thesis (Metcalfe, 2003). Torraco (2005) designates an integrative literature review as appropriate for mature as well as immature research fields. In the case of an immature research topic such as, for example, EA, an integrative literature review can produce a holistic conceptualisation and synthesis of the topic's literature. The benefit of a holistic conceptualisation of EA relates directly to the awareness of EA research problems, because the problems will either be stated explicitly in the extant literature, or be implicit, and therefore be evident as a gap in EA's body of knowledge. Torraco (2005), as well as Levy and Ellis (2006), describe the process of conducting a literature review as a disciplined and structured process that includes the steps of *identify, analyse, synthesise,* and *report*. These steps, guided by the objectives of the literature review, are used to construct the method used in conducting the literature review in this chapter. The general steps of the process followed in this chapter are described as follows:

- Identify and collect appropriate literature sources.
- Analyse selected sources to find main concepts.
- Synthesise to find meaning.
- Report on the problem found.

By following the four general steps, the EA literature review aims to provide an overview of the academic literature that reports on the questions of EA definition and terminology.

A set of guiding questions to represent an interrogative line of inquiry, is used to guide the overview of EA, namely –

- What does the literature say about the definition of the term EA?
- What EA terms are specified in the literature, and how are they defined?

2.2.1 Data Sources

The literature selected for analysis is limited to the English language, due to the large volume of available publications among English-speaking scholars. (In cases where an English paper referred to other languages such as, for example, German, it was translated through Google Translate). A total number of 19 papers, specifically designated as literature reviews, were used in the analyses, as well as a total of 19 papers that reported on EAF comparison research. These papers span a period from 2004 to 2013. Additional theoretical papers from the same period were also used in the analyses, for their relation to the topic of EA definition and terms.

2.2.2 Data Analysis and Synthesis of Results

The importance of stating the definition of terminology and concepts in the understanding of a piece of research, is discussed in section 1.3. The analysis of EA terminology, definitions and related concepts is discussed in terms of the conceptual description of EA, as found in EAF comparisons as well as EA literature reviews.

2.2.2.1 The Conceptual Description of EA According to Framework Comparisons

The EA academic literature that discusses EAF comparisons directly addresses the issue of terms and definitions and spans a wide spectrum of topics. These topics range from the *consistency in usage of EA terms* (Tang et al., 2004; Ohren, 2005; Abdallah & Galal-Edeen, 2006; Greefhorst et al., 2006; Namkyu et al., 2009; Herden & Zenner, 2011), the *integration of EAFs* (McCarthy, 2006; Zarvic & Wieringa, 2006; Adenuga & Kekwaletswe, 2013), the *selection process of EAFs* (Sessions, 2007; Odongo et al., 2010; Cameron & McMillan, 2013), and the *application of EA in the enterprise* (Kozina, 2006; Leist & Zellner, 2006; Urbaczewski & Mrdalj, 2006; Franke et al., 2009; Alghamdi, 2010; Magoulas et al., 2012).

In terms of the specific definition given to describe EA, the results are equally varied. From the earliest academic paper to the most recent, researchers are in agreement on the lack of universally accepted definitions. Tang et al. (2004) groups EA under the broad category of architecture frameworks, where the idea of a framework is designated as having a specific underlying goal. EA therefore would be the goal of a specific architectural framework. By using the IEEE Standard 1471-2000 definition of architecture as a reference point, Tang et al. (2004) propose a range of common goals for architecture frameworks, of which one, in particular, is of importance to this section – namely *Architecture Definition and Understanding*. Tang et al. (2004) illustrate the early association of EA with the development of enterprise software – an association that started as early as Zachman, who titled his first published papers on the topic, *A Framework for Information Systems Architecture* (Zachman, 1987) and *Extending and Formalizing the Framework for Information Systems Architecture* (Sowa & Zachman, 1992). Ohren (2005), in turn, proposes an architecture framework based ontology to enable framework comparisons, and defines an architecture framework as a set of rules, guidelines and patterns for describing the architecture of systems. Abdallah and Galal-Edeen (2006) specifically focus their research on the comparisons of EAFs, and define EA as a *coherent whole of principles, methods and models that are used in the design of an enterprise's organisational structure, business processes, information systems and infrastructure*. Although Abdallah and Galal-Edeen (2006) broadened the scope of the EA definition, the link with information systems is still evident. The link between EA and IS is recognised by Greefhorst et al. (2006), by regarding the ANSI/IEEE Std 1471-2000 standard as an important milestone in the field of architecture descriptions. By analysing a number of existing EAFs, given this standard, Greefhorst et al. (2006) make six observations:

- EAFs make use of different terms for similar aspects, and similar terms for different aspects.
- EAFs often define terms informally, making it difficult to demarcate boundaries clearly.
- EAFs often do not name dimensions explicitly, leaving their interpretation up to the reader.
- EAFs sometimes do not distinguish clear values within the dimensions, hindering effective communication.
- EAFs often have slightly different sets of values for particular dimensions.
- EAFs sometimes have dimensions with values that do not have a clear relationship, which makes it hard to understand the dimension altogether.

Frameworks are, in essence, an attempt by their creator to enable the clustering of architectural information in a way that suits a particular context and goal.

Kozina (2006) points out that the association of EA with IS development is due to the rapid development of the concept of enterprise-wide information technology (IT) architecture. EA is specifically defined as a structured framework that captures and manages the complexity of modern organisations. EAFs, in turn, present a conceptual map necessary for building an integral business model supported by the relevant IS. The relationship between EA and EAF as highlighted by Kozina (2006), and is made explicit by McCarthy (2006), who states that EA is implemented by using EAFs. McCarthy also points out that, to date (2006), no single universal definition for EA has been adopted. EAFs, according to Urbaczewski and Mrdalj (2006), differ in terms of their approach and level of detail. Some EAFs, for example, are proposed guidelines, whereas others have specific methodologies and aspects to follow when creating an EA. They also claim that the majority of the frameworks (up to 2006) are abstract formulations, and due to their generality in defining terms, raise the question of the validity, or even the ability, to do accurate work within that framework. To conclude the discussion of comparison research published during 2006, Zarvic and Wieringa (2006) hold that the concept of EA is defined by various sources as the structure of the IT systems of an enterprise, or even of the entire enterprise, or sometimes as an analysis and documentation of this structure, rather than the structure itself. Namkyu et al. (2009)

describe EA as an integrated model or representation of the enterprise, whereas an EAF describes the fundamental elements of an EA and the relationship between them. Besides their classification of EAF scope, Namkyu et al. (2009) also introduce the aspect of the architecture artefact as a product of EAF work.

2.2.2.2 The Conceptual Description of EA According to Published Literature Reviews

A number of literature reviews addressing various aspects of EA have been published over the period 2004 to 2013. Among these publications, researchers point to the lack of commonality in defining EA terms and concepts. For example, Schöenherr (2009) describes the situation as a "horrible mess", while Simon et al. (2013b) characterise the lack of commonality as an indication of EA's developing journey. Literature review authors, apart from pointing out problems, also propose a number of explanations and solutions. Langenberg and Wegmann (2004) conclude their review with a five-category framework for the classification of EA topics, namely *overview, usage, modelling, framework* and *design and principles*. Goethals (2005), in turn, points out that even though the terms and definitions associated with EA are technically correct, researchers might not be using these terms in their technically correct sense. This charge is supported by Kappelman et al. (2008), who regard the lack of agreement on common terms as a division between an understanding of the term's enterprise and architecture. Schöenherr (2009) proposes that the EA research community focus attention on thinking about EA in terms of a common structure, and developing an EA core theory. If the lack of commonality problem is not resolved, it will result in an inhibition in the development of EA as a research discipline (Boucharas et al., 2010), as well as raising the entrance barrier for young scholars in the field, since the core literature is unknown or undefined (Mykhashchuk et al., 2011).

2.2.3 Summary and Discussion

The year 2006 was a productive year for EA and EAF comparison publications, while 2010 was known for literature review publications. The results from the above analysis indicate that the concept of EA was at first strongly associated with information systems development – for example, Tang et al. (2004) and later Abdallah and Galal-Edeen (2006) and Greefhorst et al. (2006), and developed into research discussing EA as a concept in itself. The EAF was characterised as the mechanism that led to the realisation of EA (Kozina, 2006; McCarthy, 2006), and selecting an appropriate EAF for this task in the organisation is a complex question to answer (Namkyu et al., 2009; Cameron & McMillan, 2013). That said, throughout the EAF comparison literature the consensus was that there is no universal adoption of a definition of EA, although there are underlying characteristics that enable the possibility of creating classification schemes (for example, (Namkyu et al., 2009)) and ontologies (for example, (Ohren, 2005)) that suggest unifying elements implicit in the EA concept. One such unifying aspect is the regularity in reference to the IEEE 1471-2000's definition of architecture (Winter et al., 2010).

The discussion on commonality of terms and definitions is not limited to literature review and framework comparison research. A number of opinions on the matter have been proposed and published. Johnson et al. (2004) described EA as a tool to manage the evolution of enterprise-wide IS, a task which is one of the main responsibilities of the chief information officer. Lillehagen and Karlsen (2005) widened the scope of EA by emphasising it as a decision-making mechanism for business managers in general, since EA provided a better understanding of the assets that the enterprise owns, operates and produces. This improvement in understanding was made possible by the creation of an EA model that, according to Winter and Fischer (2006), is a representation of an *as-is* or *to-be* architecture of an actual corporation or government agency.

2.3 A REVIEW OF THE REPORTED EFFORTS TO DEFINE ENTERPRISE ARCHITECTURE

The literature contains a number of published accounts on attempts and proposals to address the issue of the lack of a universal EA definition and terminology. The reviewed publications represent the efforts of the academic researcher as well as those of the EA practitioner.

2.3.1 Academic Approaches

Dankova (2009) described the purpose of EA as a task that is responsible for ensuring the successful execution of all processes in the enterprise, so that its efficiency is increased. As a result, a key principle in EA design is the synchronisation of IT with the mission, vision and goals of the organisation. Dankova (2009) furthermore proposed a classification scheme that consists of four groupings for EA definitions (Table 2.1):

Table 2.1: EA definition classification scheme (Dankova (2009)

Group	View
1	EA represents a summarised conceptual plan, describing the structure of an organisation, with its separate components and interrelations between them. The main goal of EA is considered finding the most efficient way in which the enterprise can reach its goals.
2	EA is treated as a set of principles, rules, and models upon which the development and implementation of organization structure, business processes, information systems, applications, and technical structure in an organization, are based.
3	The emphasis is on a system approach to organization, according to which EA deals with understanding and explanation of the different components of the enterprise, the interrelation between them, and the principles of their design and development.
4	EA as an approach to the achievement of business goals through the best possible application of IT. EA is considered a framework used to synchronize business goals and processes with IT by documenting existing information systems, their interrelations, and the way in which they interact to fulfil the enterprise mission.

Buckl et al. (2010) emphasise the importance of the creation of an EA model as a design activity that can only be successful if the stakeholders agree on concepts. This agreement arranges stakeholders into a linguistic community (a group of people who agree on shared conceptualisations). In order to promote the development of an EA-specific linguistic community, Buckl et al. (2010) proposed a set of key EA terms with definitions (Table 2.2):

Table 2.2: Key EA terms (Buckl et al. (2010)

Key term	Definition
EA vision	A distant target representing an ideal state, i.e. an implicit model and understanding of a target state of an EA.
EA principle	The constraints and guides of the design of the EA and may in turn provide justification for decision-making throughout an EA.
EA strategy	Outlines a series of means (activities) to pursue a desired end, i.e. a dedicated target state of an EA.
Conformance to EA vision	Describes an intuitive understanding for the degree to which the current or a planned state of the EA matches the EA vision.

Lapalme (2012) located common agreement in the minds of the EA practitioner and created a schools of EA thought classification scheme (Table 2.3):

Table 2.3: Schools of EA thought (Lapalme, 2012)

School	Description
Enterprise IT Architecting	For this school, enterprise architecture is about aligning an enterprise's IT assets (through strategy, design, and management) to effectively execute the business strategy and various operations, using the proper IT capabilities.
Enterprise Integrating	For this school, enterprise architecture is about designing all facets of the enterprise. The goal is to execute the enterprise's strategy by maximising the overall coherency between all of its facets—including IT.
Enterprise Ecological Adaptation	For this school, enterprise architecture is about fostering organisational learning by designing all facets of the enterprise—including its relationship to its environment—to enable innovation and system-in-environment adaptation.

Kotzé et al. (2012) proposed the application of the pattern approach to facilitate the development of EA pattern languages. The Pattern Framework for Enterprise Architecture (PF4EA) aims to facilitate the application of patterns to the creation of EA artefacts and is structured according to five construct layers (Table 2.4) and eleven components (Table 2.5).

Table 2.4: PF4EA construct layers (Kotzé et al. (2012)

Construct Layer	Description
Theoretical context	The theoretical context and best practices of both patterns and pattern languages and enterprise architecture, providing the theoretical foundation for PF4EA.
Context-specific rules and properties	Determining and specifying the specific best practices, rules and properties related to patterns and pattern languages, which will be used in the patterns and pattern language to be developed, the specific enterprise architecture aspects for which the patterns and pattern language are to be developed, and the specific enterprise architecture framework(s) that will be supported by the patterns and pattern language to be developed in PF4EA.
Context-specific pattern relationships	Specifying the context-specific pattern relationships that will apply to the pattern language under development, including the generic pattern relationships, the EA-specific pattern relationships and the related EA framework-specific pattern relationships.
Pattern search/ creation	Searching/creating individual patterns to support the aspects identified in the pattern context specific rules and properties, making use of the EA processes and methodologies and EA framework rules and properties.
Pattern language creation	Applying the context-specific pattern relationships to the set of standalone patterns created to develop a pattern language based on coherent principles. The output is the

	target pattern language for the specific enterprise architecture aspect under consideration.

Table 2.5: PF4EA components (Kotzé et al. (2012)

Component	Description
Component 1: Patterns, pattern languages and best practices	This component represents the theoretical foundation and best practices related to patterns and pattern languages in general. It represents the generic pattern concepts to be considered for the composition of patterns for EA, and the pattern languages for EA.
Component 2: EA processes, methodologies, frameworks and best practices	This component represents the theoretical foundation and the best practices related to EA, covering the generic concepts of EA processes, methodologies, frameworks and related best practices. It represents the generic EA concepts to be considered for the composition of patterns for EA and the pattern languages for EA. Both general EA concepts and EA framework detail are incorporated in this component, since the EA framework in use often 'prescribes' the process or methods to be followed in developing and EA or maintaining it.
Component 3: Pattern and pattern language rules and properties	This component provides the framework with selected context-specific pattern rules and properties to govern the creation of patterns and their relationships in the pattern language to be developed. These rules and properties provide PF4EA with functionality to formalise the creation of patterns in a consistent manner through enforcement of specific rules, characteristic and properties of patterns and pattern relationships.
Component 4: EA processes and methodologies.	This entails the detailed specification of the specific aspect of EA to be covered by the resulting pattern language. It specifies the conceptual foundation, and specific methodologies, related to the selected EA aspect to be considered.
Component 5: EA framework rules and properties.	This component provides for all the rules and properties of the relevant EA framework(s) that will be supported by the resulting pattern language. EA frameworks provide the ground rules on the validity of connecting any two patterns in a pattern language.
Component 6: Generic pattern relationships	This component provides the valid generic pattern relationships by which one pattern can be associated with another in the resulting pattern language and what the nature of such a connection is. These pattern relationships are the essential aspects of producing pattern language constructs.
Component 7: EA-specific pattern relationships.	This component defines EA, or domain specific, pattern relationships. It specifies how a particular EA pattern may be linked to another through valid context-specific pattern relationships.
Component 8: EA framework relationships	This component defines specific relationship semantics to support the selected EA framework(s). It thus provides for framework-specific context relationships in the resulting pattern language.
Component 9: Patterns for EA processes and methodologies	This component involves the creation of, or searching for, relevant individual patterns to support the EA concept under consideration.
Component 10: Pattern language constructs	This component involves identifying the relationships that exists between the individual patterns (identified in Component 9), using the generic pattern relationships (Component 6), the EA-specific pattern relationships (Component 7), and the EA framework relationships (Component 8). This creates the individual pattern language pieces that, when combined, form the pattern language for EA.
Component 11: Pattern language for EA processes and methodologies	This component integrates all of the patterns, and the relationships that exist between them, into a pattern language, and identifies any orphan patterns and gaps that may require the development of additional patterns or pattern relationships. It also includes a description of the overall context of the pattern language, and provides a problem/solution summary and glossary.

Korhonen and Poutanen (2013) describe EA as a relatively young discipline that is lacking a shared vocabulary and a consensus on definition. The definitions of EA range from a focus on IT-based configuration management to big-picture enterprise design and management. In order to deal with this situation, Korhonen and Poutanen (2013) propose a conceptual framework that consists of three distinct yet interlinked architectures – namely a *technical (AT), socio-technical (AS),* and *ecosystemic architecture (AE)*. Each of these types of architecture is based on different ontological and epistemological assumptions, has its own vertical scope, and requires its own distinct methods and tools.

The efforts illustrated above serve to indicate the variation in approaches to establish agreement in EA definition and terms. These attempts include a classification of existing EA definitions (Dankova, 2009), the development of linguistic communities (Buckl et al., 2010), description of schools of thought (Lapalme, 2012), application of a pattern approach (Kotzé et al., 2012), and the development of a conceptual framework (Korhonen & Poutanen, 2013).

2.3.2 Practitioner Approaches

The EA practitioner is responsible for the implementation of the ideas and concepts of EA in the enterprise. During the execution of the EA implementation task, the practitioner is required to make decisions in the absence of established terms and definitions. The following sections summarise three efforts that are each an example of the intention of practitioners to understand what EA is.

2.3.2.1 Gartner Research's EA Definition

Gartner Research (Gartner Inc, 2012) is a resource of Gartner Incorporated, and specialises in technology-related insight to aid their client's decision-making processes. The acquisition of the Meta Group was a significant contributor to the development of the Gartner Enterprise Architecture Framework (James et al., 2005). The clarification effort of the definition of EA was based on the existence of as many 'definitions for enterprise architecture as there are enterprise architects*'* (Lapkin, 2009:2). This effort resulted in three significant publications that relate to an EA definition:

- Gartner defines the term 'Enterprise Architecture' (Lapkin, 2006): The process of defining EA resulted in a short, as well as comprehensive, definition. Gartner structured their effort on four EA dimensions, namely: What EA is, scope, result and benefit. The definition team also studied the IEEE 1471-2000 standard, as well as the definition from TOGAF[2]. The short version of the Gartner EA definition is said to encompass most of the important EA concepts, and reads as follows:

  > *Enterprise architecture is the process of translating business vision and strategy into effective enterprise change by creating, communicating and*

[2] The specific version of TOGAF is not mentioned in the report. The published version in 2006 was TOGAF 8.1.1.

improving the key principles and models that describe the enterprise's future state and enable its evolution (Lapkin, 2006:3).

- Gartner Clarifies the Definition of the Term 'Enterprise Architecture' (Lapkin et al., 2008): This report spelled out important concepts of the Gartner definition in more detail. The explanations emphasised the importance of –
    - Thinking of enterprise architecture as a process rather than as a set of artefacts.
    - Understanding the role of the enterprise architect as a facilitator in a team context, with the strategic decision-making power residing with those in the enterprise that carry this responsibility.
    - The actionable nature of enterprise architecture as aiming at solving problems and not creating useless artefacts.
    - The outputs of the enterprise architecture process as including planning, management, executing disciplines, and governance.
    - Understanding that the most important deliverable of enterprise architecture is change.

  The report closed with the concession that different enterprises might define EA in different ways, since its business value is rooted in the culture, strategic maturity and strategy of the enterprise.

- Myth Busting: What Enterprise Architecture Is Not (Lapkin & Burton, 2008): Gartner lists 12 aspects that intersect with EA, but which in itself is not EA. These findings are summarised in Table 2.6:

Table 2.6: Gartner's list of aspects that intersect with EA (Lapkin & Burton, 2008)

Enterprise area of concern	Enterprise architecture intersection point (excerpt from report)
Business strategy	The architecture team needs to work with business and senior executives to help them articulate the strategy in an actionable way. Business and senior executives should take the lead, but EA must support and help these efforts. The ultimate decision rights on the business strategy and business plans are with business leaders and senior executives, not the EA team.
IT strategic planning	EA teams should serve as an advisor in IT strategic planning, along with the chief technology officer, senior IT staff, and business leaders and users. The IT strategic planning team leverages critical architecture artefacts, including the common requirements vision, the future-state view of the enterprise, and the gap analysis and road map that define the migration from the current state to the desired future state.
IT governance	The IT governance strategy is developed from the articulation of the business strategy in the common requirements vision, ensuring alignment with strategic goals. The road map and the principles, standards and guidelines provide the decision criteria that IT governance uses to make investment decisions.
Program management	EA is responsible for defining the future state of the enterprise, analysing the gaps between the current state and the future state, and developing the standards and guidelines that support the realisation of the future state. Part of the discipline of program management is to make sure that the projects are executed in a way that adheres to the standards, guidelines and principles that are created as part of the EA effort.

Portfolio management	Portfolio management takes its strategic guidelines from the common vision of the business strategy articulated during the EA process, and it uses the road map, principles standards and guidelines as part of the criteria for portfolio decisions, while balancing between strategic and tactical needs.
Process management	EA provides the analysis of the strategy and identifies the most critical strategic imperatives. EA also provides the high-level process topology and the principles that guide the design and implementation of processes.
Performance management	EA teams must participate in performance management efforts relating to critical business processes and functions. This will allow them to track key business metrics that demonstrate the business value that EA is delivering. In addition, any efforts to define key performance management metrics should leverage the artefacts of EA - specifically, any change metrics or any direct metrics associated with EA principles. Last, EA should leverage the discipline of performance metrics to define metrics with respect to the business value and impact of EA efforts and investments.
Implementation	EA provides the foundational principles, guidelines, standards and constraints that enable implementation teams to make better decisions.
Technology or application inventory	EA is a much broader process that is directly reflecting the business vision and strategy, and it represents people, processes, organisation, information and technology (including applications) that are critical to the business strategy. EA provides actionable, prescriptive guidance for project-level decision-making, consistent with executing a transition plan toward a described future-state architecture that aligns with the business strategy.
Change management	EA provides the strategic context for the change through the common requirements vision or some similar vehicle, and it provides the view of the future state from a process, organisation, information and technology perspective. This gives everyone a coherent view of the strategic drivers for the change, as well as a clear picture of the target state.
Standards-setting exercise	Standards are the result of a complete, business-driven EA effort, and they are guidelines for reaching the future state. Any defined standards should evolve with the business strategy and thus the enterprise architecture. Organisations should incorporate the process of re-evaluating and updating standards into the EA process.
Enforcement	EA and architects must be viewed as helping, supporting, advising and guiding the organisation to achieve its business strategy through a future-state vision.

In summary, Gartner's enterprise definition and clarification efforts are the result of the importance of EA to their clients. The importance of EA is consistently described in the Gartner Hype Cycle reports (Burton & Allega, 2010; 2011; 2012; 2013), where the renewed business interest in EA is described as a move away from IT and closer to business.

2.3.2.2 The Open Group EA Definition Initiative

The Open Group is known for The Open Group Architecture Framework (TOGAF), and is a global consortium that consists of more than 350 member organisations (The Open Group, 2011a). TOGAF is based on the Technical Architecture Framework for Information Management (TAFIM) (Josey, 2009) and is in its ninth[3] version. The development of TOGAF is a community-driven effort with more than 200 participants (Josey, 2009) on its architecture forum.

The official documentation for TOGAF (The Open Group, 2009b) lists two definitions for architecture, that implies an association with the enterprise. During the Glasgow Enterprise Architecture Conference

[3] TOGAF 9 was released in 2009 with an update release (TOGAF Version 9.1) in 2011. Regardless of the 9.1 update TOGAF is still referred to as TOGAF 9.

(The Open Group, 2008a), it was reported that Fehskens was leading an activity to define EA as a term. The EA definition initiative aimed at creating a *state of the art* definition for the TOGAF Version 9 release (Fehskens, 2008). The result of the initiative was reported at the Open Group's 2010 conference, hosted in the city of Boston in the United States of America (The Open Group, 2010). Progress on the project was conveyed during various Open Group Conferences (The Open Group, 2008b; 2009a). Amongst the 18 definitions proposed by the participants of the architecture forum, five were selected for the final phase of the definition process (Fehskens, 2009) (Table 2.7):

Table 2.7: The Open Group Architecture Forum top 5 definitions

Definition author	Definition
Terry Blevins (Forum Member)	The fundamental organisation of an enterprise embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution. An enterprise architecture should provide perspectives of mission, resources (people, information, service, applications, and technology) and how it allocates and applies resources to accomplish the mission of the enterprise.
Easwaran Nadhan (Forum Member)	Enterprise architecture is a discipline, methodology and practice for translating business vision and strategy into the fundamental structures and dynamics of an enterprise at various levels of abstraction. The models, principles, guidelines and policies focus the creativity of the organisation on areas that need innovation, and away from areas that have already been resolved.
William Sheleg (Forum Member)	Enterprise architecture is a management discipline concerned with describing the components of an enterprise and the inter-relationships between those components necessary to achieve the enterprise's purpose. In short, EA is Master Planning for the Enterprise. EA can refer to both the discipline and the work product of the discipline.
Len Fehskens (Forum Member and project initiator)	Enterprise architecture is the architecture of an enterprise – i.e. those properties of an enterprise, its mission, and their environment, that are essential for the enterprise to be fit for purpose for its mission in that environment, so as to ensure continuous alignment of the enterprise's assets and capabilities with its mission and strategy
Paul Van der Merwe (Forum Member on behalf of the EA Research Forum)	Enterprise architecture is the continuous practice of describing the essential elements of a sociotechnical organisation, their relationships to each other and to the environment, in order to understand complexity and manage change.

Fehskens (The Open Group, 2010) reported that an integrated definition was selected as the top definition, but it is not clear from the literature what this definition is. The definition initiative process was concluded after the release of TOGAF Version 9, but the integrated definition was not included in its documentation. Whatever the final integrated definition is, the process has shown that the question of defining EA is of interest to multiple participants, and as a result, difficult to establish and finalise.

2.3.2.3 The Enterprise Architecture Network's Definition Challenge

A member of the Enterprise Architecture Network group hosted on LinkedIn (LinkedIn Corporation, 2014), posted a challenge to its members to describe the purpose of EA in one 160-character message (Smith, 2010a). The aim of this challenge was to explore an explanation of enterprise architecture concise enough to communicate effectively. The results of this effort indicated participation by 308 members of the group, with postings ranging from 1 to 85 comments per participant (Smith, 2010c).

The submissions were synthesised into a definition that describes the purpose of EA as existing to –

> *Enable an enterprise to realize its vision through the execution of its mission, whilst enabling it to respond to change and increasing its effectiveness, profitability, customer satisfaction, competitive edge, growth, stability, value, durability, efficiency and quality while reducing costs and risks by strategic planning, architecture and governance supported by a decision support framework in the context of aligning all parts of the enterprise using models, guidance, processes and tools* (Smith, 2010b:44).

2.4 OVERVIEW OF ENTERPRISE ARCHITECTURE FRAMEWORKS

The discussion on an EA definition would be incomplete if the most prominent EAFs were not considered and summarised. The process to decide which of the EAFs are prominent in the practitioner and research literature is discussed in this section. Due to scoping limitations, it was important to keep the list as short as possible, with the result that three EAFs, namely the Zachman Framework for Enterprise Architecture (Zachman Framework), The Department of Defense[4] Architecture Framework (DoDAF) and the Open Group Architecture Framework (TOGAF), were selected for analysis. The task of capturing the essence of each EAF is focused on a broad description of the characterising features of each framework, the description of important definitions, and their relationship to one another. The EAF summaries do not aim at being a complete representation of each framework; for such a reference, the reader is encouraged to examine each framework's key documentation.

2.4.1 Enterprise Architecture Framework Selection

Given that a multitude of EAFs have been created, and that the literature (Liimatainen et al., 2007) indicates the continual development of new frameworks, it is possible that maps listing EAFs and their dependencies might grow faster than it has to date. Figure 2.1 shows an EAF map developed by Ernst and Matthes (2009), and shows the list of EAFs and their evolution over time up to 2009. The volume of different EAFs is testimony to the flexible application of the concept of EA in different contexts. The analysis problem faced by researchers, faced with a lack of time and limited access to research sources, is that a complete analysis of every possible framework would be untenable. A selection, based on popularity, should thus be made. Such a selection, in order to satisfy the demands for scientific rigour and to ensure the quality of conclusions based on the research, cannot be of an arbitrary nature. The following sections discuss the motivation and reasoning for the selection of EAFs, based on popularity, to be summarised and submitted for deeper analysis.

[4] Note that the American spelling for 'defence' is adopted, due to the ownership of the framework by the United States of America's Department of Defence. This approach is taken to ensure technical correctness in the usage of the DoDAF framework name.

2.4.1.1 Selection Criteria

The framework map in Figure 2.1 shows EAF activity as recent as 2009 and as early as 1984. This time span essentially represents the historical timeline of the field of EA, and allows critical analysis on the grounds of a known and documented evolution of its development. Various other EAF maps are available for study, such as Schekkerman (2006) and ISO/IEC/IEEE 42010 Users Group (2013), but proved to be either outdated (Schekkerman, 2006) or too complex (ISO/IEC/IEEE 42010 Users Group, 2013). The first selection criteria focus attention on the contents of the EAF map, in the sense that a *selected EAF must have a clearly distinguishable and traceable history*, to be considered as potentially popular.

The openness and availability of research results is a key aspect that enables the research endeavour to solve the problems of a field of study. Accessibility to an EAF is an important part of the popularity analysis, since an obscure EAF will not represent popular opinion. More importantly, the selected EAF should be open for examination by the academic community, without undue financial investments. Finally, the EAF should ideally already be under examination to show academic interest. Additionally, academic interest provides a body of knowledge to enable other researchers to build upon what is already known. These factors are captured in a set of criteria such as *a selected EAF must be widely referenced in the research literature* and *a selected EAF must be open for evaluation by the academic community*.

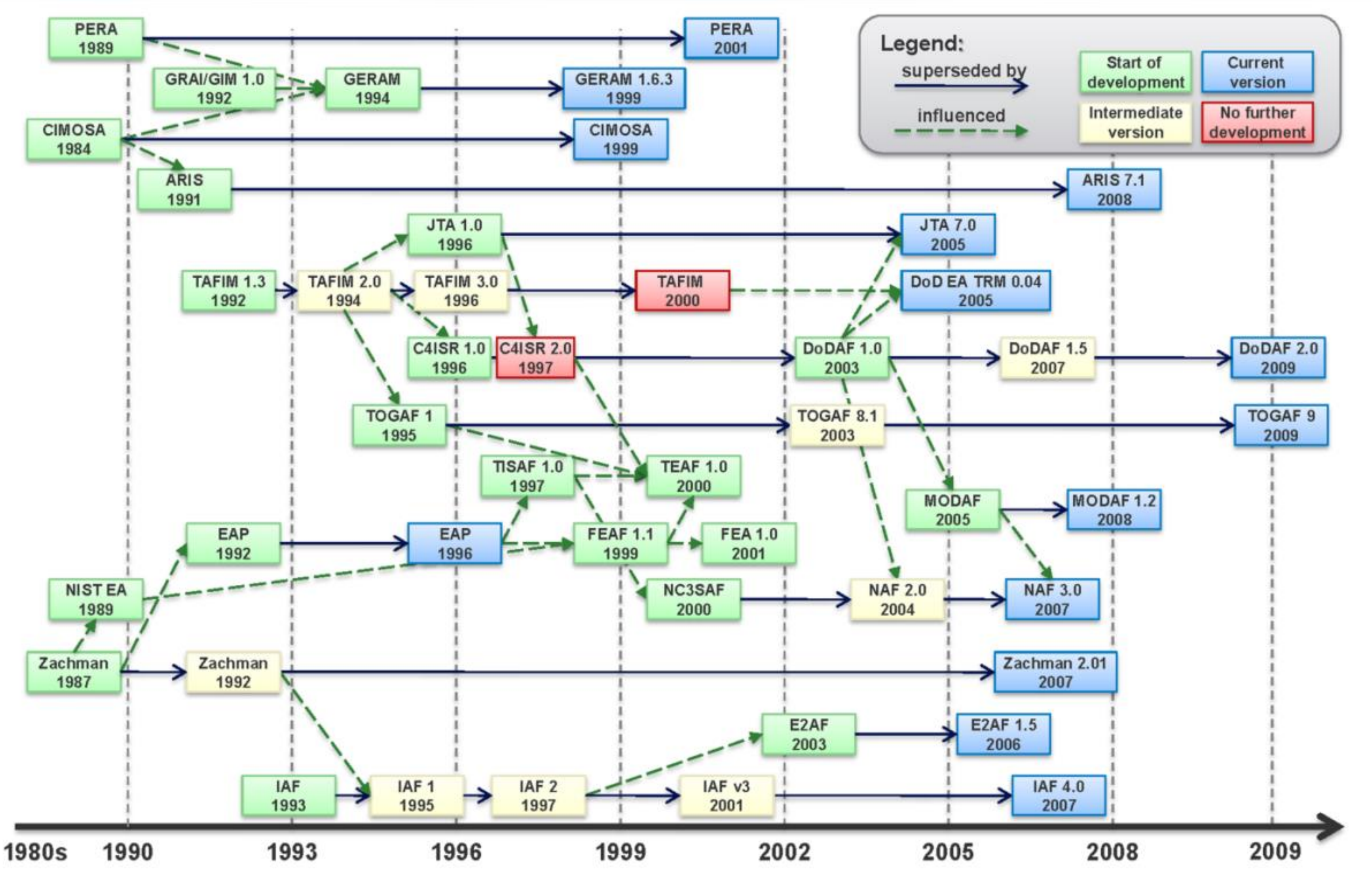


Figure 2.1: EAF Evolution and Relationships Map

Finally, to provide validity in the results of academic research, and promote the possibility of making generalised conclusions, it is important that the selected EAF be active in terms of its own development, and in its implementation by practitioners. The aspect of an evolving EAF is captured in the final set of criteria – namely that a selected *EAF must be actively under development* and *used for actual EA work*."

The final set of selection criteria prescribes that a selected EAF must –

- Be referenced in the academic literature.
- Have a traceable history.
- Be up to date and actively under development.
- Have accessible descriptions – i.e. not commercially closed to academic examination.
- Be in use for actual architecture work in industry, and not only for academic research.

These criteria serve as the selection guide to determine the popularity of EAFs used by the EA research community.

2.4.1.2 Applying the Selection Criteria

In keeping with the criteria of openness and accessibility, two types of sources will be consulted in determining a short list of EAFs. These are academic research reports based on surveys, and comparison articles published in journals and academic conference proceedings.

2.4.1.2.1 EA Surveys

Three surveys reported on in the research literature were selected as a starting point for the framework shortlist. These are projects managed by the Institute for Enterprise Architecture Developments (IFEAD[5]), the Finnish Ministry of Finance (FEAR Project[6]) and an Enterprise Architecture survey from students of the Copenhagen Business School[7]. These are summarised as follows:

- IFEAD survey, Trends in Enterprise Architecture 2005 (Schekkerman, 2005):

  The purpose of the research was to measure the progress of EA usage and implementations in several organisations across the world. The survey was executed as an online web-based mechanism, with the participants taking part on a voluntary basis. In total, 25 questions covered, among others, aspects such as geography, EA implementations and methodologies. The survey results are of interest, due the direct questioning relating to the usage of EAFs – namely, *what kind of Enterprise Architecture Framework does your organisation use?* The answer to which has direct bearing on setting a shortlist of frameworks. Out of 79 respondents, the frameworks listed were *Zachman Framework (25%), Organisation's own (22%), DoDAF (11%), TOGAF (11%) and E2AF (9%).*

---

[5] Accessible at http://www.enterprise-architecture.info/index.htm

[6] Accessible at https://www.jyu.fi/it/laitokset/titu/projektit/kaynnissa/fear/in_english

[7] Accessible at http://www.easurvey.org/

- FEAR project (Liimatainen et al., 2007):

  The FEAR project, as sponsored by the Finnish Ministry of Finance, has as its goal the support of the development of the Finnish state IT function, particularly in terms of the enterprise architecture work of public administration. The project made use of a five-viewpoint evaluation framework to compare enterprise work in 15 different countries. The third viewpoint of *architecture frameworks and methodologies* is of interest to this research project. The results indicated that not all governments explicitly stated the frameworks used in their respective enterprise architecture work. From what could be discerned, it was learned that the *Zachman Framework* was used by the Danish government, and in a simplified form by the Netherlands. Germany made use of the *RM-ODP standard*, while Switzerland made use of *TOGAF*. Finally, the USA listed various frameworks such as *TOGAF*, *FEAF and FEA*.

- Copenhagen Business School survey (Paszkowski & Mortensen, 2008):

  This survey was managed by students, in support of their master's degree studies in business. The purpose of the *survey* was to gather information from government participants, in order to establish a maturity rating for enterprise architecture work in government. The results from the 13 governments that participated in the survey showed that the *Zachman Framework*, as well as *EAF, E2AF, EAG and Capgemini's IAF,* were used as a formal basis for localised framework formulations.

In summary, the EAFs identified by the various participants in the above research led to the first shortlist of frameworks, as follows:

- The Zachman Framework for Enterprise Architecture (Zachman Framework).
- The Department of Defense Architecture Framework (DoDAF).
- The Open Group Architecture Framework (TOGAF).
- The Extended Enterprise Architecture Framework (E2AF).
- The Federal Enterprise Architecture (FEA).
- The Federal Enterprise Architecture Framework (FEAF).
- The Reference Model for Open Distributed Processing (RM-ODP).
- Capgemini's Integrated Architecture Framework (AF).

To conclude, research companies such as Gartner and Forrester research, make it their business to be informed about the frameworks most used by industry for EA work. However, since their results are available as a paid service to clients, the criteria of availability to the academic community were not met, and these results were thus excluded.

2.4.1.2.2 EAF Comparison Articles

The purposes of comparison articles are to facilitate an understanding of EA in the context of the newness of the research field, and the promotion of EA interoperability. As a result, a number of EAF comparison papers have been published over a period ranging from 2004 to 2013. For the purposes of shortlisting EAF, 19 published research articles were found (see Appendix A). The approach followed to refine the EAF selection shortlist was to identify the most referenced frameworks in these published papers, in combination with the EAF map (Figure 2.1). Table 2.8 shows the results of the analysis, as well as the expanded EAF shortlist. The combined score for each framework is an indication of the amount of times it was referenced, relative to the selected research articles. For example, the Zachman Framework was selected 15 times for examination in the list of 19 papers:

Table 2.8: Shortlist of EAFs

Framework	Based on	Combined score
Zachman Framework	None	15
TOGAF	TAFIM	16
DoDAF	C4ISR	10
FEAF	EAP, NIST EA	9
Kruchten 4+1	Not on map	4
E2AF	CapGemini IAF	3
RM-ODP	Not on map	3
TEAF	TISAF	4
MDA	Not on map	2
GERAM	CIMOSA, PERA, GRAI/GIM	2
GARTNER	Not on map	1
ArchiMate	Not on map	1

2.4.1.2.3 Selected Frameworks

The final step in the process was to measure each framework on the shortlist against the selection criteria, in order to present for examination a final list of EAFs. The final list (Appendix A) of EAFs, based on popularity, is *Zachman Framework, TOGAF and DoDAF*.

2.4.2 The Zachman Framework for Enterprise Architecture

Zachman published a framework for Information Systems Architecture (ISA) in 1987 (Zachman, 2009b), with the aim of creating a way to manage the complexity inherent in creating IS (Zachman, 1987). The basis of Zachman's ISA framework was the view that the creation of a complex manufactured system involved various role players, each needing their own kind of representation of the system to be constructed. The framework consisted of columns specifying three types of descriptions, namely *data*, *process* and *network,* as well as rows that described five levels of abstractions that showed the movement of a system's description from an abstract scope to an implemented system. The matrix-style arrangement intended to provide a taxonomy of architectural representations to describe the information system. The ISA was extended in 1992 by Sowa and Zachman (1992) to include three additional columns, namely *people, time* and *motivation* of descriptions. The extended framework also described a set of seven rules to govern the population of the cells in the matrix. After Zachman formed a consulting and training company, the ISA was formally named Enterprise Architecture – A Framework, in 1993, although by then it was informally called the Zachman Framework (Zachman, 2009b). A significant change in the evolution of the Zachman Framework was the change from a three-column ISA to a six-column ISA during the early years of its existence. The developments after this period were marked by a series of refinements to the Zachman Framework graphic, with the third version being published in 2011 (Ross, 2011). The most significant changes in the latest version (version 3, published in 2011) are the inclusion of the designation *the Enterprise Ontology* as part of the Zachman Framework title (Figure 2.2), the inclusion of lines between the cells of the graphic serving to show relationships between architectural primitives and their combination into composites, and the refinement of terms in the graphic.

The unique purpose of the Zachman Framework is to provide a means to create and arrange a comprehensive set of architectural primitives that describe the enterprise in as complete a way as possible (Zachman, 2008). As such, it is a schema, because it contains the answers to the six interrogatives (what, how, where, who, when and why) arranged on a reification continuum of six audience perspectives (executive, business management, architect, engineer, technician and enterprise). Each of the cells (intersection between interrogative and reification level) in this schema then comprises an *architectural primitive model* that, when combined with other primitives, creates an *architectural composite model* that enables the complete description of a complex engineering artefact. Both these terms seem to be the most difficult aspect of the Zachman Framework to understand. An architectural primitive is defined as –

> *A model that is located in a single framework cell, in other words from a single abstraction level (row) and from a single perspective (column).*

Another way to think of the architectural primitive is that the components in a cell are all of the same ‘kind’, where ‘kind’ is described in terms of reification level (row) and perspective (column) (Zachman, 2002). An architectural composite is defined as a model that is composed of models from more than one architectural primitive (Zachman, 2002).

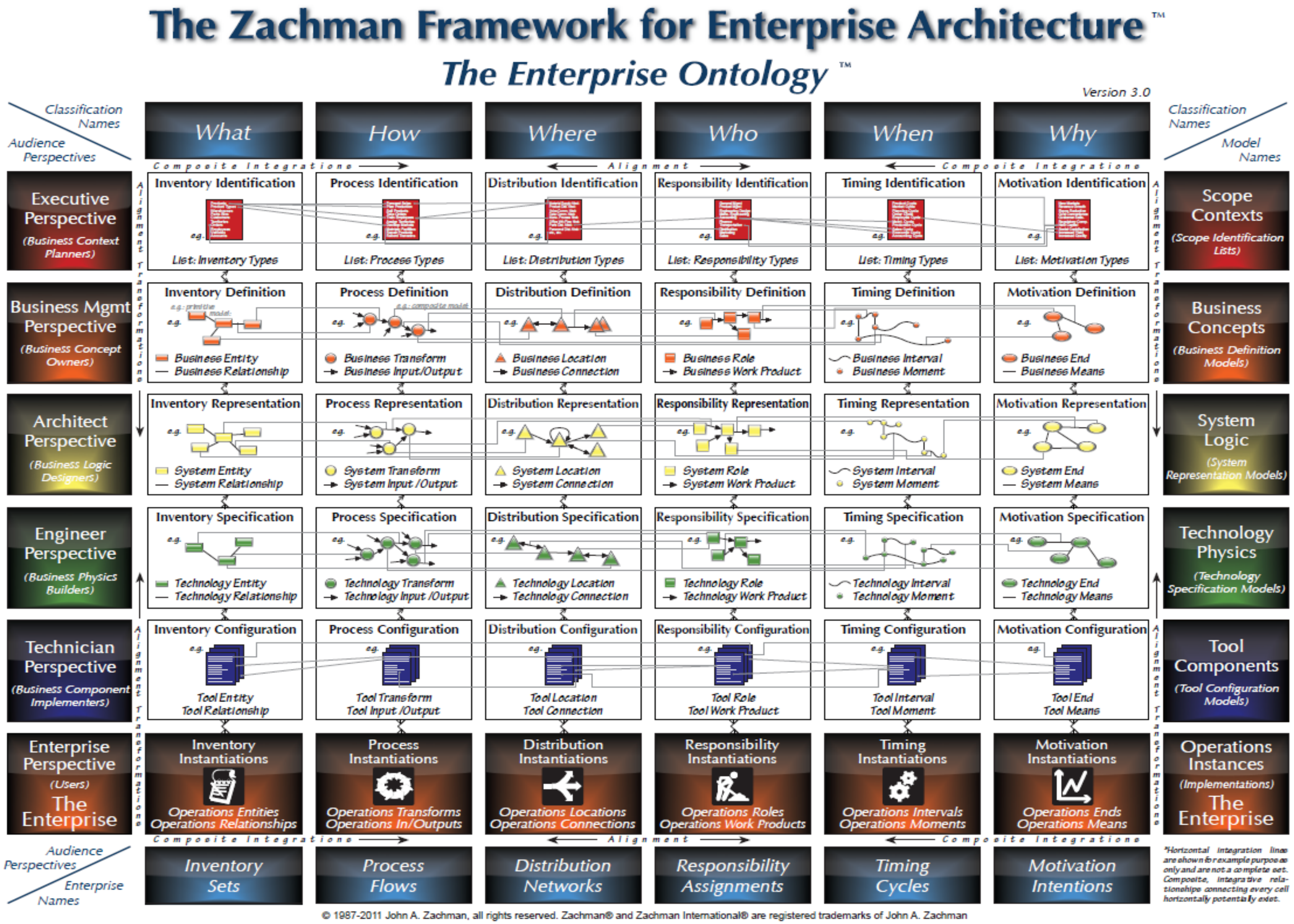


Figure 2.2: The Zachman Framework Graphic

The Zachman Framework does not include a definition of EA as such, the reason being that the Zachman Framework, once populated, is the definition of an enterprise – or stated differently, it is the ontology of the enterprise (Zachman, 2008). Zachman (1997a) describes the Zachman Framework as 'a comprehensive, logical structure for descriptive representations of any complex object'; this is summarised in Table 2.9:

Table 2.9: Characterisation of Zachman Framework for Enterprise Architecture

Description	Explanation
Simple	Zachman Framework is easy to understand; it is not technical, but purely logical.
Comprehensive	Zachman Framework addresses the enterprise in its entirety. Any enterprise-related issue can be mapped against it, to understand where it fits within the context of the enterprise as a whole.
A language	Zachman Framework aids in the thinking about complex concepts, and communicates them precisely, with few, non-technical words.
A planning tool	Zachman Framework facilitates improved decisions, as the decision-maker never makes choices in a vacuum. The decision-makers can position issues in the context of the enterprise, and see a total range of alternatives.
A problem-solving tool	Zachman Framework enables the practitioner to work with abstractions, to simplify, and to isolate simple variables, without losing sense of the complexity of the enterprise as a whole.
Neutral	Zachman Framework is defined totally independently of tools or methodologies, and therefore any tool or any methodology can be mapped against it to understand their implicit trade-offs.

Zachman (1997b) defines architecture in the context of the enterprise as –

> *That set of descriptive representations (models) that are relevant for describing an enterprise such that it can be produced to management's requirements (quality) and maintained over the period of its useful life (change).*

EA is defined as the set of primitive, descriptive artefacts that constitute the knowledge infrastructure of the enterprise (Zachman, 2000). The use of the Zachman Framework is governed by a set of rules (see Table 2.10) (Zachman, 2002):

Table 2.10: Rules Governing the Use of Zachman Framework for Enterprise Architecture

Rule	Description
1	Do not add rows or columns to the framework.
2	Each column has a simple generic model.
3	Each cell model specialises its column's generic model.
4	The level of detail is a function of a cell, not a column.
5	No meta-concept can be classified into more than one cell.
6	Do not create diagonal relationships between cells.
7	Do not change the names of the rows or columns.
8	The logic is generic and recursive.

The popularity of the Zachman Framework is undisputed, and many EA tools, as well as EAFs, either base their own EAF on the Zachman Framework, or make use of the Zachman Framework as a structure to organise the artefacts of the EA practice. The combination of the Zachman Framework usage rules, as well as the schema itself, supports the realisation relationship between an EAF and the EA. The elegance of the Zachman Framework is furthermore enhanced by a lack of complex methods and terminology (with perhaps the exception of the idea of an architectural primitive). What counts against it is the lack of a dedicated Zachman Framework methodology that can be used by Zachman Framework practitioners, as well as a Zachman Framework based modelling language that makes the creation of primitives easier. Zachman International manages a two-level certification programme to educate practitioners in the application of the Zachman Framework (Zachman, 2012).

2.4.3 Department of Defense Architecture Framework (DoDAF)

The information in this section is a summary of the DoDAF Version 2.02 volume 1: introduction, overview, and concepts manager's guide (DoD Chief Information Officer, 2009). The CIO of the United States of America’s Department of Defense (DoD) defines and maintains the Department of Defense Architecture Framework Version 2.02 (DoDAF Version 2.02). The description of the DoDAF Version 2.02 consists of three volumes and a DoDAF journal; volume 1 (manager’s guide) introduces DoD architecture concepts, volume 2 (architect’s guide) describes the DoDAF meta-model groups, and volume 3 (developer’s guide) introduces the DoDAF meta-model physical exchange specification. The DoDAF journal, in turn, is intended to serve as a forum to submit future changes as well as relevant how-to information.

The DoDAF is formally defined (DoD Chief Information Officer, 2009) as –

> *The structure for organizing architecture concepts, principles, assumptions, and terminology about operations and solutions into meaningful patterns to satisfy specific DoD purposes.*

DoDAF Version 2.02 (published in 2010) is the result of improvements and changes made by the DoDAF EA community (Department of Defense, 2010). DoDAF Version 2.0 (published in 2009) of the framework is an expansion of v1.5 (published in 2007), aimed at providing additional guidance on how to reflect net centric concepts in architectural descriptions. Version 1.5 of the framework served as a transitional evolution of version 1.0, which was based on the Command, Control, Communications, Computers, and Intelligence, Surveillance and Reconnaissance (C4ISR) Architecture Framework Version 2.02 (published in 2003).

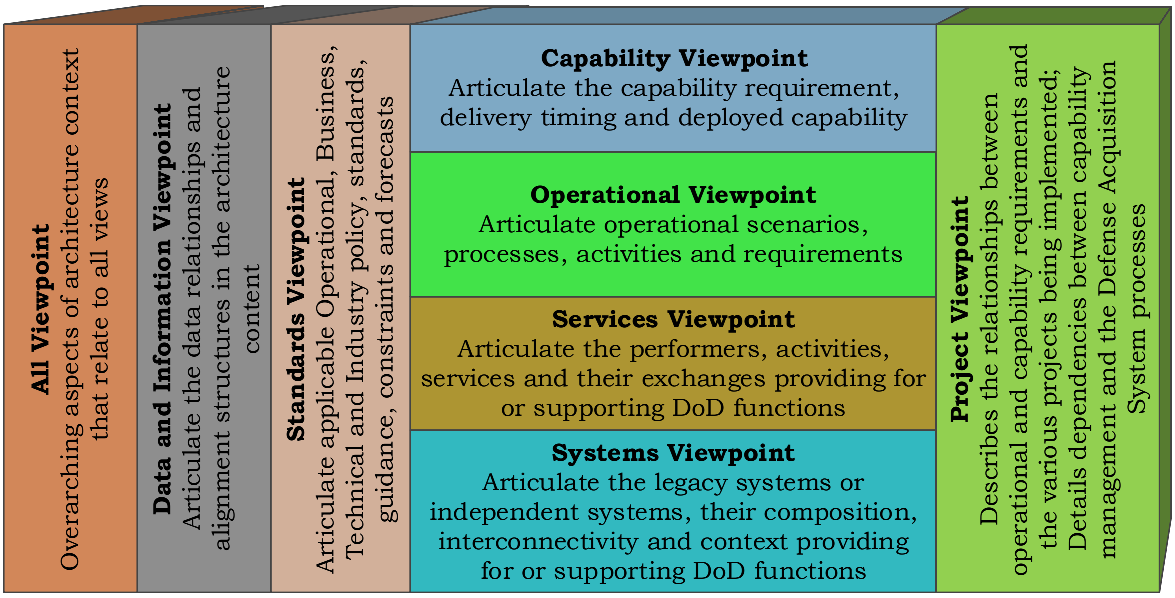


Figure 2.3: DoDAF Viewpoints

DoDAF Version 2.02 emphasises the development and use of architectural data to provide an expanded range of graphical representations that can be used to support analysis and decision-making. As a result of this approach, the DoDAF Version 2.02 is structured around the concepts of data, models and views. Views are customisable, and used to communicate architectural data to stakeholders. Each view is based on a model that is populated with architectural data. The DoDAF Version 2.02 provides an extensive list of example viewpoints (Figure 2.3), as well as DoDAF described models.

In order to facilitate the development of architectural descriptions, DoDAF provides a set of practical guidelines, as follows (Table 2.11):

Table 2.11: DoDAF Guidelines

Guidelines	Description
Architectural Descriptions should clearly support the stated objective(s) ("Fit-for-Purpose").	The framework offers general direction in the development of architectural descriptions, so that they can support critical decisions within key DoD management and change management processes. While DoDAF V2.0 describes a number of models, based on collected data, diligent scoping of a project and any guiding regulations, instructions, or standard procedures will determine the specific visualisation requirements for a particular architectural effort.
Architectural Descriptions should be simple and straightforward, but still achieve their stated purpose.	Architectural descriptions should reflect the level of complexity defined by the purpose for their creation. Scoping of a project, as described in section 7.0 methodologies, will ensure that the resulting architectural data and derived information, and the views created, are consistent with their original purpose.
Architectural descriptions should facilitate, not impede, communications in decision processes and execution.	Creation of architectural descriptions is meant to support decision processes and facilitate improvement of procedures and/or technology in the enterprise. Collection of architectural data and creation of views supports the decision-making process, and provides a record to explain critical choices to technical and non-technical managerial staff.

Architectural descriptions should be relatable, comparable, and capable of facilitating cross-architecture analysis.	Most architectural descriptions, except perhaps those at the highest levels of the DoD or an organisation, relate on their boundaries to other external processes and operations. When several processes and/or operations are evaluated, compared or cross-referenced, it should be clear how, where and why data passes among them in similar form.
Architectural descriptions should articulate how data interoperability is achieved among federated architectural descriptions.	To enable federation, the framework will provide structures to ensure that horizontal touch-points can be compared for consistency across Architectural Description boundaries. Other mechanisms will ensure that higher tiers have access to data from lower tiers in a form that supports their decision needs. DoDAF utilises the DM2, and particularly the PES described in volume 3, as a resource for interoperability. A key element in ensuring interoperability is the effort to plan for integration of data across views, architectural description boundaries, and consistency between tiers.
Architectural descriptions should be data centric and tool-agnostic.	The framework assists in the design of structures that meet specific needs, depending on the priorities of individual organisations. In particular, the framework calls for the development of integrated, searchable, structured architectural data sets that support analysis targeted to critical decisions. To that end, multiple toolsets, with varying internal rules, techniques, notations and methods may be used, consistent with the PES.
Architectural data should be organised, reusable, and decomposed sufficiently for use by architectural development teams and decision support analysis teams.	Collecting and organising architectural data for use in decision processes should not be 'overdone'; that is, the depth and breadth of data collected should be sufficient to capture the major processes' actions, and not be so broad that the original intent of the architecture project becomes clouded. Whenever possible, data common to other architectural descriptions should be used. New data should be created, utilising the structures described in Volumes 2 and 3, so that when stored in the DoD metadata registry (DMR), it becomes discoverable to others with similar requirements.
Development of architectural descriptions should be guided by the principles and practices of net-centricity to facilitate and support the net-centric strategy of the department.	Development of architectural descriptions should ensure that architectural descriptions that are developed adhere to net-centric principles, as outlined in the net-centric strategy, and clearly delineate data that must be shared across and between systems or services described in the architectural description.

In addition to the above, the DoDAF Version 2.02 also includes a generic six-step architecture development process (Figure 2.4). Table 2.12 presents a summary of a description of each step in the DoDAF architecture development process:

Table 2.12: DoDAF architecture development process

Steps	Description
Step 1: Determine intended use of architecture.	Defines the purpose and intended use of the architecture; how the architectural description effort will be conducted; the methods to be used in architecture development; the data categories needed; the potential impact on others; and, the process by which success of the effort will be measured in terms of performance and customer satisfaction. This information is generally provided by the process owner, to support architecture development describing some aspect of their area of responsibility (process, activity, etc.).
Step 2: Determine scope of architecture.	The scope defines the boundaries that establish the depth and breadth of the architectural description and establish the architecture's problem set, helps define its context, and defines the level of detail required for the architectural content.

Step 3: Determine data required to support architecture development.	The required level of detail to be captured for each of the data entities and attributes is determined through the analysis of the process undergoing review, conducted during the scoping in Step 2. This includes the data identified as needed for execution of the process, and other data required to effect change in the current process (e.g. administrative data required by the organisation to document the architectural description effort). These considerations establish the type of data collected in Step 4, which relates to the architectural structure, and the depth of detail required.
Step 4: Collect, organise, correlate and store architectural data.	Architects typically collect and organise data through the use of architecture techniques designed to use views (e.g. activity, process, organisation, and data models as views) for presentation and decision-making purposes. The architectural data should be stored in a recognised commercial or government architecture tool. Terms and definitions recorded are related to elements of the (DM2).
Step 5: Conduct analyses in support of architecture objectives.	Architectural data analysis determines the level of adherence to process owner requirements. This step may also identify additional process steps and data collection requirements needed to complete the architectural description and better facilitate its intended use. Validation applies the guiding principles, goals and objectives to the process requirements, as defined by the process owner, along with the published performance measures (metrics), to determine the achieved level of success in the architectural description effort. Completion of this step prepares the architectural description for approval by the process owner. Changes required from the validation process result in iteration of the architecture process (repeat steps 3 through 5 as necessary).
Step 6: Document results in accordance with decision-maker needs.	The final step in the architecture development process involves creation of architectural views based on queries of the underlying data. Presenting the architectural data to varied audiences requires transforming the architectural data into meaningful presentations for decision-makers. This is facilitated by the data requirements determined in Step 3, and the data collection methods employed during Step 4.

To facilitate the development of architecture views, DoDAF Version 2.02 also describes techniques for developing architecture views. The comprehensive nature of the DoDAF Version 2.02 is apparent in the structuring of the three volumes of its description. As driven by the U.S.'s legislative forces, and given that the U.S. Department of Defense is a considerable organisation in terms of its scope and purpose, it should come as no surprise that a great deal of effort is placed on its EA development and maintenance. The DoDAF set of documents does exemplify the DoD EA, but, as an approach, it can be used to achieve the development of any EA.

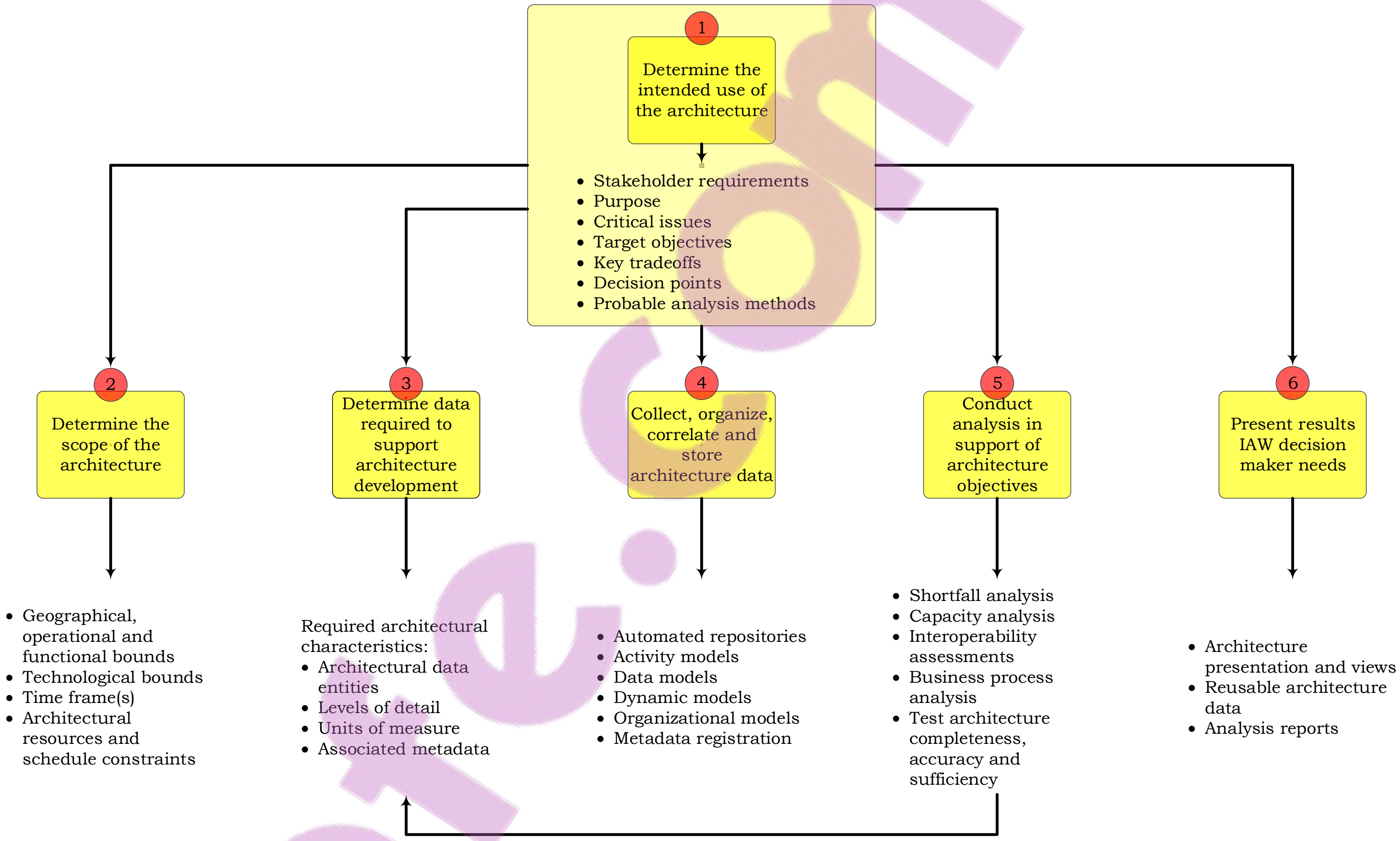


Figure 2.4: DoDAF Architecture Development Process

2.4.4 The Open Group Architecture Framework (TOGAF)

The first official version of The Open Group Architecture Framework was published in 1995 (Keller, 2009), and was based on the U.S Department of Defense's Technical Architecture Framework for Information Management (TAFIM). Since then, it has grown to its latest publication as Version 9.1 (The Open Group, 2011d). The framework is owned by The Open Group as a formal standard developed by Open Group members within the context of the Architecture Forum (Josey, 2009). The main vision of the Open Group is the creation of a boundary-less information flow by achieving access to integrated information to support business process improvements (The Open Group, 2011a). This vision is realised by the Architecture Forum's EA development activities (The Open Group, 2013).

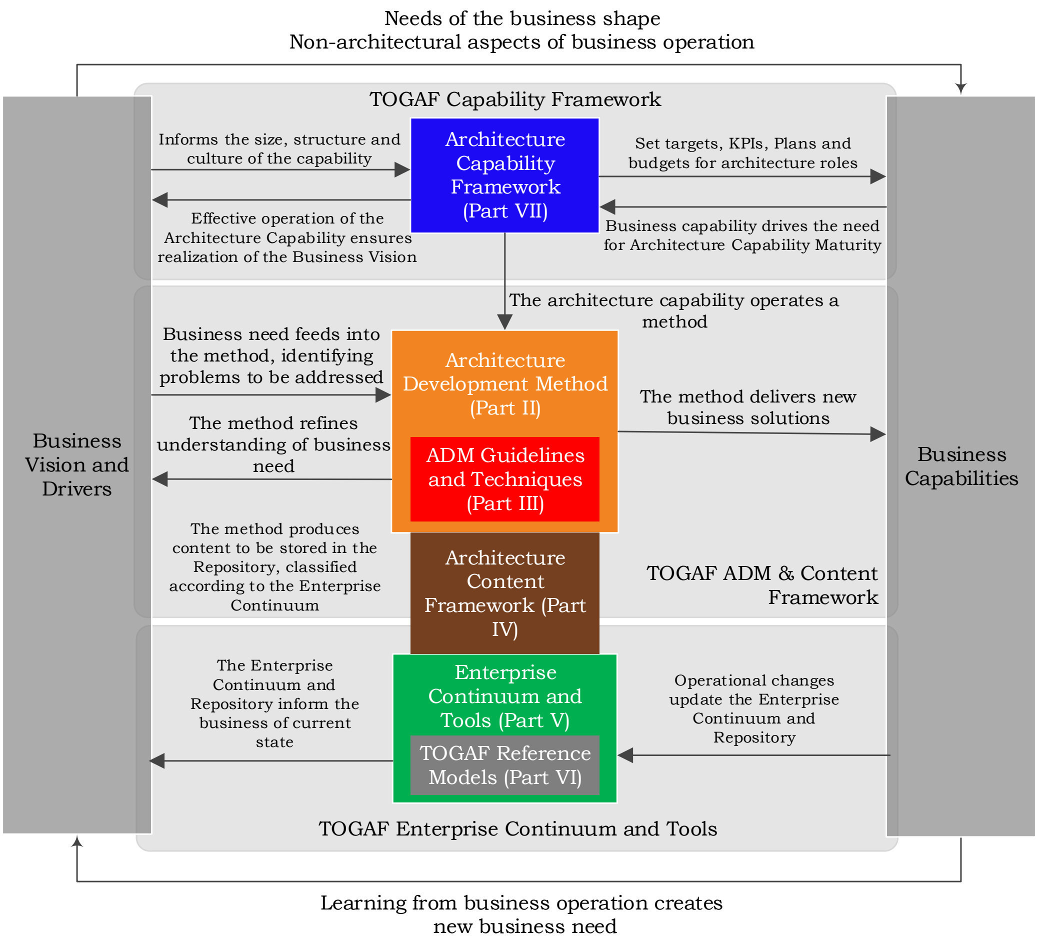


Figure 2.5: The TOGAF Capability Framework

The formal description of TOGAF Version 9.1 states that it is a framework which includes a detailed method, as well as a set of tools, for the development of an EA (The Open Group, 2011d). The TOGAF Version 9.1 documentation is arranged in seven sections, aimed at reflecting the structure and content of an architecture capability (see Figure 2.5 for illustration, and Table 2.13 for overview of sections). Each section of the TOGAF document is summarised in Table 2.13:

Table 2.13: TOGAF document layout

Part	Description
I – introduction	This part provides a high-level introduction to the key concepts of enterprise architecture and, in particular, the TOGAF approach. It contains the definitions of terms used throughout TOGAF, and release notes detailing the changes between this version and the previous version of TOGAF.
II – Architecture Development Method (ADM)	This part is the core of TOGAF. It describes the TOGAF Architecture Development Method (ADM) – a step-by-step approach to developing an enterprise architecture.
III – ADM guidelines and techniques	This part contains a collection of guidelines and techniques available for use in applying TOGAF and the TOGAF ADM.
IV – Architecture Content Framework (ACF)	This part describes the TOGAF content framework, including a structured meta-model for architectural artefacts, the use of re-usable architecture building blocks, and an overview of typical architecture deliverables.
V – Enterprise Continuum and Tools	This part discusses appropriate taxonomies and tools to categorise and store the outputs of architecture activity within an enterprise.
VI – TOGAF reference models	This part provides a selection of architectural reference models, which includes the TOGAF Foundation Architecture and the Integrated Information Infrastructure Reference Model (III-RM).
VII – Architecture Capability Framework	This part discusses the organisation, processes, skills, roles and responsibilities required to establish and operate an architecture function within an enterprise.

TOGAF proposes the Architecture Development Method (ADM) as a process to create the four distinct types of architectures identified by TOGAF, namely business architecture, information systems architectures (data and application) and technology architecture (Figure 2.6).

Each phase of the ADM is described in terms of its objectives, an approach, specific steps, inputs to the phase, and the outputs of the phase. The ADM cycle starts with a preliminary phase, where the important questions (where, what, why, who and how) that guide the architecture initiative are asked and answered. The architecture development process is then continued in the light of a description that entails the existing EA capability in the enterprise, as well as important business information such as, for example, business drivers for the EA initiative. The ADM can be modified or adapted to work in an iterative fashion, in order to suit the requirements of the architecture request for work. In addition to the ADM, TOGAF also defines the Enterprise Continuum and Repository (ECR). The ECR sets the context for the architect against which generic solutions can be specialised for a given enterprise.

The TOGAF documentation provides a range of detailed descriptions and definitions of the terms used by the standard. The terms most directly associated with EA, such as framework, enterprise and architecture, are defined as follows:

- Framework: A structure for content or process that can be used as a tool to structure thinking, ensuring consistency and completeness.
- Architecture Framework: A conceptual structure used to develop, implement and sustain an architecture.
- Enterprise: The highest level (typically) of description of an organisation, and typically covers all missions and functions. An enterprise will often span multiple organisations.

- Architecture: defined in two senses:
  - A formal description of a system, or a detailed plan of the system at component level, to guide its implementation (based on ISO/IEC 42010:2007).
  - The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time.

An interesting feature of the TOGAF Version 9.1 standard is the avoidance of an explicit EA definition, and the reader (or TOGAF practitioner) is left with understanding the two terms as separate, but closely related. The emphasis for TOGAF is on the architecture aspect, but understood within the context of an enterprise.

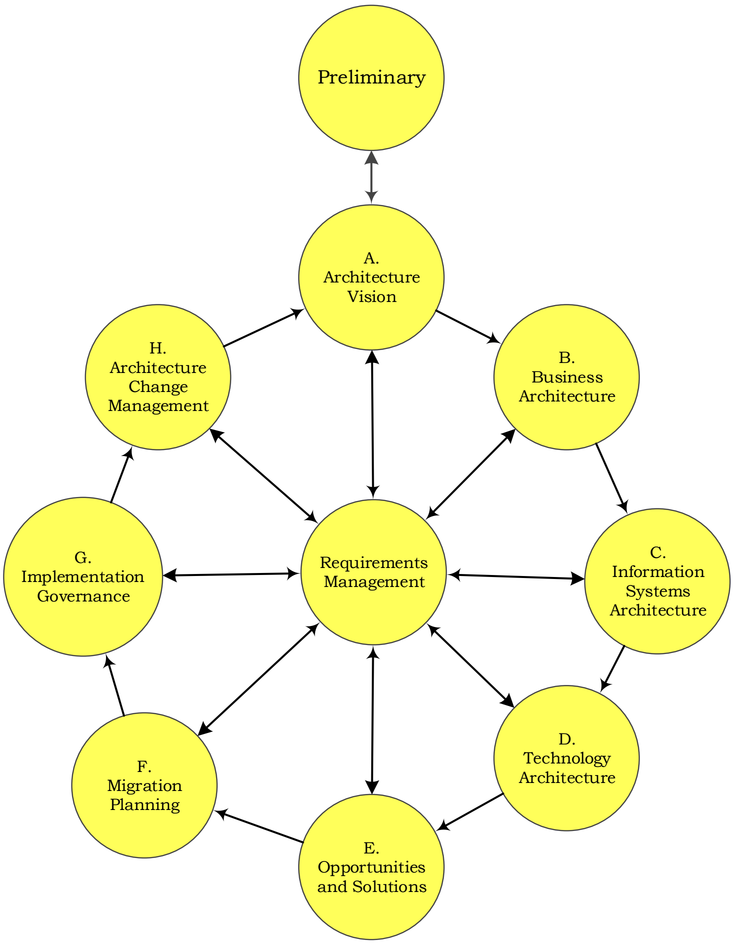


Figure 2.6: The TOGAF Architecture Development Method

2.4.5 Summary and Discussion

The discussion in the previous sections illustrates that EA, as approached by three very distinct frameworks, is using terms and definitions in different ways. For the Zachman Framework, the emphasis is on architectural primitives that, once combined to form architectural composites, can and will describe the enterprise coherently. Zachman's insistence that the Zachman Framework is complete, and not in need of expansion, is worded as a guiding rule in the use of the Zachman Framework (Rule 1, see Table 2.10). The inclusion of the phrase ‘the enterprise ontology’ in the title of the Zachman Framework, is an indication of the maturity of Zachman’s thought on the Zachman Framework, and makes a declarative statement about the intent of the Zachman Framework to describe the enterprise in simple and straightforward primitives (or models). How the practitioner of EA populates the Zachman Framework is left open, and therein lies its power, since the case can be made that any method capable of understanding the concept of a complete description of an enterprise in terms of primitives, could be used to populate the cells in the Zachman Framework schema.

Frameworks such as DoDAF Version 2.02 and TOGAF Version 9.1 provide more detail in terms of the approach to the creation of an EA either as an architectural description (DoDAF Version 2.02), or as an architecture capability (TOGAF Version 9.1). In the context of each framework (TOGAF and DoDAF), the Zachman Framework is recognised as a structure for artefact repositories. The DoDAF Version 2.02 bases its description and identification of stakeholders, and their communication needs, on the Zachman Framework, while TOGAF Version 9.1 characterises the Zachman Framework as a content framework that can be used in conjunction with the ADM.

2.5 DESIGN SCIENCE RESEARCH MODEL

The design science research (DSR) model is discussed in detail in the research design chapter (section 3.2.2). In order to provide a context for creating awareness of the research problem, an overview of the DSR model is provided in this section. The general process of design science research (DSR) as proposed by Vaishnavi and Kuechler (2013), consists of a sequence of steps (Figure 2.7). The first step’s purpose is to create *awareness of a problem* that can be solved with the creation of an artefact. The importance of the first step in the design science research process cannot be overstated, as it essentially provides the starting point of understanding the research problem. The degree to which the researcher understands the problem impacts directly on the type of solution proposed and, ultimately, the design of the artefact. The awareness of the problem is followed a *suggestion* of a possible solution. After this solution is suggested, the model moves to the *development* of the artefact. The effectiveness of the artefact in solving the problem is tested in the *evaluation* step, and the process concludes with a *communication* step. During the execution of the steps in the DSR model, lessons are learned that lead to the awareness of problems, or constitute a contribution to the body of knowledge.

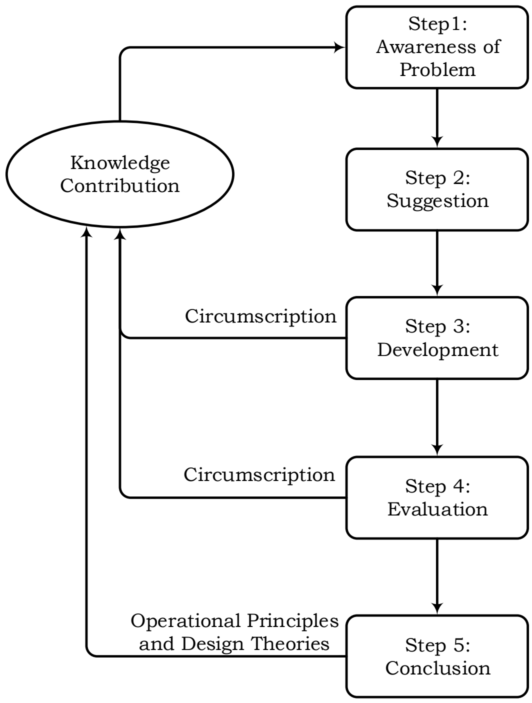


Figure 2.7: The Design Science Research Model

2.5.1 Awareness of the Problem

The clarity inherent in each EAF (Zachman Framework, DoDAF Version 2.02 and TOGAF Version 9.1) strongly suggest that each framework is capable, in their own right, of creating architectures for the enterprise. As such, they might be in competition with one another when it comes to an EA practitioner making a framework decision. This is the core of the research problem stated in section 1.3 and section 2.1, namely: *on what basis is an EAF selection decision made?* Furthermore, which of the EAFs discussed (section 2.4) is more suited to the specific task or need of the EA initiative? What makes the question troublesome to the researcher is the seeming absence of an EA ground on which to stand when entering a debate on EA choice. At this point, the DSR model (Figure 2.7) is entered by creating an awareness of the existence of a problem (Vaishnavi & Kuechler, 2013). In order to facilitate the awareness creation, the following points need to be taken into account:

1. The academic literature states that no universal agreement on EA terms exist; in fact, the issue of terms and definitions is regarded as being in a disorganized state. The absence of agreement on universal terms indicates a lack of clarity of the conceptual foundations of EA (important to note that these foundations are not regarded as completely absent, since such a state would have prevented an EA industry and discipline to develop and grow).
2. Various attempts at creating a universally accepted EA definition ended as either an academic exercise, or were, to date, not completely resolved.

3. The delineations and internal meanings of existing EAFs suggest the development of a type of EA silo, since a separate field of inquiry is needed to integrate or even migrate EAs that were realised by a specific EAF.
4. The adaptability of EAFs to the needs of an EA initiative, leads to the creation of new and unique EAFs, but using existing EAFs as reference or baseline frameworks. This adaptability suggests that some common ground is embodied in EAFs, such that the frameworks contain the implicit theoretical foundation of EA.
5. The volume of available EAFs suggests that the inherent meaning of EA, as a representation of the enterprise, essentially allows for the creation of unique EAFs. This point is made in the consideration that the EAF realises an EA, and that a specific context would necessitate a unique approach, due to a localised (to the enterprise) understanding of the meaning of EA, in combination with localised (to the enterprise) needs.

These five points indicate a problem that is the result of the diversity in the acceptance of the meaning of EA as a concept, as well as the number of EAFs available to realise an EA. This problem impacts and creates the problem of EAF selection. The problem is formally stated as follows:

> *The conceptual foundation of EA is implicit and as a result prevents universal agreement on terms and definitions.*

2.5.2 Suggested Solution

Once the problem awareness is achieved, a solution to the problem can be suggested (Figure 2.7) (Vaishnavi & Kuechler, 2013). Various solutions to the problem, stated in section 2.5.1, can be proposed and put forth for examination. In order to be effective in this discussion of possible solutions, the conceptual nature of the problem should be recognised, so that the proposal of a solution can be approached in a likewise conceptual manner. This recognition is achieved by focusing the discussion of proposing a solution on the role of EA terms and definitions, in addressing the essential or foundational or core concepts of EA. The solution to a conceptual problem therefore calls for the creation of an artefact that aids in the understanding of concepts. Three candidates are suggested – namely ontologies, standards and theoretical knowledge structures (also known as an architectonic). Of these three options, an architectonic holds the most promise as a conceptual artefact that can provide a basis for holding explicit foundational EA knowledge. The reasons for this claim are set out as follows:

- Ontologies are difficult to construct and have already been attempted (Kang et al., 2009; Ohren, 2005; Kappelman & Zachman, 2013), with no reported impact on the problem described.
- Standards also require a great deal of effort and time to develop, and, once accepted as standards, must be owned by a standards body for maintenance and continual development. This type of ownership can make the enforcement of the standard complex, as the idea of compliance to the standard suggests a specific need (regulative or economic). The history of computing has shown that popularity can lead to the creation of a de facto standard (such as

was the case with the IBM personal computer), and in terms of EAFs, TOGAF is perhaps the most likely candidate for a de facto EA standard. The risk with this approach is that the essential or foundation knowledge would be that which is entailed by TOGAF, and not necessarily representative of the field of study. Some examples of EA-oriented standards do exist; see, for example, IEEE 42010 (IEEE, 2011) and the Generalized Enterprise Reference Architecture and Methodology (GERAM) (IFIP-IFAC Task Force, 1999).

- Architectonics is defined as the *scientific study of architecture* (Oxford Dictionaries) and highlights the concepts that describe architecture. In the case of EA, an architectonic that will contain knowledge of EA concepts can be called an Enterprise Architectonic (EAt).

The proposed solution, therefore, for the EA selection problem, is to design and implement a conceptual structure called an EAt, in such a way as to contain the fundamental conceptual knowledge of EA as proposed by the main authors and creators of EA. The EAt will then represent an explicit formulation of the foundations of EA, and, as such, serves as a solution to the research problem.

2.5.3 Solution Development

The kind of knowledge stored in an architectonic aims to achieve understanding of a topic of interest in the way that knowledge or theory is structured. In the case of the EAt, the aim of the artefact is to make the foundational meaning of EA explicit in such a way that an understanding of the foundations of EA is possible. Examples of the application of architectonics in information systems research is found in the work of Richmond (2007) and Del Rosso and Maccari (2007). To construct the EAt, a key element is an understanding of EA. An understanding of EA is contained in the EAF, as discussed in section 2.4, but, as the background to the stated problem (section 2.5.1) emphasised, there is no universal agreement on an understanding of EA in terms of terminology and definitions.

One direction that the solution design can take is to select an EAF and use its contents as a guide to develop the EAt. Such a solution will then, however, have a content that favours a specific EAF, and this too will not solve the EAF selection problem. The DSR development phase seemingly is in a stalemate position, since the contents needed to develop the EAt is at the heart of the EAF selection problem. The DSR model does allow for such situations, because of the circumscription exit during the demonstration phase.

Vaishnavi and Kuechler (2013) describe circumscription as a process that generates understanding that could only be gained from the act of construction. In the case of the EAt, the understanding that has been generated at this point is that the EAt development process cannot continue unless there is an understanding of EA that is separate and distinct from an EAF. The DSR cycle therefore ends with a knowledge contribution that can feed into another cycle by creating awareness for a problem that must be solved before the EAt's development can continue (Figure 2.8). An essential part of the EAt is therefore an understanding of term EA itself, and for this task a second solution that produces an EA understanding, needs to be proposed.

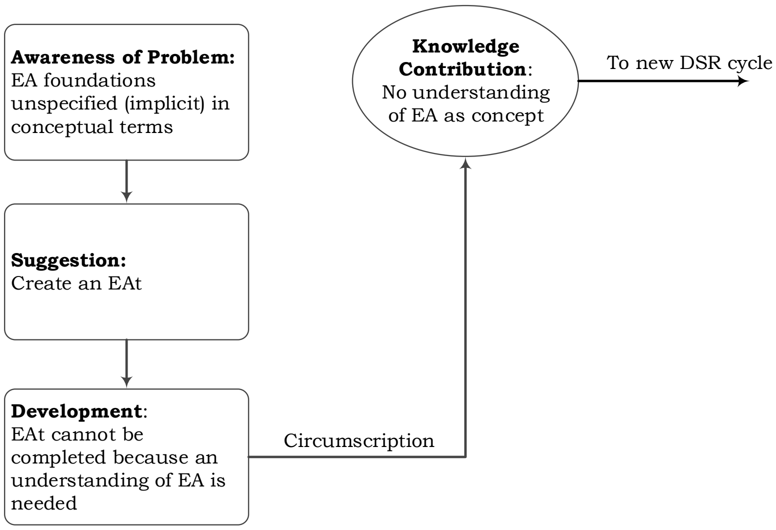


Figure 2.8: First DSR Cycle

2.6 CONCLUSION

The literature shows that the issue of EA terms and definitions is far from settled. The lack of universally agreed terms and definitions can result in the conclusion that EA researchers and practitioners do not yet understand what EA is. Such a conclusion, though, would be an oversimplification of the issue, since a review of the literature also shows that individual attempts at defining EA and its terms are lucid and understandable (section 2.3). The overview of prominent EAFs shows that, from the perspective of EAF, EA is very well understood. Furthermore, the level of detail contained in EAFs, such as, for example, TOGAF, shows that the task of *doing* EA is complex but clear (section 2.4). It follows, therefore, that EA is, in fact, understood by EA practitioners and researchers alike. The problem lies with the implicit nature of this understanding, and is evidenced in the localised (per interest group or EAF) understanding of EA.

The problem of a set of implicit assumptions and theoretical foundations to EA resolves in the questions of ‘what makes the EA conversation possible?’ or, to put it in different terms, ‘what is the common ground that EA stands on?’ To answer this question, and to attempt making the implicit foundations of EA explicit, an EAt is proposed as a conceptual artefact that will show fundamental concepts and their relationships. The purpose of this EAt is very narrow, in that it is designed to explain the minimum set of concepts, so that the fundamental understanding of EA can be made explicit. In Chapter 3, a detailed research strategy, based on the DSR model, is discussed, to present the plan for achieving the design, demonstration and evaluation of the EAt artefact.

CHAPTER 3: RESEARCH DESIGN

Chapter Map

CHAPTER 3: RESEARCH DESIGN

- **3.1 INTRODUCTION**
- **3.2 THE COMPONENTS OF A RESEARCH STRATEGY**
  - 3.2.1 The Philosophical Foundation
  - 3.2.1 The Research Process
- **3.3 THE RESEARCH PLAN**
  - 3.3.1 Step 1: Research Goals and Objectives
  - 3.3.2 Step 2: Execution of the Research Plan
  - 3.3.3 Step 3: Data Collection, Data Sources and Assumptions
  - 3.3.4 The Research Map
- **3.4 CONCLUSION**

Chapter Summary

RESEARCH PARADIGM	Positivist Ontology: reality exists outside the realm of human cognition
	Interpretivist Epistemology: knowledge is constructed by the human subject
	Theoretical Perspective: the science of the artificial as described by Herbert Simon
	Research Methodology: Design Science Research Model
DESIGN OBJECTIVES	Design structured interpretation method (SIM) to understand meaning of EA
	Design enterprise architectonic (EAt) to organize meaning of EA in terms of concepts and relationships
ARTEFACTS	Structured Interpretation Method (SIM)
	Enterprise Architectonic (EAt)
DATA SOURCES	Primary writings of prominent enterprise architecture frameworks (EAFs)
	Enterprise architecture propositions (result of SIM demonstration)
THEORIES	SIM: Theory of interpretation (Hermeneutics), Phenomenology
	EAt: Architectonic theory, business complexity, Heidegger equipment analysis, worldview theory

3.1 INTRODUCTION

Research is defined as the creation of new knowledge by making use of an appropriate process in order to satisfy the needs of the users of the research (Oates, 2006). The previous chapter discussed the problem of the implicit common ground in the understanding of EA by practitioners and researchers. The EA practitioner and researcher represent the two groups of users of EA research. The diversity in the knowledge needs of these groups, namely the practical needs of the practitioner and the academic discourse of the researcher, makes the creation of new knowledge by way of an appropriate process, a complex undertaking. Design science research (DSR) provides an approach to address this complexity, due to its focus on creating new knowledge as a result of building artefacts (Vaishnavi & Kuechler, 2013). The benefit to the practitioner resides in the artefact itself, while the EA researcher benefits from the new knowledge that is discovered during the design process. Because of these benefits, DSR was selected as the methodology to create artefacts as solutions for the research question posed in Chapter 1. The aspect of what constitutes new knowledge is described in the context of a research paradigm where the philosophy of the research effort is understood and categorised. The research paradigm for this thesis falls under the category of a subtle realist position. Guided by the research paradigm, a DSR methodology is employed to design, implement and demonstrate the EAt and SIM conceptual artefacts.

The chapter is structured in two parts, namely a discussion of the components of the research strategy (section 3.2) and the details of the research plan (section 3.3). The subtle realist paradigm that guides the research strategy is discussed in the first part, whereas the DSR methodology is discussed in the second part.

3.2 THE COMPONENTS OF A RESEARCH STRATEGY

A research design describes the researcher's plan for addressing a research problem. Creswell (2003) proposes a research design framework that contains the key components of a research design, namely the *elements of inquiry*, *approaches to research* and the *research design processes*. This framework, illustrated in Figure 3.1, shows the placement of the key elements of inquiry, namely *knowledge claims, strategies of inquiry* and *research methods,* as part of the researcher's conceptualisation process. The elements of inquiry determined the researcher's approach to research, in terms of the decisions that will influence the execution of the research plan.

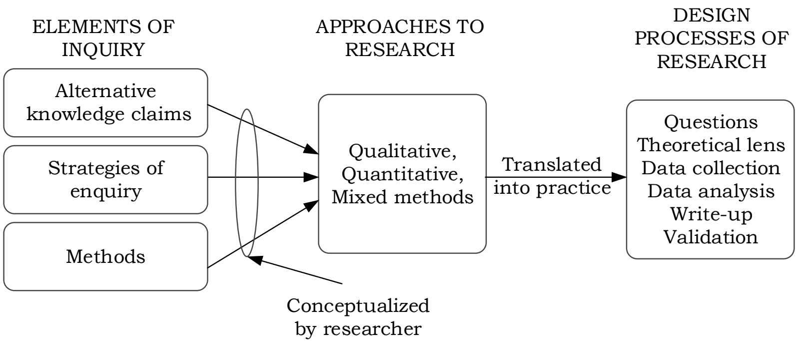


Figure 3.1: Creswell's Elements of Inquiry

According to Crotty (1998), the components of a research design follow a logical sequence (Figure 3.2). An epistemology informs a theoretical perspective that supports a research methodology that, in turn, contains a method or number of methods.

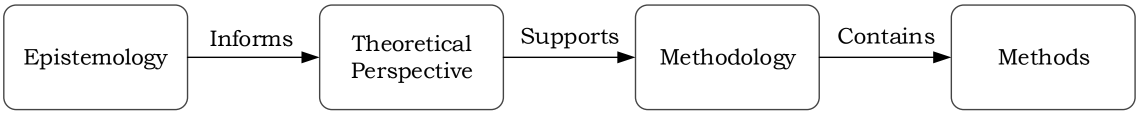


Figure 3.2: Crotty's Research Model

Each component is further explained by Crotty (1998) as follows:

- *Epistemology* is the theory of knowledge, and serves as the philosophical context from which the validity of knowledge claims is justified.
- The *theoretical perspective* represents the philosophical stance of the researcher, and informs the methodology that will be followed while doing the research.
- The *methodology* is the strategy of the research, and impacts on the appropriate choice of research methods.
- *Methods* are the specific techniques or procedures used to gather and analyse the data for the research project.

The quality of the research results is dependent on the unity between these four components (Figure 3.1). The theoretical perspective should be based on an appropriate epistemology for the researcher’s knowledge claims to be valid. The chosen research methods should, in turn, align with the research methodology as well as the theoretical perspective, in order to guarantee useful scientific results. The relationship between the elements of inquiry in Creswell’s framework and the research plan, is illustrated by mapping the components of a research design as described by Crotty (1998) (Figure 3.3), to the elements of inquiry described by Creswell (2003). The result of the mapping forms the basis of the research design, and is shown in Figure 3.3:

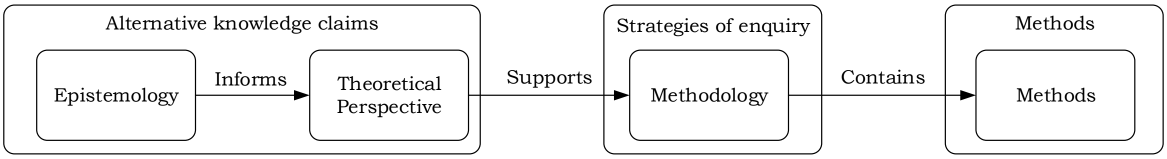


Figure 3.3: Creswell's Elements of Inquiry Mapped to Crotty's Model

In keeping with the definition of research, as put forth by Oates (2006), the new knowledge produced by the research is grounded on a *philosophical foundation* that includes an epistemological and theoretical perspective, while the appropriate research process is designated by the specific *research process* followed by the researcher (Figure 3.4). The sections that follow discuss the philosophical foundation of the research design used to answer the research question.

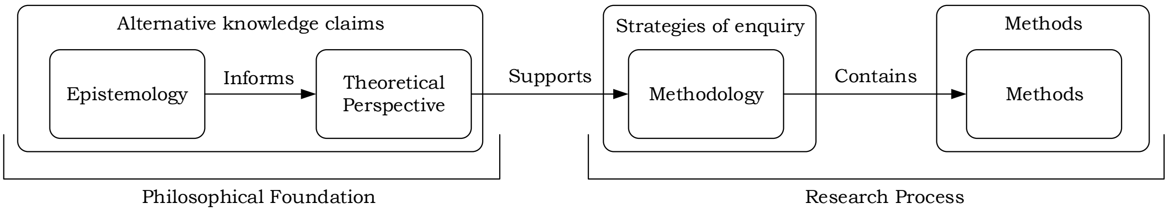


Figure 3.4: The Thesis Research Framework

3.2.1 The Philosophical Foundation

A philosophical foundation consists of an epistemological as well as a theoretical perspective (Figure 3.4), and is understood as a research paradigm. Guba (1990) defines a paradigm as a basic set of beliefs that guides action. A paradigm includes the researcher's epistemological, ontological and methodological position. Epistemology is described as the study of human knowledge (Mouton & Marais, 1988), and consists of sentences that claim knowledge about reality. Reality, in turn, as far as it speaks of a world and the things in it, is described by way of an ontology (Scott & Marshall, 2009). Hevner et al. (2004) present design science research (DSR) as an appropriate research paradigm for information systems research, because of the use of artefacts in solving problems. Iivari (2007) proposes Karl Popper's three-world model as a basis to construct an ontology for DSR research. In Iivari's ontology, information technology (IT) is viewed as the core artefact of information systems research. In Popper's three worlds model (1978), World 1 consists of physical bodies, and is called the physical world (another way to view this world is to see it as the world of everyday existence); World 2 is called the mental (or psychological) world, and contains subjective human experiences; and, finally, World 3 contains the products of the human mind. The DSR-oriented ontological perspective proposed by Iivari is summarised in Table 3.1:

Table 3.1: Iivari's Ontology (Iivari, 2007)

World	Explanation	Research Phenomena	Examples
World 1	Nature	Artefacts + World 1	Evaluation of artefacts against natural phenomena
World 2	Consciousness and mental states	Artefacts + World 2	Evaluation of artefacts against perceptions, consciousness and mental states
World 3	Institutions	Artefacts + World 3 institutions	Evaluation of organisational information systems
	Theories	Artefacts + World 3 theories	New types of theories made possible by information system artefacts
	Artefacts	Artefacts + World 3 artefacts	Evaluation of the performance of artefacts in the context of other artefacts

March and Smith (1995) created a general typology of IT design artefacts that includes *constructs, models, methods* and *instantiations*. *Better theories* are listed as a fifth artefact in the list of design research artefacts by Vaishnavi and Kuechler (2013). Table 3.2 shows a description of each artefact type:

Table 3.2: DSR artefact types (Vaishnavi & Kuechler, 2013)

Artefact type	Description
Constructs	The conceptual vocabulary of a domain
Models	A set of propositions or statements expressing relationships between constructs
Methods	A set of steps used to perform a task – how-to knowledge
Instantiations	The operationalization of constructs, models and methods
Better theories	Artefact construction as analogous to experimental natural science, coupled with reflection and abstraction

Iivari (2007) also proposes an epistemology for DSR that includes three types of knowledge, namely *conceptual*, *descriptive* and *prescriptive*. Table 3.3 shows a summary of this epistemology, with each type of knowledge's associated research goal:

Table 3.3: DSR epistemology (Iivari, 2007)

Type of knowledge	Research goal
Conceptual knowledge (concepts, constructs, classifications)	Identify essences in the research territory and their relationships.
Descriptive knowledge (observational facts, empirical regularities, theories and hypotheses)	Describing, understanding and explaining how things are.
Prescriptive knowledge (design product knowledge, design process knowledge)	Achieving the specified ends in an effective manner in terms of how things could be.

Niehaves (2007) argues in favour of a pluralistic approach to using positivist and interpretivist epistemologies for design science. The position taken in this research thesis is based on Niehaves's standpoint of a paradigm that a) accepts a reality outside the realms of human cognition (positivist ontology), and b) regards knowledge as determined by the subject (interpretivist epistemology) – thus accepting that objective knowledge of the world is not possible. This paradigmatic position is descried by Ritchie and Lewis (2003) as a *subtle realist* position.

As a theoretical perspective, the science of the artificial (Simon, 1996) frames the understanding of artificial things (artefacts) as a 'knowing by making', and is designated as foundational to the field of design science research (Baskerville et al., 2011). Design in this context is defined as the act of *creating something new that does not exist in nature* (Vaishnavi & Kuechler, 2013). DSR's defining feature is *learning through building or learning though artefact construction*, by making use of design as a research method (Vaishnavi & Kuechler, 2013). The knowledge that is the result of this learning process, relates to the process of making the artefact, as well as understanding the effectiveness of the artefact in adhering to the purpose it is designed to achieve. Hevner and Chatterjee (2010) capture this relationship between knowledge, design and artefact as the fundamental principle of design – namely *knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact.*

The interpretivist epistemology, as illustrated in Figure 3.5, informs a science of the artificial theoretical perspective that is situated in Design Science Research. The knowledge claim of this research thesis is therefore an understanding (interpretation) of what can be learned by making and using the artefact (Science of the Artificial), where the artefact is understood to be the solution to the research question (section 1.4.2) posed in this thesis.

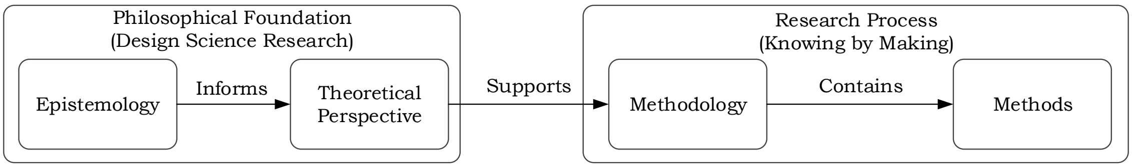


Figure 3.5: The Thesis Philosophical Foundation

3.2.2 The Research Process

The purpose of the research process is to actively engage in the execution of the research, and includes a methodology and methods (Figure 3.5). Methodology is defined as the science of method, where method is understood as the procedure that is followed to gain knowledge (Wyssusek et al., 2003). For the purpose of this chapter, the specific meaning of methodology is based on the definition by Mingers (2001), and is taken to mean the actual research method or methods used in a certain piece of research. The aspects of a research project that a methodology should address and describe, are the identification of appropriate data sources, the collection and analysis of data, and the justification of conclusions based on this analysis. The specifics of each research method in turn address aspects such as the collection of data by way of interviews, or the interpretation of results from a data-gathering exercise. A methodology may therefore contain and combine multiple methods or parts of methods. The most important role of the methodology is that it should make logical sense, and stay true to the philosophical principles underlying each method and, ultimately, the study as a whole. In accordance with the artificial nature of EA, the research process is based on the design science research (DSR) model described by Vaishnavi and Kuechler (2013). The DSR model consists of five steps – namely *awareness of problem, suggestion, development, evaluation* and *conclusion.* The meaning of each step is briefly discussed as follows:

- Awareness of problem:
  In this step, an interesting problem is identified for potential solution, by developing an artefact. The awareness of the problem is documented in a proposal for a new research effort.
- Suggestion:
  During this step, a tentative design for a solution is suggested. The suggestion step is essentially creative in nature, due to the task of the researcher to envision a possible solution to the problem stated in the research proposal.
- Development:
  During the development, the tentative design of the suggestion step is enhanced and implemented. A range of theories can be used to inform the design of the solution.
- Evaluation:
  The developed solution is evaluated against a set of criteria, to test its ability to solve the problem. Any deviation in expected performance of the solution is noted and explained. The results of the evaluation step constitute the lessons learned, and can lead to more cycles of the DSR model.
- Conclusion:
  The final step in the process is used to consolidate and communicate the results of the DSR cycle. The knowledge acquired during the execution of the DSR process informs the creation of design theories that can be used in further DSR cycles. Figure 3.6 illustrates the complete DSR model, and indicates the knowledge flows as well as cognitive processes.

The core of the DSR model consists of five process steps which produce outputs and consume resources during the execution of a design cycle. The process steps of a design cycle proceed from Step 1 through the rest of the steps to Step 5, in a sequential manner. Each of the process steps in a design cycle produces outputs and consumes resources. The development (Step 3) and evaluation (Step 4) produce knowledge according to a circumscription process. The circumscription process is described by Vaishnavi and Kuechler (2013) as a formal logical method that assumes the validity of knowledge fragments as part of specific situations. Furthermore, the applicability of knowledge can only be determined by the analysis of contradictions (Vaishnavi & Kuechler, 2013). The usefulness of circumscription to the DSR researcher, is that learning takes place when something does not work according to theory (see section 2.5.3 for an example of the circumscription process). Circumscription allows the researcher to *learn by making* – a process that is in keeping with the research process described in Figure 3.5.

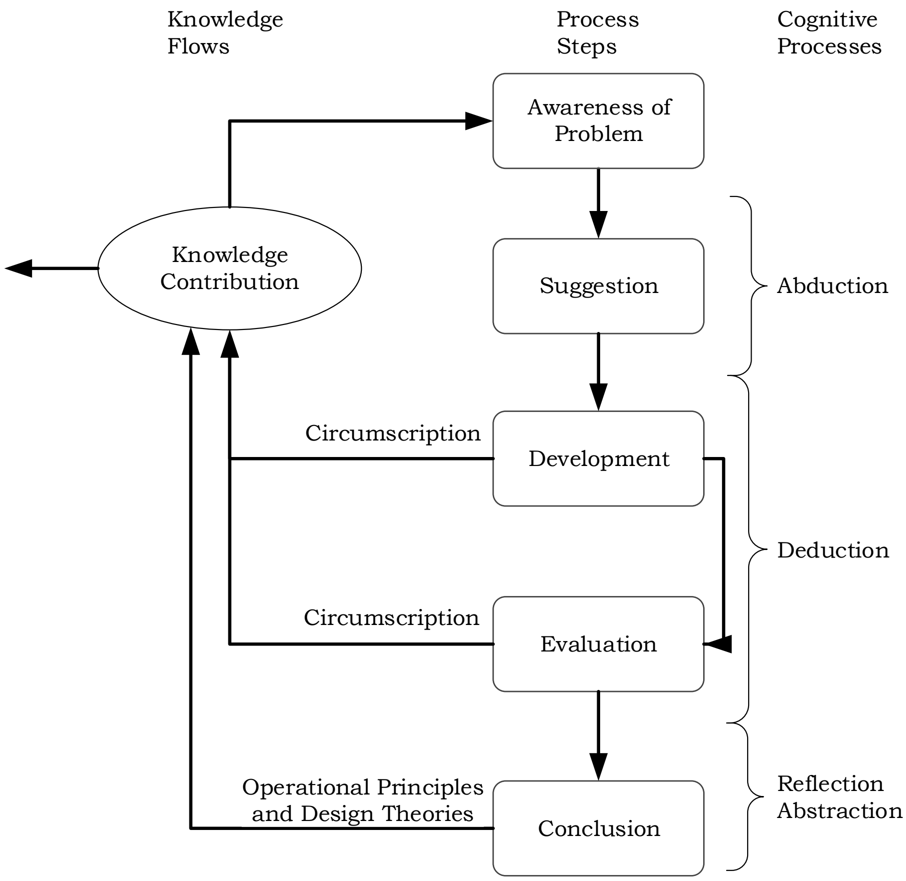


Figure 3.6: The Complete DSR Model

Resources consumed by each activity in the design cycle can be *knowledge, data, a theory* or *an artefact*. Activity 1, for example, consumes knowledge about the state of a problem, as well as the importance of a solution to a research problem. As illustrated in Figure 3.7, the design activities mostly consume knowledge. When considering the link between data and knowledge, it is possible to establish the data collection and verification methods, as well as the data sources, for each resource in the design cycle (Figure 3.8). The knowledge about the state of the problem was produced by a literature review (section 2.3), while the selection of a proposed solution was achieved by way of an argument (section 2.5.2). The data sources used to prepare the literature review in section 2.3 included the EA literature associated with the research problem. The evaluation results of existing artefacts, such as, for example, the SIM (Table 4.11) were used as a data source to complete the EAt artefact. Figure 3.7 and Figure 3.8 are combined to produce a research map that will chart the process of the execution of the research plan (Figure 3.9):

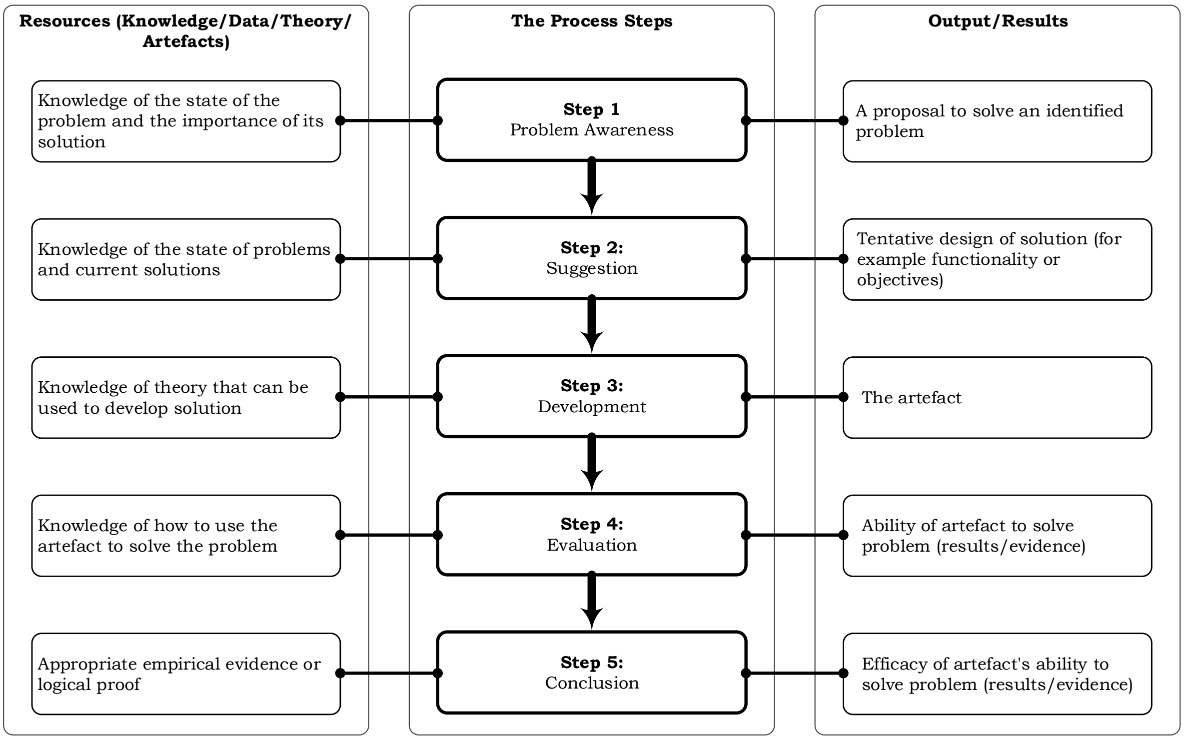


Figure 3.7: The Research Design Cycle

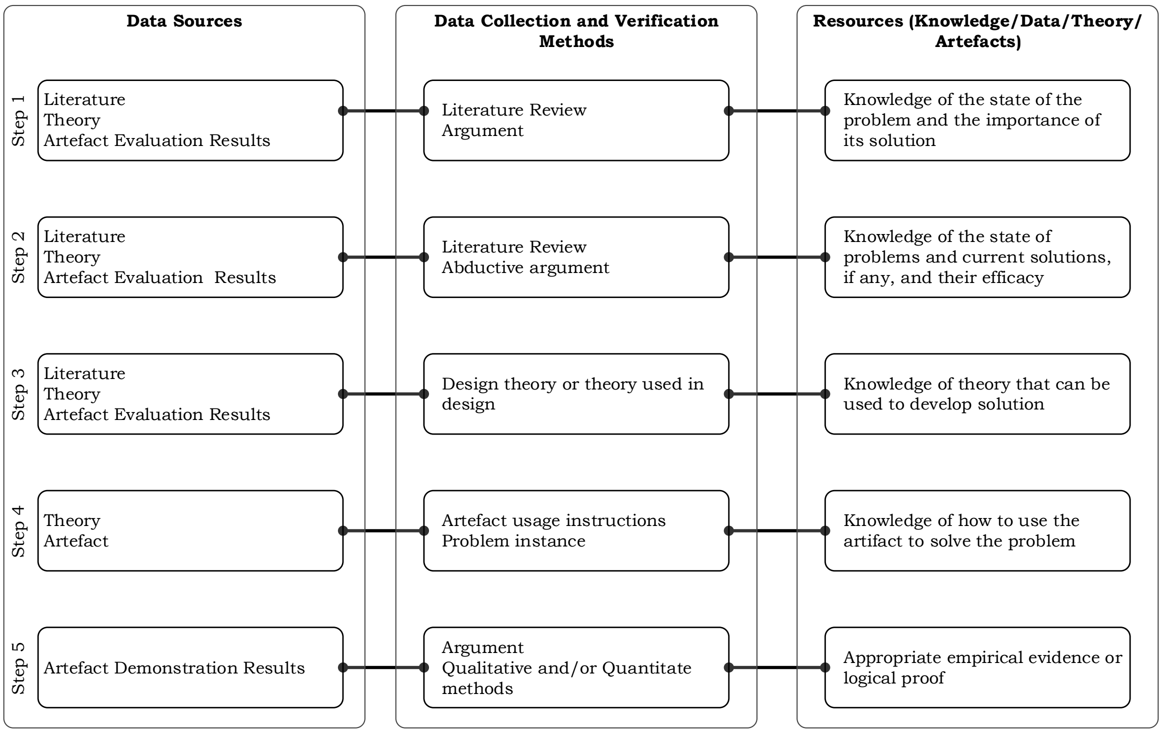


Figure 3.8: Data Collection Methods and Data Sources

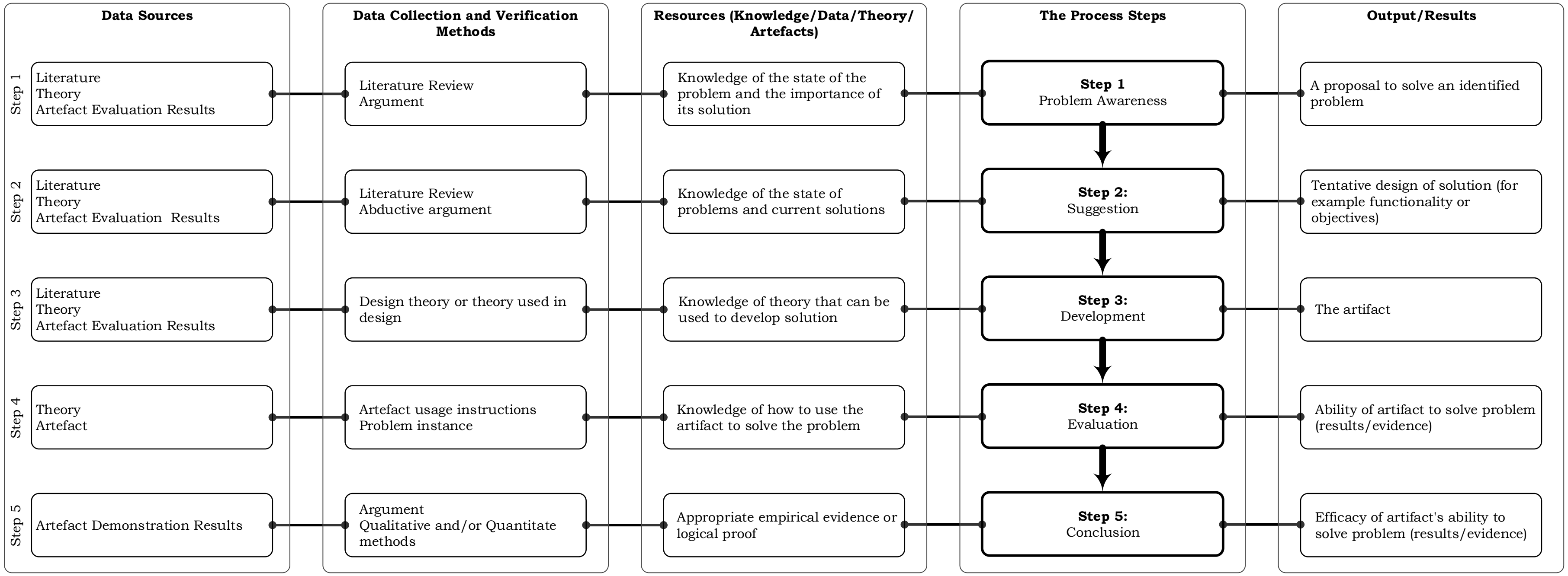


Figure 3.9: Research Plan Template

3.3 THE RESEARCH PLAN

In this section, the research design framework (section 3.2) is used to create a detailed research plan in a sequence of three steps. During the first step, the research goals are specified in order to facilitate the development (Step 3 in Figure 3.7) of the proposed solution (section 2.5.2). The second step discusses the execution of the five process steps in the DSR model, by emphasising the outputs of each activity, as well as the resources needed to successfully complete an activity. The third and final step consists of a discussion about assumptions, data sources and data analysis techniques needed to produce the resources for each activity. The section concludes with a detailed map (Figure 3.15 and Figure 3.16) of the research plan, to aid the navigation of the research process.

3.3.1 Step 1: Research Goals and Objectives

Three research goals were stated in Chapter 1 (section 1.4.1), and are repeated here for the sake of clarity in the research design discussion:

1. Describe the theoretical background of EA research in terms of EA definition efforts and the difficulties with EAF selection.
2. Determine an understanding of EA by interpreting the key works of three prominent EAFs.
3. Construct an enterprise architectonic (EAt) to structure the understanding of EA, in terms of fundamental concepts and their relationships.

The first research goal constitutes the theoretical background to the research problem, and culminates in creating awareness of the research problem (section 2.5.1). The second and third goals address the proposed solutions to the identified research problem (section 2.5.2). According to the activities in the research design cycle (Figure 3.7), the first goal is associated with the first and second activities. The discussion in Chapter 1 (section 1.8.1 and section 1.8.2) and Chapter 2 (section 2.5.2) proposed two artefacts (SIM and EAt) to address the research problem. Each of the artefacts is associated with a separate and unique research goal, as follows:

1. SIM: Determine an understanding of EA by interpreting the key works of three prominent EAFs.
2. EAt: Structure the understanding of EA in terms of fundamental concepts and their relationships.

The SIM artefact is a *method* type artefact as described by March and Smith (1995), and the EAt is a *conceptual artefact* as described by Bereiter (2002). Both the SIM and the EAt take into account that EA exists as a concept in the everyday world of human activity. In other words, EA is not understood as a physical object. In ontological terms, the existence of EA is expressed as a concept created by the human mind towards a purpose that is situated in, and determined by, the needs of the business world. The business world (also referred to as the enterprise) is understood as the external reality, described by Popper (1978) as World 1 (Table 3.4).

The knowledge that results from the demonstration of the SIM and EAt artefacts falls in the categories of *conceptual* and *descriptive*, as described by Iivari (2007) and summarised in Table 3.4:

Table 3.4: Artefact relationship with knowledge

Artefact	Knowledge Type (epistemology)	Ontological Reality
Structured Interpretation Method (SIM)	Conceptual knowledge	World 1 – world of business
Enterprise Architectonic (EAt)	Descriptive knowledge	World 2 – world of practitioner and researcher

The SIM produces conceptual knowledge, in that the meaning of EA contains concepts and constructs. The EAt, in turn, produces descriptive knowledge, by describing how the understanding of enterprise architecture can be structured.

3.3.2 Step 2: Execution of the Research Plan

The research problem constitutes the research context for the design of both the SIM and the EAt. The EAt artefact is designed to address the problem of the implicit foundations of EA, by transforming an understanding of EA (result of SIM demonstration) into a set of concepts and relationships (section 2.7). The SIM is designed to interpret the key writings of three prominent EAFs (section 2.4) to produce an interpreted understanding of EA. The EAt and SIM artefacts therefore stand in relation to each other in the sense that the EAt's design and development (Step 3 of DSR model) (Figure 3.7) cannot be completed unless the SIM's demonstration has first produced an understanding of EA (Figure 3.10).

The SIM's results are therefore a prerequisite for the EAt's design and implementation. The execution of the research plan is an application of the DSR model proposed by Vaishnavi and Kuechler (2013) (section 3.2.2), to the task of first designing, developing and evaluating the SIM – after which the EAt can be designed with the SIM's evaluation results as input.

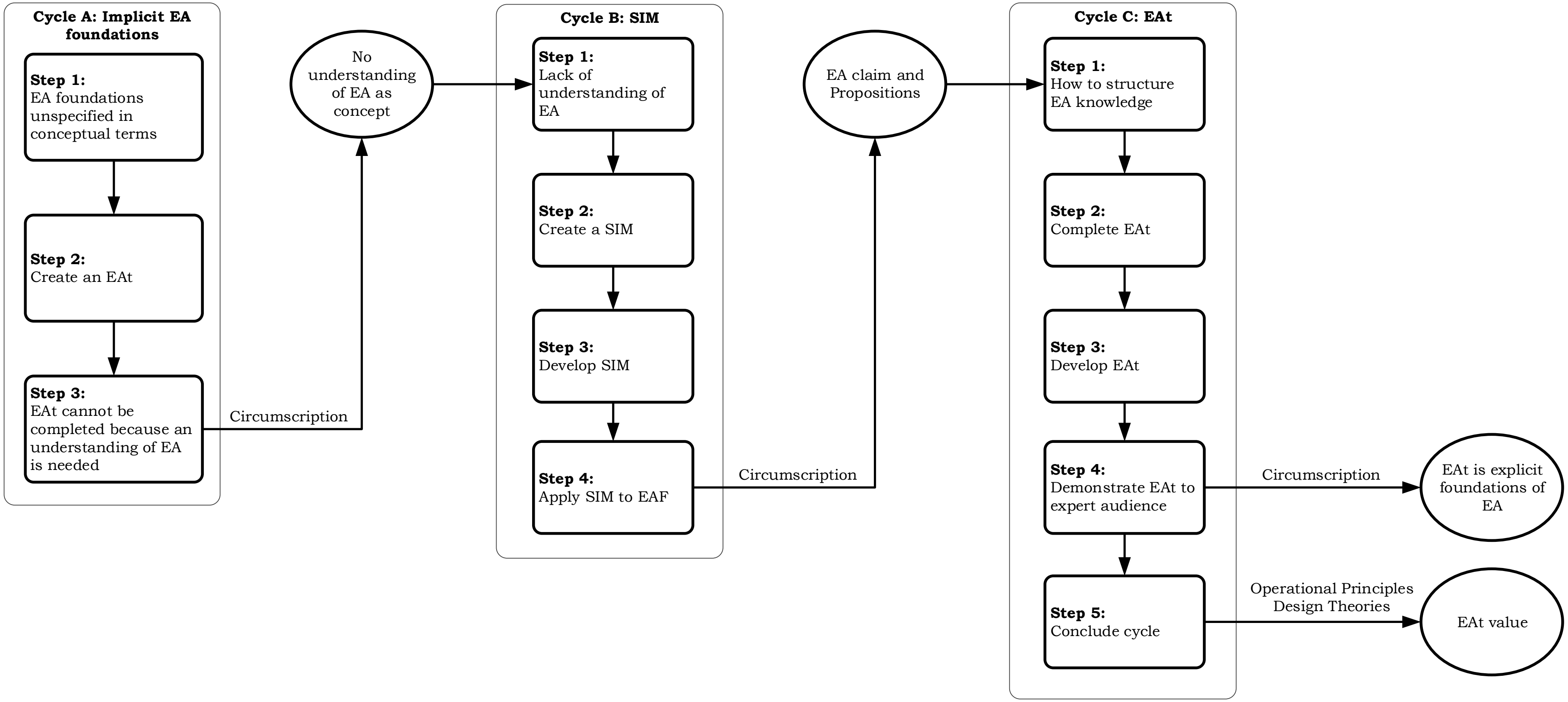


Figure 3.10: Research Thesis Map

3.3.2.1 SIM Design Cycle

The design problem that drives the design of the SIM states that the unresolved discussions of EA terms and definitions show a lack of universal acceptance of a general understanding of EA. Two sub-problems are derived from the SIM's design problem:

1. The understanding of EA is undecided and assumed.
2. The understanding of EA is localised in the EAF.

In addressing the SIM design problem, two objectives are formulated to guide the design of the SIM:

1. Construct a structured approach to interpret an understanding of EA.
2. Capture the understanding of EA in a set of EA propositions.

The resources needed to complete Step 1 (Figure 3.7) are knowledge of the state of the problem, as well as the importance of a solution. Step 2 (Figure 3.7), in turn, needs knowledge about the state of the problem, as well as existing solutions. During Step 3, the artefact (the SIM) is developed. The resources needed for the third step in the cycle are knowledge of theory that can be used to inform the design, and development of the artefact. In the case of the SIM, the theory of interpretation and understanding is needed. The artefact is evaluated in Step 4, and for this step a comprehensive set of instructions on how to use the SIM, is needed. The SIM design cycle ends after the fourth step, as shown in Figure 3.11:

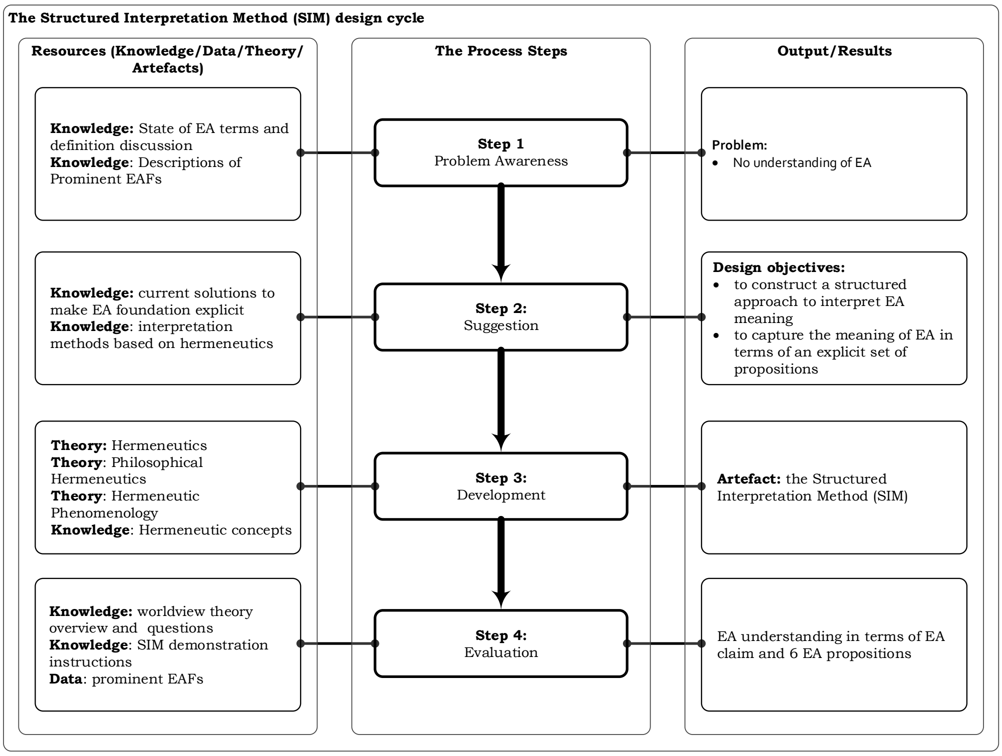


Figure 3.11: The SIM Design Cycle Activities

The description of the design of the SIM is described as follows, in terms of its desired functionality, as well as its architecture:

1. Desired functionality of the SIM contains –
    a. Repeatable steps to facilitate ease of use.
    b. A recognised interpretation theory foundation to facilitate validity and rigour of interpretation.
    c. The ability to interpret EA definitions in a phenomenological way.
    d. The means to produce a meaning and understanding of EA definitions.
    e. The means to allow for qualitative reflection.
2. The architecture of the SIM embodies –
    a. Distinct phases of execution, in terms of method preparation, method application and communication of results.
    b. Distinct executable steps with clearly defined inputs and outputs.
    c. Points of reflection on results of executable steps.
    d. The hermeneutical cycle of interpretation.
    e. The influence and impact of the interpreter in the execution of the method.

The net result of the demonstration of the SIM is an understanding of EA, in the form of a claim about the meaning of EA, as well as a set of supportive propositions.

3.3.2.2 EAt Design Cycle

The design problem that drives the design of the EAt states that the foundational meaning of EA (the result of the SIM demonstration) is unspecified in conceptual terms. The EAt design problem is reached by achieving the following two objectives:

1. Identify the foundational EA concepts and their relationships.
2. Structure EA foundational concepts and relationships in an architectonic.

The resources needed to complete Step 1 and 2 are similar to the SIM – namely knowledge of the state of EA terms and definition discussion, as well as knowledge about solutions that make EA's implicit foundations explicit. In the execution of Step 3, the EAt is developed by making use of Heidegger's equipment analysis (Heidegger, 2000) to determine the foundational concepts of EA. The SIM evaluation results (i.e. an understanding of EA) serve as a resource for the development of the EAt. In Step 4, the EAt is evaluated according to a set of instructions that capture the knowledge of how to use the EAt. The efficacy of the EAt in solving the research problem is assessed in Step 5, by applying an EAt evaluation instrument to demonstrate the EAt to a group of EA practitioners and academics. The interviewee responses are analysed in terms of the EAt evaluation metrics, and produce observations on the value of the EAt to explain the foundations of EA in an explicit manner. Figure 3.12 illustrates the complete design cycle in terms of outputs and resources.

The description of the design of the EAt is described as follows, in terms of its desired functionality, as well as its architecture:

1. The desired functionality of EAt contains –
    a. A set of foundational EA concepts.
    b. A description of the relationships between foundational EA concepts.
    c. A graphical representation of the EAt, to facilitate its use in explaining the foundational meaning of EA.
2. The architecture of the EAt embodies –
    a. Distinct representation of EA foundational concepts.
    b. Distinct representation of the relationships between EA foundational concepts.

The evaluation of the EAt produced opinions and observations about the value of the EAt as a tool to explain the fundamental concepts of EA. The EAt evaluation protocol (Appendices C, D and E) was approved by the Unisa School of Computing ethics committee, after which the evaluation was conducted over a period of two weeks to an audience of six EA practitioners and researchers. Due to research scope and time limitations, an exhaustive evaluation of the efficacy of the EAt is outside the scope of this research, and will be listed as an important issue for further research. The results of the EAt evaluation and the research contributions are discussed in detail in Chapter 5 (section 5.5.3).

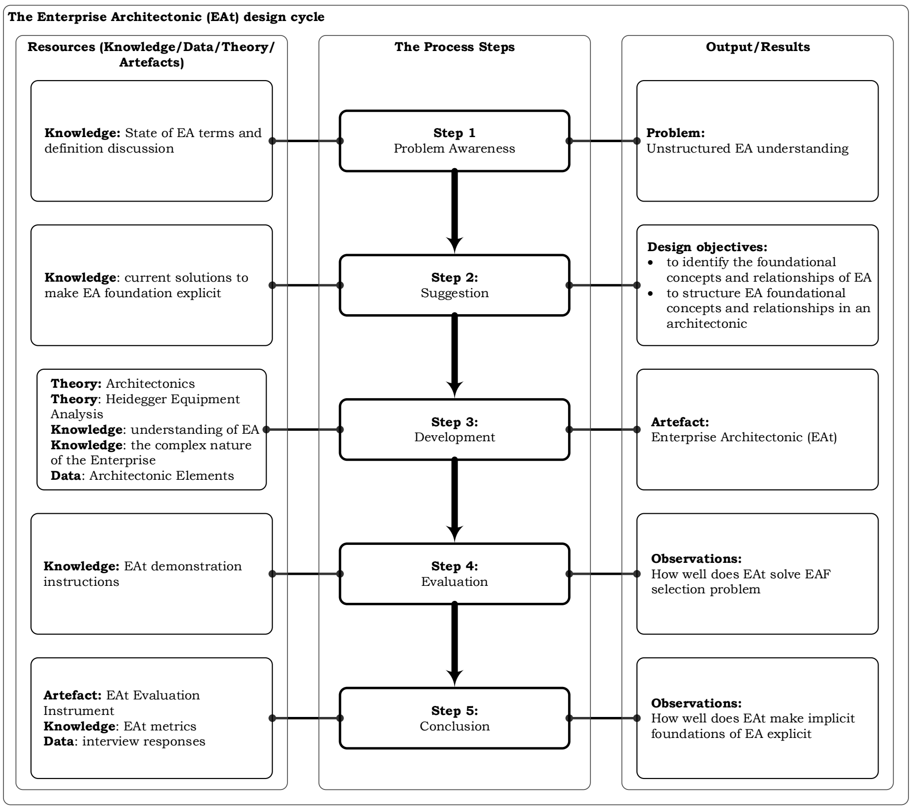


Figure 3.12: The EAt Design Cycle Activities

3.3.3 Step 3: Data Collection, Data Sources and Assumptions

The resource for each process step is produced by a number of possible data collection and verification methods (Figure 3.8). Knowledge, for example, is the result of a review of the literature, whereas data is the result of methods such as interviews and artefact demonstrations. Data is therefore an important part in the design process.

3.3.3.1 The Role of Data and Analysis in the SIM

The SIM's design goal (section 3.3.2.1) is to determine an understanding of EA. The data source needed to achieve the SIM's design goal is the EAF, because of the realisation relationship between an EAF and EA. In the SIM's design cycle, a literature review is used to establish the knowledge resources for Step 1 and Step 2. The resource for Step 3 is a synthesis of the theoretical concepts of the theories of interpretation and understanding. Finally, to adequately demonstrate the SIM in Step 4, resources such as theory (worldview theory) and knowledge of how to execute the SIM, are needed. The resources, as well as the data methods and data sources, are shown in Figure 3.13:

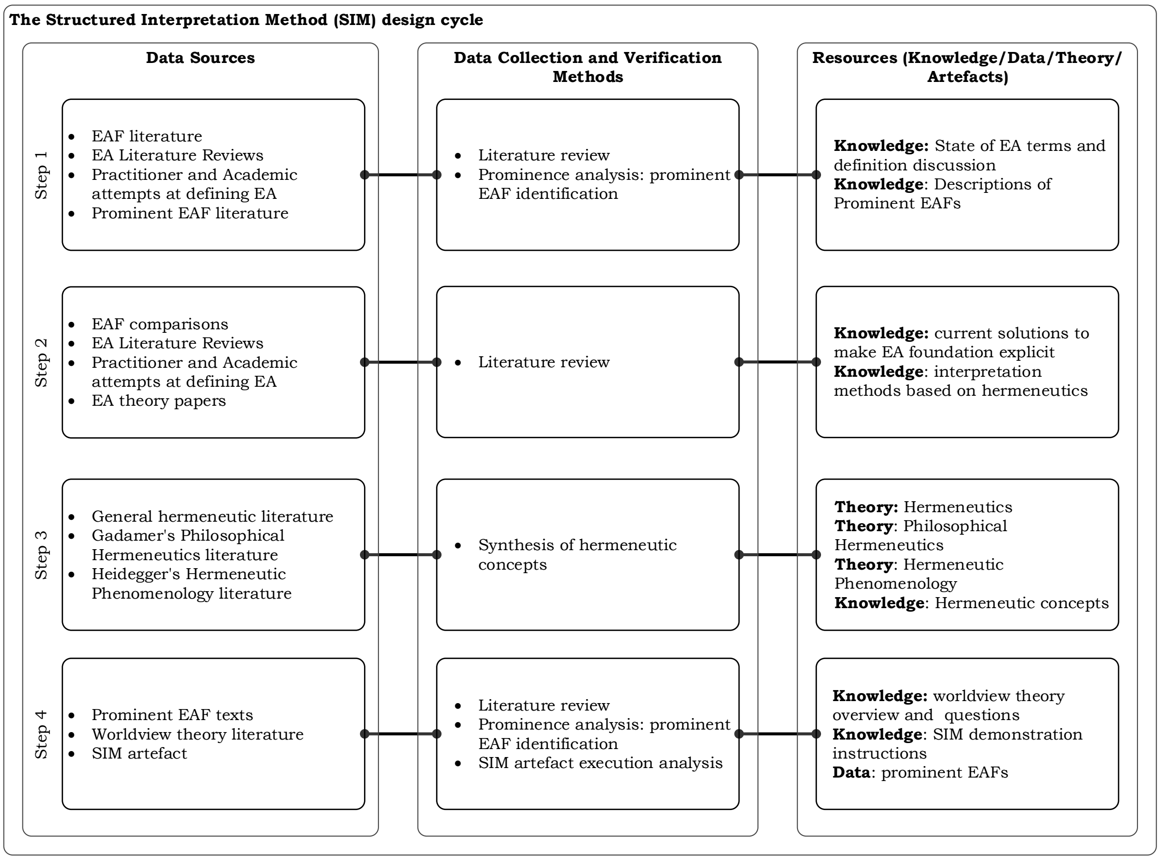


Figure 3.13: The SIM Design Cycle Data Collection and Sources

The demonstration of the SIM results in a claim about the understanding of EA, supported and enhanced by a set of EA propositions. The SIM evaluation results serve as the input to the design and development of the EAt.

3.3.3.2 The role of data in the EAt

The goal of the EAt's design (section 3.3.2.2) is to structure the understanding of EA (the EA claim and set of propositions) into a set of specific concepts and relationships. The data used to reach the EAt's design goal is therefore the results from the evaluation of the SIM. The analysis technique is a twofold process: firstly, interpreting the SIM's evaluation results in the light of Heidegger's equipment analysis (section 5.3.2) to determine the set of EA concepts and their definitions; and secondly, establishing the relationships between EA concepts. Finally, the concepts and relationships are organised in the architectonic, according to architectonic theory (section 5.3.1). The EAt evaluation results in a set of interview data that is analysed against the evaluation metrics, to measure the EAt's effectiveness in solving the problem of providing a structured explanation of the fundamental meaning of EA in terms of concepts and their relationships. The resources, as well as the data methods and data sources, are shown in Figure 3.14:

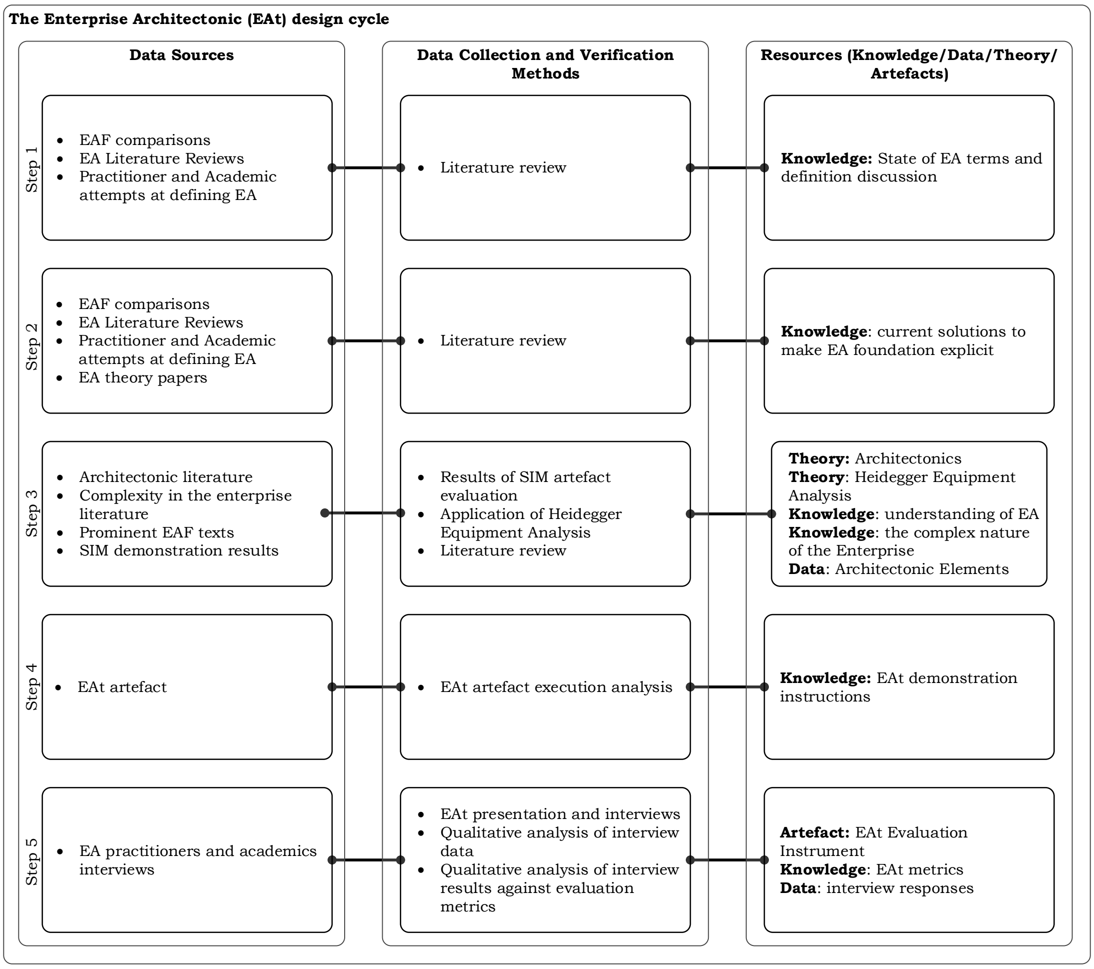


Figure 3.14: The EAt Design Cycle Data Collections and Sources

3.3.3.3 Assumptions

Due to the conceptual nature of the design, implementation and demonstration of the SIM, as well as the EAt artefacts, a number of assumptions guide the research process, namely –

1. With regard to the aspect of EAF representation, the assumption is that the selected EAFs represent the meaning of EA in a conceptually balanced manner. The selection of the prominent EAFs is described in detail in Chapter 2 (section 2.4.1), and, as such, represent a reasoned approach to determine popular EAFs as reflected in academic research publications. This reasoned process did not make any allowance for the scientific value of the selected EAF. The assumption is that a selected EAF, based on academic popularity, will produce results useful to the resolution of the main research question.
2. The use of the philosophies of Heidegger (2000) and Gadamer (2004) is assumed to be sufficient for the role of interpretation of the representative EAF texts. This assumption is made in the light of Gadamer's resistance to the idea of a method as a means to determine truth. The intent in the creation of the SIM was not to develop a method as a guarantee of interpretation, but rather to bring a sense of structure to the process of interpretation. Heidegger, in his philosophical project, asked after the meaning of being, and provided an equipment analysis that is applied to EA research.
3. Finally, the appropriateness of DSR to conduct research of a fundamentally conceptual nature, is assumed, as at the very least, possible, and cognisance is taken as to the difficulty of using a *learning by making* approach to the study of a phenomenon that in essence is conceptual, and not a tangible, substance-based thing.

The impacts of these assumptions are addressed again at the end of this thesis (section 7.3).

3.3.4 The Research Map

The detailed research map combines the five DSR process steps, as well as data sources. Figure 3.15 shows the detailed research plan of the EAt cycle, whereas the research map for the SIM is shown in Figure 3.16.

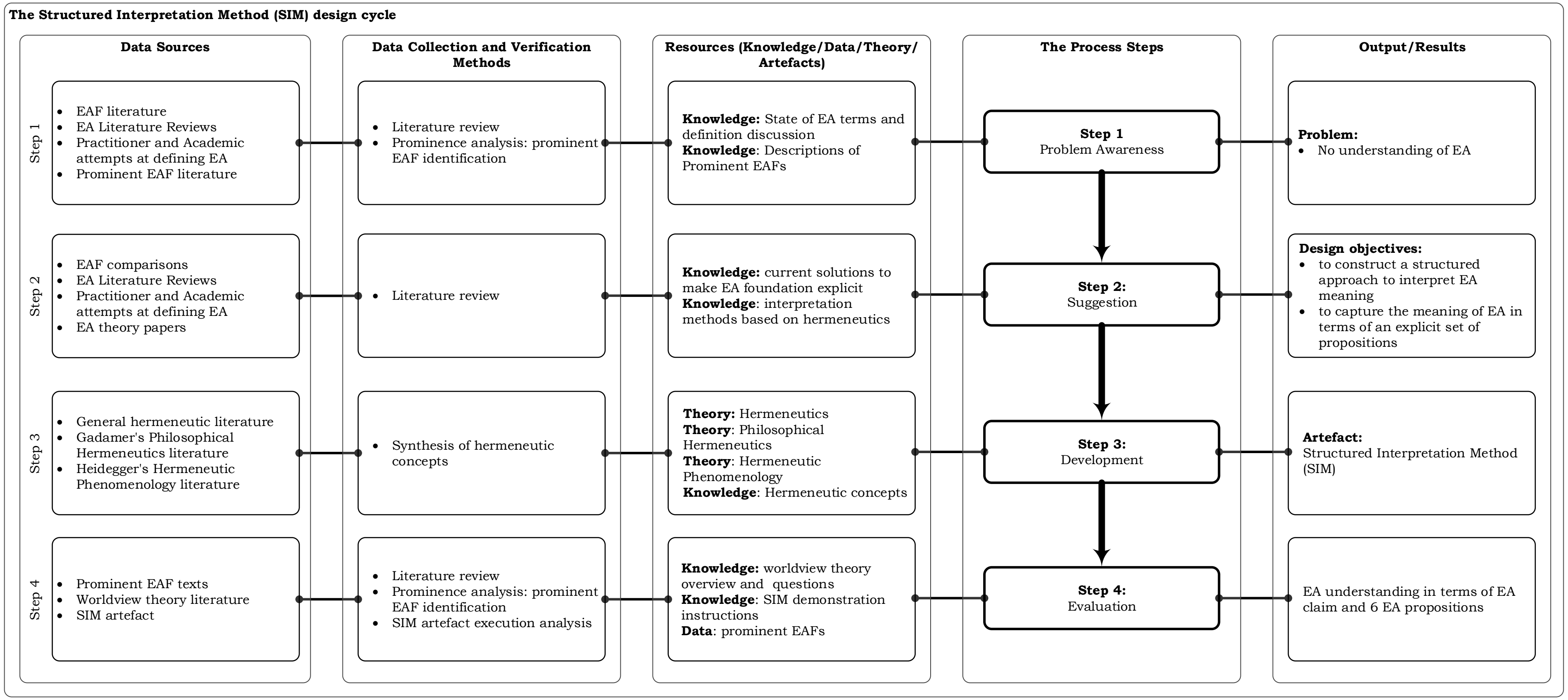


Figure 3.15: The SIM Design Cycle

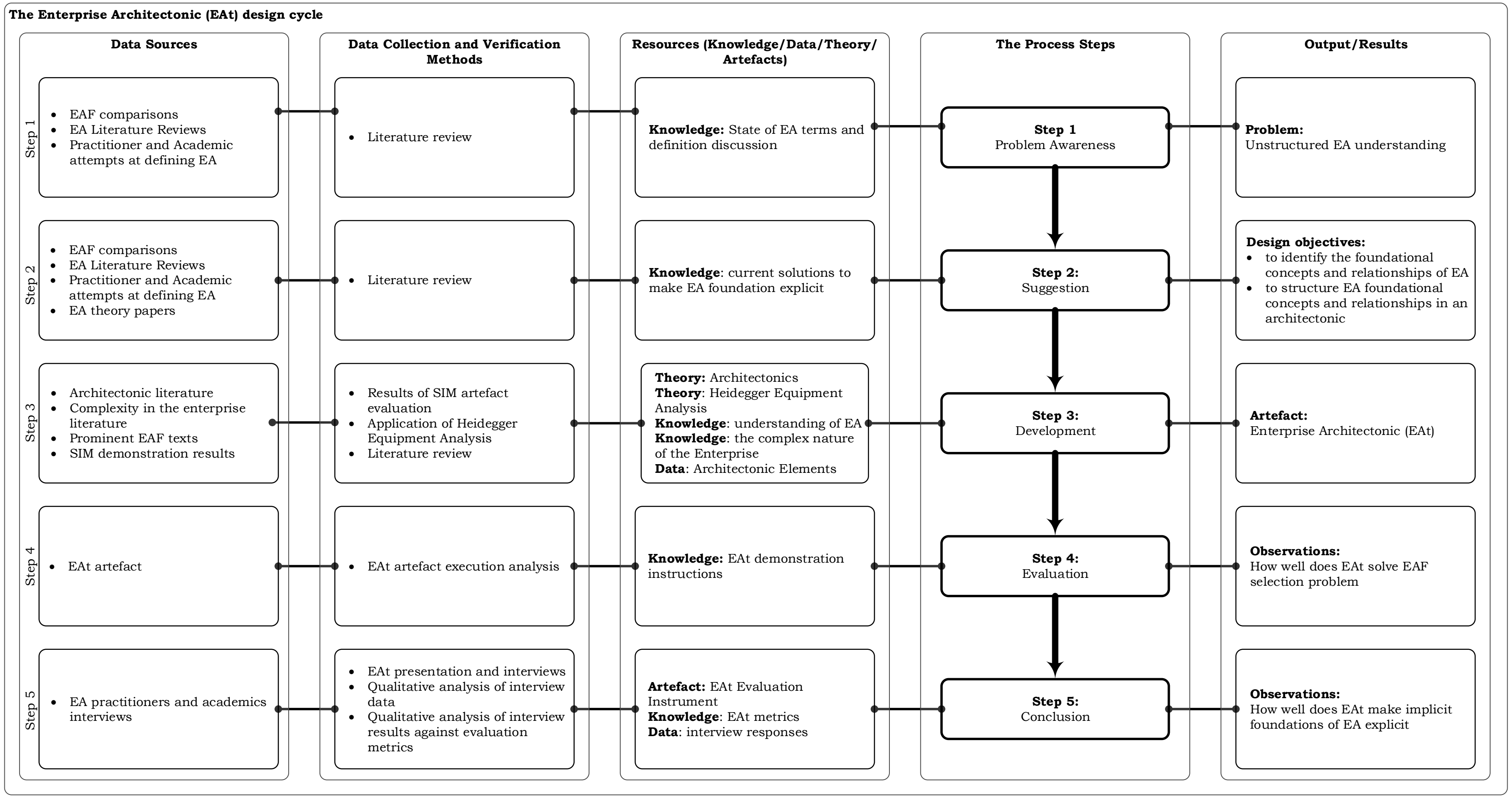


Figure 3.16: The EAt Design Cycle

3.4 CONCLUSION

The aims of research are to produce new knowledge to add to an existing body of knowledge, so that the field of inquiry can grow in its understanding of itself. The process to increase the body of knowledge must of necessity be technically correct, so as to be of value and trustworthy. What makes research results more than a matter of opinion, is the relationship between the research plan and the demands of good science.

This research is approached as, fundamentally, a qualitative study that approaches the world from a realist perspective. Understanding is achieved as a function of the human mind's ability to interpret the world as meaningful. The knowledge created in this research, as a social construction, is the result of designing, implementing and demonstrating artefacts. The result is a conceptual understanding of EA that expands the EA body of knowledge. The next two chapters discuss the details of the execution of the research plan discussed in this chapter.

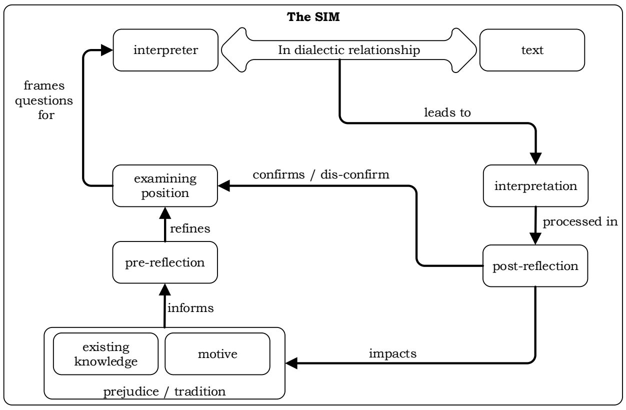
CHAPTER 4: A STRUCTURED INTERPRETATION METHOD

Chapter Map

CHAPTER 4: A STRUCTURED INTERPRETATION METHOD

- **4.1 INTRODUCTION**
- **4.2 THE PROBLEM AND SOLUTION**
- **4.3 THEORY USED TO DEVELOP THE SIM**
  - 4.3.1 An Overview of Phenomenology
  - 4.3.2 An Overview of Hermeneutics
  - 4.3.4 The Theory of Interpretation
- **4.4 THE DEVELOPMENT OF THE SIM**
  - 4.4.1 The Dialectic Relationship between Interpreter and Text
  - 4.4.2 The Interpretation of the Text
  - 4.4.3 The Role of Tradition and Prejudice
  - 4.4.4 The Hermeneutic Circle
  - 4.4.5 The Role of Reflection
  - 4.4.6 The Conceptual Representation of the SIM
  - 4.4.7 The SIM Applied as a Process
  - 4.4.8 The Limitations of the SIM
- **4.5 THE EVALUATION OF THE SIM**
  - 4.5.1 Phase 1: Setup and Preparation
  - 4.5.2 Phase 2: Understanding and Contextualization
  - 4.5.3 Phase 3: Write Up and Communicate
- **4.6 CONCLUSION**

Chapter Summary



An EA Understanding

EA Claim

Enterprise architecture is similar in intent to the enterprise as a worldview is to the world.

6 EA Propositions

- EA underlying theoretical knowledge is in a pre-suppositional state.
- EA is a description of the structure of the systems of an enterprise.
- EA represents the enterprise in time-oriented architectures such as an as-is, to-be and has-been architecture.
- EA translates the values/strategy of the enterprise into operational systems appropriate to the information society.
- EA provides a means to manage decisions about the IT/IS) management and implementation in the enterprise.
- EA captures a representation of the enterprise in the form of a model or set of models.

4.1 INTRODUCTION

The effort expended in understanding a research domain and its key concepts, is a non-trivial exercise. Philosophers and scientists alike have spent many hours in debating seemingly basic questions such as "what is reality?" and "what is knowledge?" Since the purpose of the artefact discussed in this chapter addresses the issue of an understanding of EA, it is appropriate to be clear on the theoretical foundations of the artefact's design. The nature of the artefact is closely related to its purpose, in that it should aid understanding by way of interpretation; as such, it is formally called a Structured Interpretation Method (SIM). Due to the conceptual nature of the SIM's intent, its design rests on an interpretation theory foundation. This foundation provides a context that describes the relationship between understanding, interpretation and meaning, as it relates to the knowledge of a subject.

This chapter describes the design and demonstration of the SIM artefact, and is structured according to the five process steps of the DSR model discussed in Chapter 3 (section 3.3). The awareness of the problem (Step 1) and solution suggestion (Step 2) are discussed in section 4.2. Sections 4.3 and 4.4 provide a discussion on the theories used in the design and development (Step 3) of the SIM artefact. The SIM is evaluated (Step 4) in section 4.5, and concludes in section 4.6.

4.2 THE PROBLEM AND SOLUTION

The awareness of the problem with EA's implicit foundations was highlighted in Chapter 2 (section 2.5.1), and led to the suggestion of using architectonics to solve the problem. Once the DSR process entered the development step of the process, another problem was identified. The second problem arose as a result of the need for architectonics to have conceptual contents to work with, in order to create the EAt. What was missing was an understanding of EA (section 2.5.3), and the awareness of the absence of a general understanding of EA led to the awareness of the second cycle of the DSR process (Figure 4.1):

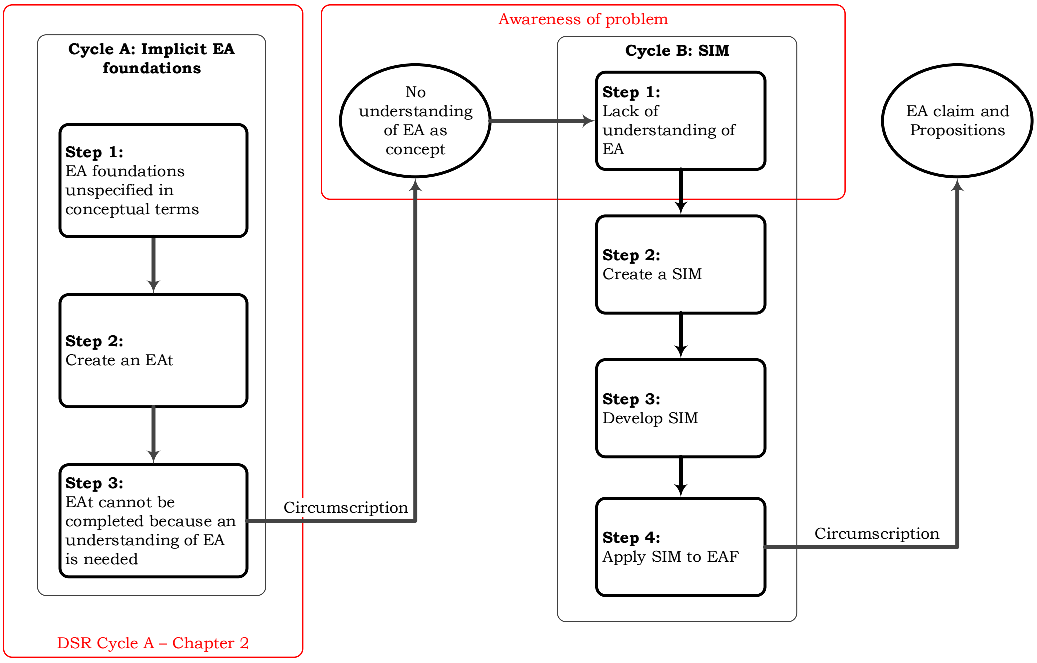


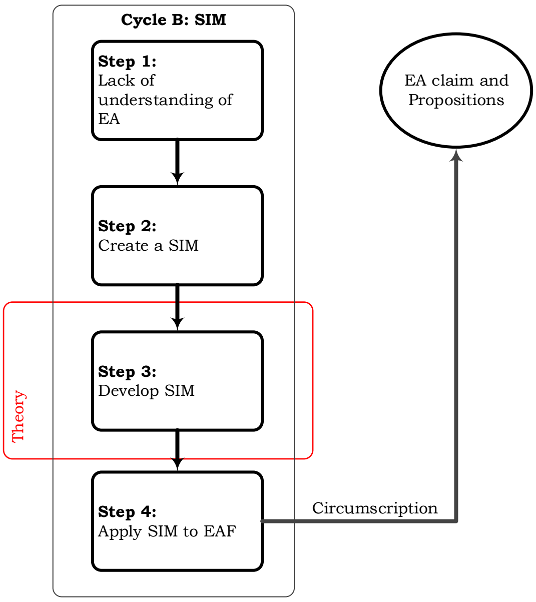
Figure 4.1: SIM Problem Awareness

The suggested solution to address the lack of general EA understanding, is to design and develop a structured method (the SIM) to interpret the key texts of EAF authors. The requirements of the SIM are as follows:

1. The desired functionality of the SIM contains –
   a. Repeatable steps to facilitate ease of use.
   b. A recognised interpretation theory foundation to facilitate validity and rigour of interpretation.
   c. The ability to interpret EA definitions in a phenomenological way.
   d. The means to produce a meaning and understanding of EA definitions.
   e. The means to allow for qualitative reflection.
2. The architecture of the SIM embodies –
   a. Distinct phases of execution, in terms of method preparation, method application and communication of results.
   b. Distinct executable steps, with clearly defined inputs and outputs.
   c. Points of reflection on results of executable steps.
   d. The hermeneutical cycle of interpretation.
   e. The influence and impact of the interpreter in the execution of the method.

The SIM was applied to the interpretation of the key texts of three prominent EAFs (section 2.4.1), namely the Zachman Framework, the DoDAF Version 2.02 and TOGAF Version 9.1.

4.3 THEORY USED TO DEVELOP THE SIM



DSR Progress Map

For the qualitative researcher, operating from an interpretative standpoint, the notions of knowledge, understanding and interpretation are not fixed in an absolute manner. Knowledge, for example, can be considered as *socially constructed* (Berger & Luckmann, 1966), understanding is a way to engage with everyday life (Inwood, 1999), while interpretation is formulated formally in the discipline of hermeneutics (Palmer, 1969).

Kinsella (2006) states that hermeneutics informs qualitative thought, due to the shared aspects of interpretation and understanding. Throughout the evolution of hermeneutics, the *thing* in need of interpretation started as religious texts, but later widened in scope to include anything that can be understood (or for that matter expressed) in terms of language. Philosophers such as Heidegger (2000) used hermeneutics as a means to interpret phenomena by developing a hermeneutic phenomenology (Van Buren, 2005). Later thinkers such as Gadamer (2004) developed Heidegger's hermeneutic phenomenology into a system of philosophical hermeneutics (Bontekoe, 1996). These two thinkers' work forms the theoretical foundation for the design of the SIM.

The sections that follow take the following assumptions into account in applying hermeneutics to the design of the SIM, namely –

1. EA can be understood in phenomenological terms.
2. EA is formulated by certain key thinkers, and their work is accessible in the form of textual representations of their thought on what EA is.

Finally, EA is understood as a phenomenon that can be studied by way of phenomenological methods, and its meaning can be understood by means of a hermeneutic approach. The following sections will clarify the basic tenets of phenomenology (section 4.3.1), hermeneutic phenomenology (section 4.3.3.1) and philosophical hermeneutics (section 4.3.3.2), and show how their main concepts feed into the design of the SIM.

4.3.1 An Overview of Phenomenology

The term 'phenomenology' means the study of the way things appear to the human consciousness (Hammersley, 2003), in order to identify the essential structures that characterise experience of the world. Berrios (1989) describes phenomenology as the combination of the Greek words *phainomenon* (which means to appear) and *logia* (which means discourse). Husserl (1859-1938) is associated with the development of phenomenology as a discipline that grew over a period of four decades (Wrathall & Dreyfus, 2006). Husserlian phenomenology is described as a descriptive enterprise aimed at clarifying phenomena by way of eidetic and reflective inquiry (Crowell, 2006). Thinkers and philosopher such as Heidegger, Jaspers and Stein developed Husserl's original ideas into various directions, to the degree that Husserl called himself a *leader without followers* (Moran, 2002).

Heidegger (1889-1976), in particular, called for a radicalisation (Harman, 2007) of phenomenology in its application as a way to think about life. Husserl's discoveries were portrayed by Heidegger (1992) as *an analytical description of intentionality in its a-priori*, and his application of phenomenology to the question of the meaning of *being*, led to the development of a *hermeneutic phenomenology*. Whereas Husserl argued for a phenomenology that removed, from the thinker, any preconceived ideas or notions about the phenomena, Heidegger worked towards a phenomenology that was based on an interpretation of the phenomenon (Cerbone, 2008). This circular movement made no allowance for an absolute or final understanding of the phenomenon, but, rather, an interpretation that increased understanding as the inquiry proceeded.

Figure 4.2 aims to capture the basic understanding of phenomenology. An entity (whatever it may be) is perceived by an observer as a projection of possibilities against a background of meaning that always already exists. The interpretation of the phenomenon depends on the relation between the observer and this background, as it forms part of the *world* that both the entity and the observer occupy.

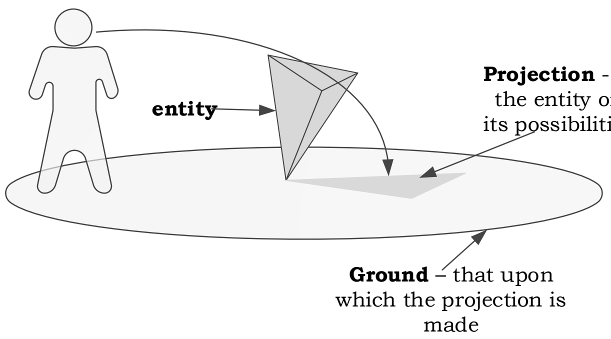


Figure 4.2: The Basic Understanding of Phenomenology

4.3.2 An Overview of Hermeneutics

Demeterio (2001) describes hermeneutics as a *theory, methodology and praxis of interpretation that is geared towards the recapturing of meaning of a text, or a text-analogue, that is temporally or culturally distant, or obscured by ideology and false consciousness*. Hermeneutics has a long and rich history that evolved from the interpretation of religious texts to a scientific method in its own right (Crotty, 1998). Figure 4.3 illustrates the evolution of hermeneutics from pure praxis to scientific praxis:

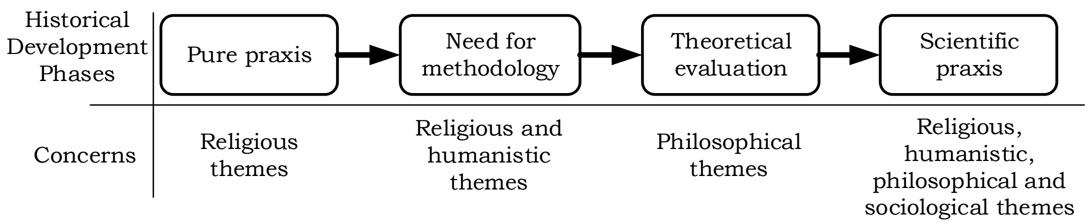


Figure 4.3: The Evolution of Hermeneutics

The meaning of the text, as an interpretation, is made possible, as the reader understand the parts in the context of the whole, and, conversely, the whole in terms of the parts (Jasper, 2004). This arrangement is called the hermeneutic circle (Jeanrond, 1994) (Figure 4.4):

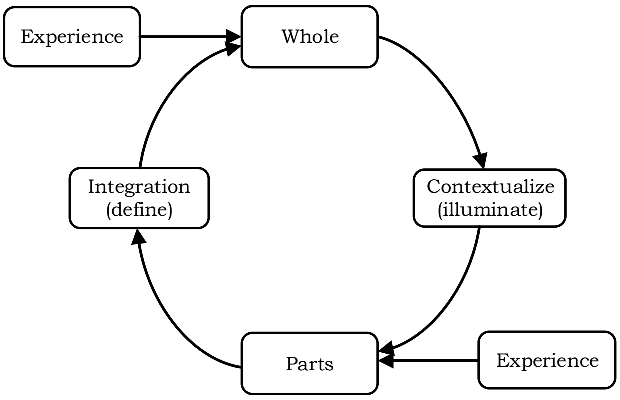


Figure 4.4: The Hermeneutic Circle (Bontekoe, 1996)

Another way to explain the exchange between whole and parts, is to consider interpretation as an engagement between a subject (or interpreter) and an object (or text) in order to reach the goal of understanding (Figure 4.5):

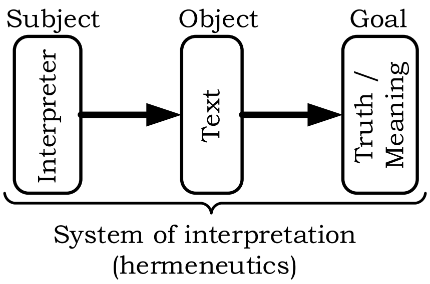


Figure 4.5: The Hermeneutic System

The range of interpretive systems that developed, as hermeneutics evolved, places diverse emphasis on the elements described in Figure 4.5. Various classifications of the approaches to interpretation have been proposed, and are summarised in Table 4.1. The main difference between the systems listed in Table 4.1, is the way that the hermeneutic system views the relationship between the subject and the object (Figure 4.5) of the interpretive act:

Table 4.1: Summary of Hermeneutic Systems (adapted from (Demeterio, 2001)

Hermeneutic System	Conception of the Subject	Conception of the Object	Goal	Structure of the Hermeneutic Arrow
Romanticist	Cartesian	Realist, but incomplete without the temporal and cultural contexts	Truth as authorial intention	Emanates from the subject through the text via the context
Phenomenological	Cartesian	Realist, and complete in itself	Truth as the thing as such	Emanates from the text
Dialectical	Heideggerian / Existential	Contains an infinity of meanings	Consensus as existential meaning	Circular

Critical	Cartesian	Warped by ideology and power	Ideologically purified truth	Emanates from the subject, and penetrates deep into the linguistic fabric of the text
Post-Structural	De-centred but wavers between Cartesian and Existential	Warped by ideology and power, and contains an infinity of meanings	Ideologically purified truth and meaning of the here and now	Combination of the romanticist, phenomenological, dialectical and critical arrows

The majority of the systems of interpretation based the nature of the subject and object interaction on a Cartesian perspective (also referred to as the mind-body dualism) of the world. Heidegger's exploration of the question of being, and his departure from the phenomenology of Husserl (Moules, 2002), brought about a decisive challenge against the mind-body dualism of the Cartesian perspective. Heidegger (2000) approached the question of being from a phenomenological perspective, explaining his approach as *letting things show themselves as themselves from themselves* (more precisely referred to as *apophantic* interpretation). As such, the exploration of being is an ontological activity and, in Heidegger (2000) case, a fundamental ontology, examined by way of a hermeneutic phenomenology. Bontekoe (1996) describes the work of Gadamer, who is credited with furthering Heidegger's ideas, as a move back towards epistemology. Gadamer (2004) was concerned with understanding as a mode of being-in-the-world, and developed a philosophical hermeneutics to aid in his task.

The impact of Heidegger's philosophy on the theory of interpretation, is significant (Clark, 2002). Heidegger (1968) claimed that a philosopher of value thinks but one great thought, which, in his case, was the *question of being*. The *question of being* was explored over a lifetime of philosophical work, and was highlighted and asked, as such, in the work *Being and Time*, published in 1927. The *question of being*, claimed Heidegger (2000), has been forgotten by philosophy, and taken as self-evident. Heidegger revived the *question of being,* and proposed a phenomenological approach in formulating an answer. The phenomenological approach described by Heidegger, although based upon the work of Husserl, became known as a Heideggerian phenomenology (Harman, 2007; Boedeker, 2005). Heideggerian phenomenology is technically described as a type of method that deals with the *how-being* of the objects of philosophical research. The essence of the phenomenological method is captured in the maxim: *to the things themselves* (Heidegger & Stambaugh, 1996).

Stated in a different way, the method of phenomenology serves to give the researcher (or philosopher) access to the research object (or *thing*[8]) being studied, in such a way that the *what-is* of the object is revealed by the object itself as it is in itself. In so doing, the process of the phenomenological method gives access to the *what-is* of the research object, and therefore makes the result of the research inquiry ontological. The meaning of the results of the phenomenological inquiry is understood as an interpretation of the meaning of the research object. As a result of Heidegger's hermeneutic approach

[8] In true Heideggerian vein, the thing that is researched is not to be viewed as an object observed and studied by a subject. In essence, Heidegger replaced the subject-object dualism by another way of "looking" at things as a "being-in-the-world".

to phenomenology, hermeneutics is changed into an ontology of understanding and interpretation (Palmer, 1969).

Heidegger introduced a number of terms with meaning specific to the project of understanding the meaning of being. First of all, a differentiation is made between *beings* and *being* (Gelven, 1989). *Beings* are the things that exists as such – for example, humans, trees and so forth, while *being* is the kind of thing that designates the *is-ness* of *beings*. In other words, *being* is the *what-is* of *beings*. For the purpose of his inquiry, Heidegger described the being of human beings as *dasein* (a German term that literally means *being-there* or *there-being*) (Inwood, 1999). *Dasein* serves the purpose of describing the kind of entity that has the capacity of asking and answering the *question of being*.

Heidegger's reasoning was that human beings are the only beings capable of asking the *question of being*. A human being, in asking the *question of being,* shows a sense of care for the outcome of the question, and therefore is the entity that possesses the possibility of an answer. Secondly, Heidegger made a distinction between an *ontological* and an *ontic* examination of things (Gelven, 1989), where 'ontic' designates the properties of *beings* (objects and things) from a scientific perspective, and the term 'ontological' means the properties or structures of *being*. The differentiation between ontological and ontic is termed the *ontological difference*. Finally,[9] Heidegger treated the meaning of *understanding* in a unique way. Palmer (1969) describes Heidegger's unique characterisation of understanding as a 'power to grasp your own possibilities for being, within the context of the life-world in which you exist'. Seen in this way, understanding represents a way of being-in-the-world, and forms the basis for all interpretation.

In simpler terms, understanding means that dasein has a relationship with being which indicates that it knows what it means to exist or to be (Inwood, 1999). Heidegger's formulation of understanding represents an ontologically fundamental, as opposed to an ontic, description of being, because an ontic description suggests that some kind of theoretical examination has already taken place (Palmer, 1969). Heidegger intends to say that dasein knows what it means to be, before starting to think about what it means to be, and, as such, forms the basis of any thinking of what things mean and are.

Heidegger provides the means to explore the understanding of EA as an ontological inquiry. If EA is considered as essentially a human creation, then it could be said that the purpose of EA's creation is towards human ends. In order, then, to understand EA (in the Heideggerian sense), it needs to be characterised as a certain kind of thing to facilitate the design of an interpretation approach. A difficulty arises as to what kind of thing (for example, a technology, concept or idea) EA is, and how the researcher can get access to EA in order to understand it in an organised, structured manner. By applying Heidegger's hermeneutic phenomenological method, this difficulty can be overcome.

[9] Note: these are not the only terms invented and used by Heidegger in his philosophy, but are for the purpose of this chapter, and the research design in particular, of prime importance.

4.3.3 The Theory of Interpretation

The characterisation of hermeneutics as interpretivist in nature, makes it an important part of the interpretive research toolkit (Webb & Pollard, 2006). Prasad (2002) proposed both a weak and strong use of the term hermeneutics in management research that highlight the possibility of a spectrum of potential research applications for hermeneutics as a theory of interpretation. The evolution of hermeneutics shows its development as the basis of a methodology for human sciences research (Gadamer, 2004), and it is thus not surprising to find hermeneutically based research methods in fields such as nursing (Annells, 1996), psychology (Sandage et al., 2008), management science (Lee, 1994; Myers, 2008) and information systems (Klein & Myers, 1999; Cole & Avison, 2007; Wang et al., 2008).

Historically, hermeneutics dealt with the relationship between ontology and epistemology in various ways. During the earlier phases of its development, hermeneutics addressed the interpretation of obscure religious texts and fulfilled an epistemological function (Prasad, 2002). In the later phases (Figure 4.3) of hermeneutics' development, the contributions of Heidegger and Gadamer (Figure 4.6) introduced an ontological focus to the application of hermeneutics and to the task of interpretation (Bontekoe, 1996). Hekman (1983) emphasised Gadamer's preference for an *ontology that precedes epistemology*. Bontekoe (1996) has described the evolution of hermeneutics as a move from an epistemological focus towards an ontological focus, through the work of Dilthey and Heidegger, and then a move back again to a focus on epistemology through the efforts of Gadamer and Ricoeur (Figure 4.6):

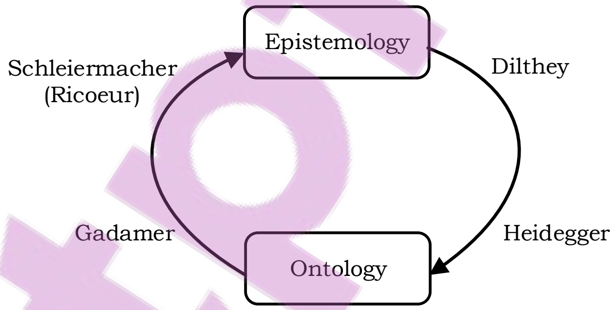


Figure 4.6: Interaction between Epistemology and Ontology in Hermeneutics

The purpose of ontology is to study what things are, while epistemology studies how knowledge is possible. Figure 4.6 illustrates the circular relationship between epistemology and ontology, in that what is known (epistemology) presupposes that there is something (ontology) that can be known. This circular relationship can be characterised as a kind of hermeneutic circle, in that the *thing* that is known in an epistemological sense must first exist ontologically, so that it can be known epistemologically. The theory of interpretation, as explicated by hermeneutics, binds these aspects together to inform interpretive research towards the goal of understanding the meaning of things.

4.3.3.1 Heidegger's Hermeneutic Phenomenology

Dasein's involvement with the world is characterised by understanding and interpretation (Inwood, 1999). Understanding relates to the environment (world) as a whole, while interpretation focuses on specific things in the world. Heidegger (2000) analysis of dasein's encounter with things in the world shows that dasein has an understanding of things, which is prior to a scientific examination of the things. An object (or thing) is interpreted *as* a certain kind of thing. The interpretation is dependent on an understanding of the world and the things in it. The development of understanding is illustrated in Figure 4.7; an explicit description (*laying out*) of *what* a thing is, is dependent on a pre-reflective understanding of the thing. In other words, dasein has some kind of understanding of the thing, even if it is a vague understanding. The pre-reflective understanding of dasein is in direct relation to the way that dasein is involved with the world; Heidegger calls this a concerned involvement that allows things to "show up" for dasein (Donnelly, 1999).

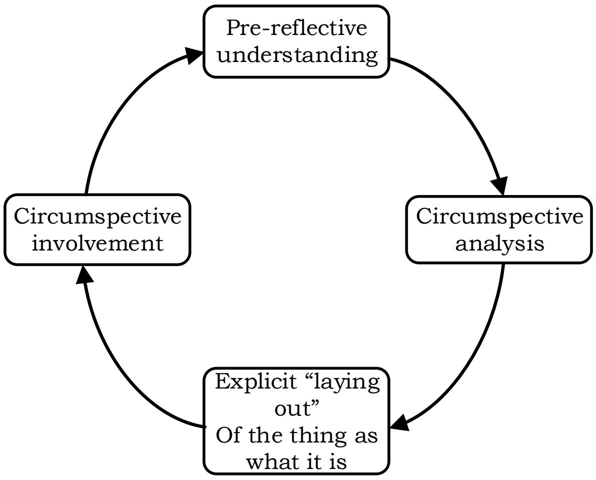


Figure 4.7: The Development of Understanding

For Heidegger (2000), all interpretation involves a *fore-structure* that consists of a *fore-having*, a *fore-sight* and a *fore-conception,* as illustrated in Figure 4.8. *Fore-having* means a general understanding of the entity to be interpreted, *fore-sight* is the idea of dasein having the entity to be interpreted in sight, and *fore-conception* means a pre-conception (in terms of the concepts at dasein's disposal) of the meaning of the entity to be interpreted (Inwood, 1999). The point of this analysis is Heidegger's intent to show that dasein's everyday engagement with the world takes on a pre-theoretical character (Clark, 2002). In a sense, dasein always already understands the things in the world in a practical way as they are encountered (Nielsen, 2007). This understanding can be described as an *as-structure* and a *for-structure*. In the *as-structure* a thing is understood as a kind of thing; for example, a hammer is understood as a hammer (Inwood, 1997). Things can also be understood as *for* something, some task or purpose; for example, the hammer is *for* hammering – i.e. to drive nails into a piece of wood. The interpretation does not end at this point, but rather moves in a circle, due to the change in the fore-structures as a result of dasein's interaction with the entity. The circular movement forms a hermeneutic circle that is never-ending, and suggests that dasein will never reach a final understanding of the thing under consideration.

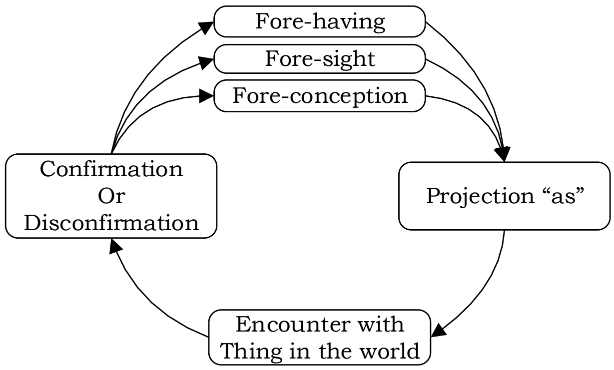


Figure 4.8: The Fore-Structures of Understanding

Phenomenology, for Heidegger, points to the *things themselves* (Seigfried, 1976), and entails phenomena that are defined as *the totality of what lies in the light of day or can be brought to the light* (Annells, 1996). Palmer (1969) explains Heidegger's phenomenology as an understanding that the thing being studied (also called a phenomenon) shows itself for what it is, without the observer forcing an understanding or view on it. Heidegger shows that this process entails the observer approaching the phenomenon with his existing presuppositions from tradition, but with an attitude of openness, so that the presuppositions can be tested by the interaction with the phenomenon (Bontekoe, 1996). The interaction of dasein with the phenomenon is thus also hermeneutic in its character, as it plays out between the observer, the phenomenon and the world.

The main point to emphasise in this section is that for Heidegger, unlike Husserl, the process of interpretation cannot proceed effectively, unless the researcher's preconceptions are made visible, and are acknowledged as playing a part in the interpretation.

4.3.3.2 Gadamer and philosophical hermeneutics

Gadamer (1900-2002) developed the implications of Heidegger's contribution to hermeneutics into a systematic work on philosophical hermeneutics (Palmer, 1969), and in so doing provided a phenomenological account for all understanding (Dostal, 2002). For Gadamer, no separation existed between a practice that is the result of understanding, and theoretical reflection on that practice (Johnson, 2000). The understanding of a text is evident in the reader's application of what the text says to the reader.

Grondin (2002) argues that Gadamer understood understanding as a three-part conception of *intellectual grasp, practical know-how* and *agreement.* This conception works itself out as a translation from what is unknown and foreign, to that which is understood and therefore able to be applied. Walsh (1996) lists the key concepts of this translation process as the *hermeneutic circle, the notion of play, prejudice* and *the fusion of horizons.*

4.3.3.2.1 Gadamer's Hermeneutical Circle

Reading a text functions in a similar way to a conversation, except that the text is standing in for the author (Bontekoe, 1996). This is not an arbitrary process wherein the reader can summarily force a meaning on the text. The text, as it is, "speaks" to the reader concerning its subject matter, while the reader engages with the text for the purpose of understanding the subject matter (Figure 4.9).

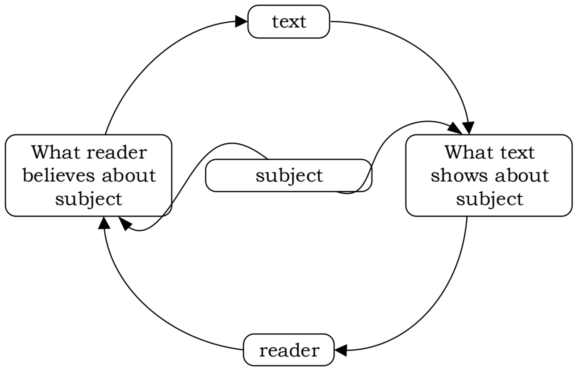


Figure 4.9: Gadamer's Hermeneutic Circle

Central to this process, therefore, is the matter (the subject) that is dealt with in the text (the German word for this is *sache*); any deviation from this matter leads to a situation where no interpretation, and thus no understanding, is possible (Grondin, 2002). The illustration in Figure 4.9 highlights this interplay as a hermeneutical circle between the text and the reader. The reader does not approach the text in an objective fashion, but with an already-formed belief of what the text is about. Gadamer modelled this on the Heideggerian fore-structures of understanding, and it serves to show that the reader and the text are actively part of the process of coming to an understanding.

4.3.3.2.2 Play and prejudice

The belief that the reader holds, in approaching the text, is also referred to as prejudice. This prejudice serves the important role of showing the impossibility of the reader approaching the text empty of opinion. This prejudice is formed, in part, by the tradition the reader and the text stand in, and is a function of what is already known and understood, by the reader, about the subject matter (Davey, 2006). The way in which the reader approaches the text is described as similar to the play between participants of a game. The idea of *play* (*spiel* in German) is taken metaphorically as the *play of light on water* (Gadamer, 2004), and indicates the way in which the *to and fro* movement is never-ending.

Put in a different way, *play* in a way absorbs the players, to the extent that the game is not played so that it can end, but that it is played for itself. Davey (2006) states that *play* is Gadamer's way of explaining that the act of interpretation, in its hermeneutic nature, is also never-ending. As the reader of the text approach the text with interpretation and understanding in mind, what comes with the reader is a horizon of already existing understanding (the prejudice) that is formed by the tradition wherein the reader stands (Gadamer, 1983). The *reading* of the text, as an act of interpretation, for Gadamer takes on the character of *play*, in that the reader and the text interact in a *to and fro* movement similar to a dialectical relationship (Gadamer, 2004).

4.3.3.2.3 The fusion of horizons

Garrett (1978) explained Gadamer's *horizon of understanding* (Figure 4.10) as a technical term based on metaphor, to indicate the limits placed on an interpreter by time and culture. Furthermore, this horizon is defined in terms of the pre-judgments of the interpreter as it is at the present time (Garrett, 1978). This horizon corresponds to the interpreter's knowledge of a particular topic at a time in history, and is subject to constant change. The text, also, is said to have a horizon in that it only says as much about the subject matter as it says, and no more. This is described as the text being, in a way, the answer to an already asked question.

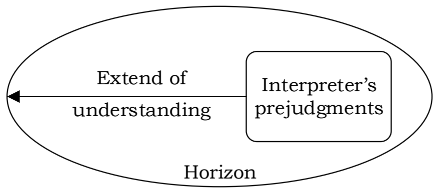


Figure 4.10: Gadamer's Horizon of Understanding

Gadamer explained that the moment understanding takes place, a fusion of the horizons of the phenomenon and the interpreter takes place (Gadamer, 2004). Figure 4.11 illustrates the fusion of horizons process. The fusion of horizons is achieved by way of a dialectical exchange between the observer and the observed, in that the text or text analogue *answers* questions posed by the interpreter, but also poses questions, in turn, back to the questioner. Understanding, in this way, is defined as an event captured in time, and therefore not final:

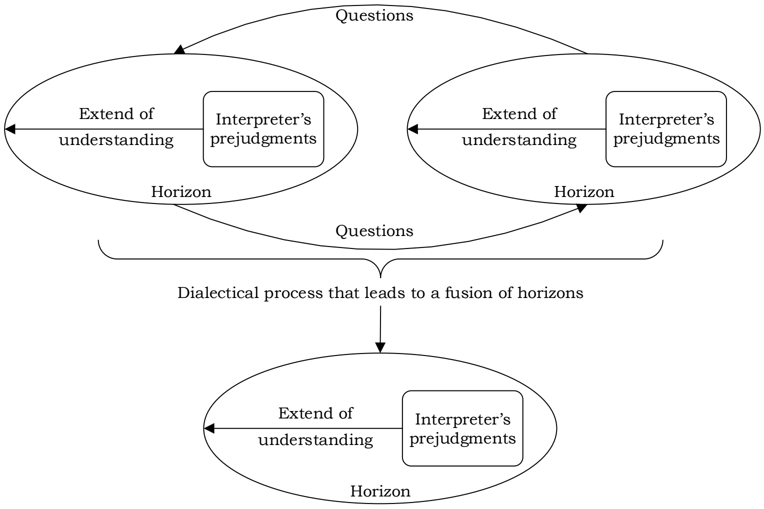
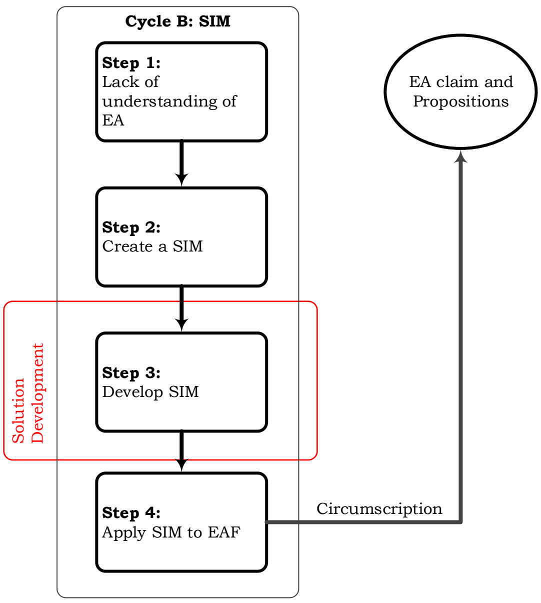


Figure 4.11: Gadamer's Fusion of Horizons

4.4 THE DEVELOPMENT OF THE SIM



DSR Progress Map

While Gadamer did not develop a method to apply hermeneutics as a research methodology, his work did provide a way to consider the act of understanding in the process of research. The concepts of *horizon of understanding* (section 4.3.3.2.1 and Figure 4.10), *fusion of horizons* (section 4.3.3.2.3 and Figure 4.11), *dialogue* (section 4.3.3.2.2) and *play* (section 4.3.3.2.2) informed the design of the structured interpretive method (SIM). The development of the SIM is described in a stepwise fashion. Firstly, the key concepts used in the design of the SIM are discussed; secondly, the design of the SIM is discussed by focusing on each critical component, after which the SIM is illustrated in a concept map (section 4.4.6) to shows its function in the task of interpretation. The development of the SIM concludes with the conversion of the SIM concept map into a process (section 4.4.7), to facilitate its application as a method.

4.4.1 The Dialectic Relationship between Interpreter and Text

In an interpretive situation, at least two central elements need to be involved – namely an interpreter and something to interpret (the *text* or *text equivalent*). A hermeneutic system includes these core elements, and adds the concept of interpretation as the result of the interaction between interpreter and text (Figure 4.5). The design of the SIM therefore starts at the point of exploring the nature of the relationship between the reader (who interprets) and the text (that which is interpreted). Gadamer (2004) described this hermeneutical relationship as dialectical in character. The text is, in a sense, the answer to an unspoken question (Aylesworth, 1991) and, thus, stresses the importance of the question in the hermeneutical experience. From the interpreter's perspective, the text is experienced in the same sense as a conversation with another person (a *Thou*) (Gadamer, 2004). The interaction, towards the goal of understanding, between interpreter (as I) and the text (as Thou) takes the form of *play* (Walsham, 2006). Play is furthermore typified by an openness, on the part of the interpreter, to take in or listen to what the text has to say (section 4.3.3.2.2). As such, the text represents its own meaning, separate from what the interpreter would want it to mean. Figure 4.12 illustrates the dialectic relationship between the reader and the text:

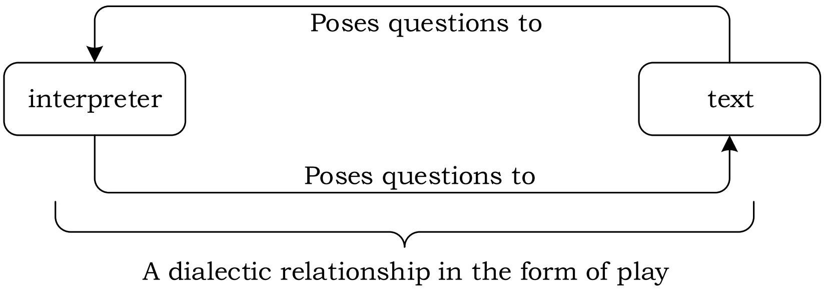


Figure 4.12: The Dialectic Relationship between Text and Interpreter

4.4.2 The Interpretation of the Text

The text, once understood as embodying a meaning, is bounded by a horizon of understanding. The text, as such, cannot say or mean more that it contains, and it is therefore important to note that meaning is not forced onto the text by the interpreter. In the same sense, the interpreter also has a horizon of understanding. In due course, the interaction between interpreter and text leads to an interpretation in the form of a fusion of these horizons. Figure 4.13 illustrates the resultant interpretation that is due to a dialectic interaction between reader and text:

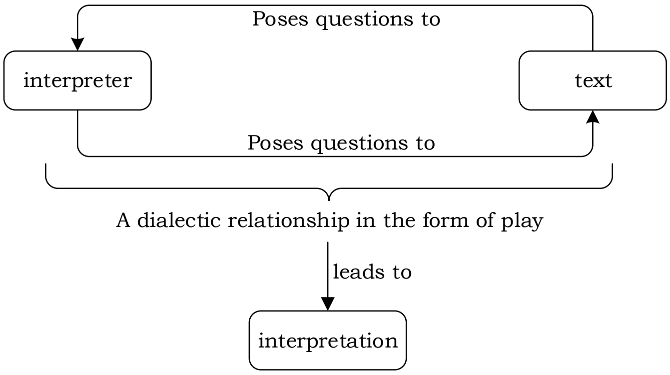


Figure 4.13: Interpretation as the Result of Dialectic Interaction

4.4.3 The Role of Tradition and Prejudice

Gadamer (2004) made it clear that no understanding is possible without bringing tradition and prejudice into the act of interpretation. A text does not exist in isolation from a framework of already existing meanings and knowledge. The interpreter, in approaching the text in order to interpret it towards the goal of understanding, does so with an existing set of meanings and knowledge about the subject matter of the text. Inherent in the design of the SIM is an opportunity for the interpreter to examine and state relevant prejudice, as well as the tradition related to the particular interpretation. Every act of interpretation is based on a reason or motive for engaging in the interpretation activity. The interpreter's motive is represented in the method as an *examining position* that is *informed* by the interpreter's *tradition* as well as *prejudice*. The examining position designates an opinion already held by the interpreter, about the meaning of the text. Figure 4.14 illustrates the way in which the tradition informs the examining position of the interpreter. The purpose of indicating this so clearly, as part of the method, is to recognise the impactful role of the interpreter's tradition and prejudice in the act of interpretation.

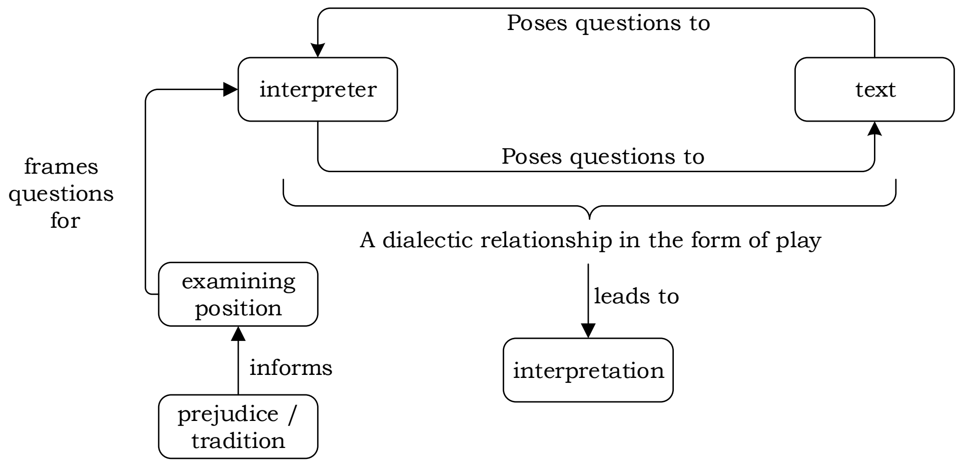


Figure 4.14: The Role of Tradition in Framing the Interpreter's Questions

4.4.4 The Hermeneutic Circle

The SIM embodies the relationship between the examining position, tradition and prejudice, and the interpretation of the text. The interpretation that results from the interaction between interpreter and text links to the interpreter's examining position in such a way as to show that the interpretation either confirms the interpreter's already held position, or not. Structurally, this forms a hermeneutic circle in that the interpretation is understood by the examining position, while the examining position forms the setting for the interpretation through its impact on the dialectical relationship between text and interpreter. This movement in the hermeneutic circle is where Gadamer's *fusion of horizons* takes place and, as a whole, represents the understanding of the text by the interpreter. Note also that the interpretation impacts the tradition and prejudice, to further add to the movement towards understanding. Figure 4.15 shows a conceptual representation of this relationship:

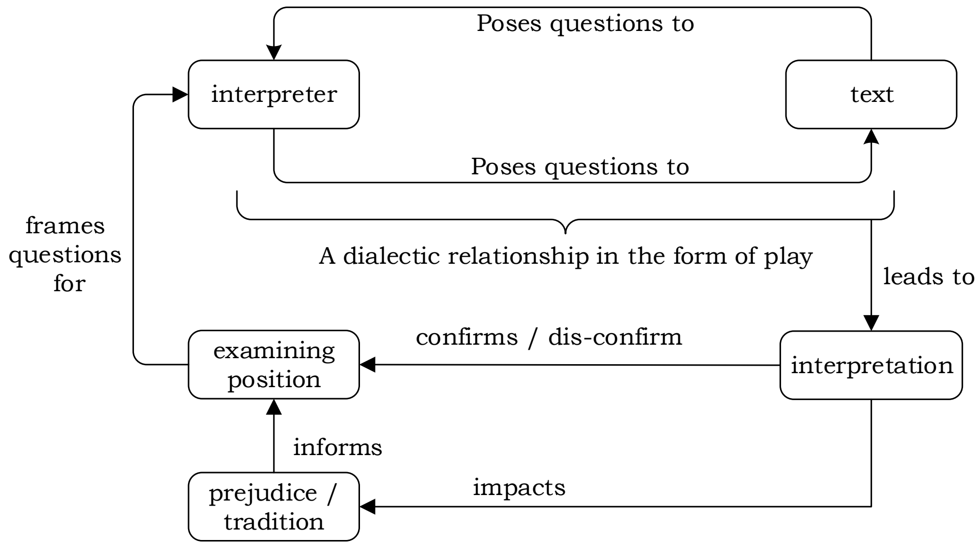


Figure 4.15: The Impact of Interpretation on Tradition

4.4.5 The Role of Reflection

Reflection is a key part of the activity of interpretive research (Klein & Myers, 1999). The researcher gets an opportunity to clarify his or her thinking process and its impact on the task of interpretation. In the design of the SIM, the points of reflection are a *pre-reflection* that feeds into the examining position, and a *post-reflection* after the interpretation is made. Figure 4.16 shows the method, with the reflection activities included:

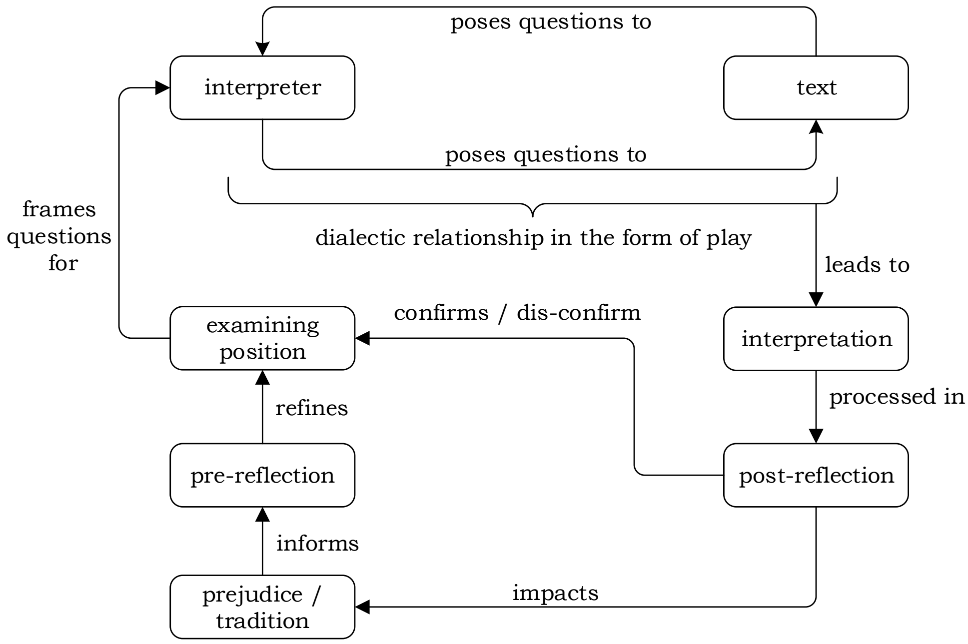


Figure 4.16: The Interpretation Method

4.4.6 The Conceptual Representation of the SIM

In order to emphasise the conceptual nature of the method, Figure 4.17 includes refinements, to capture hermeneutic meaning in the diagram. This is referred to as the conceptual map of the SIM:

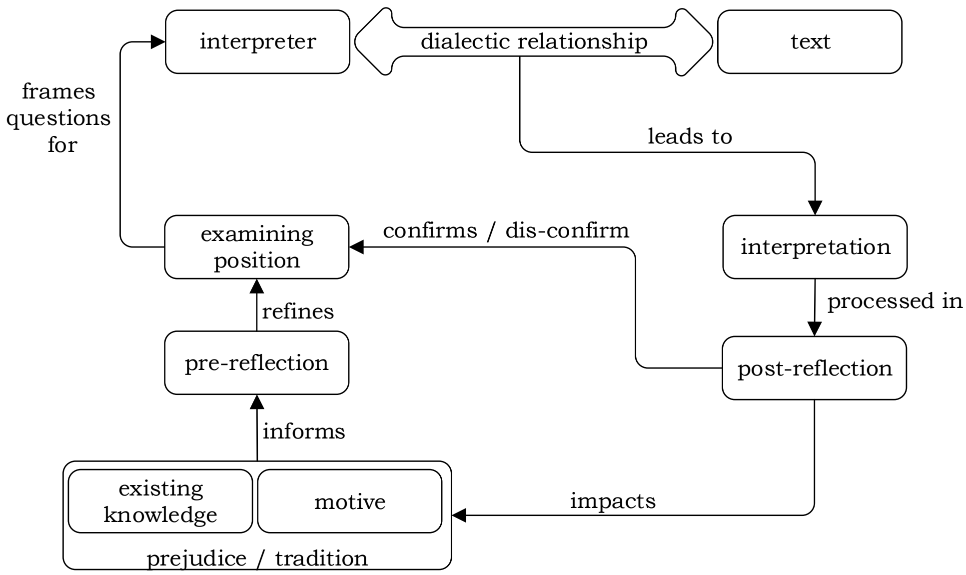


Figure 4.17: The SIM's Conceptual Representation

4.4.7 The SIM Applied as a Process

In order to facilitate the practical implementation of the SIM, it was converted to a stepwise process (Figure 4.18). An analysis of the conceptual representation of the proposed method shows the aspects of *dialectic, interpreting, reflection, prejudice and questioning:*

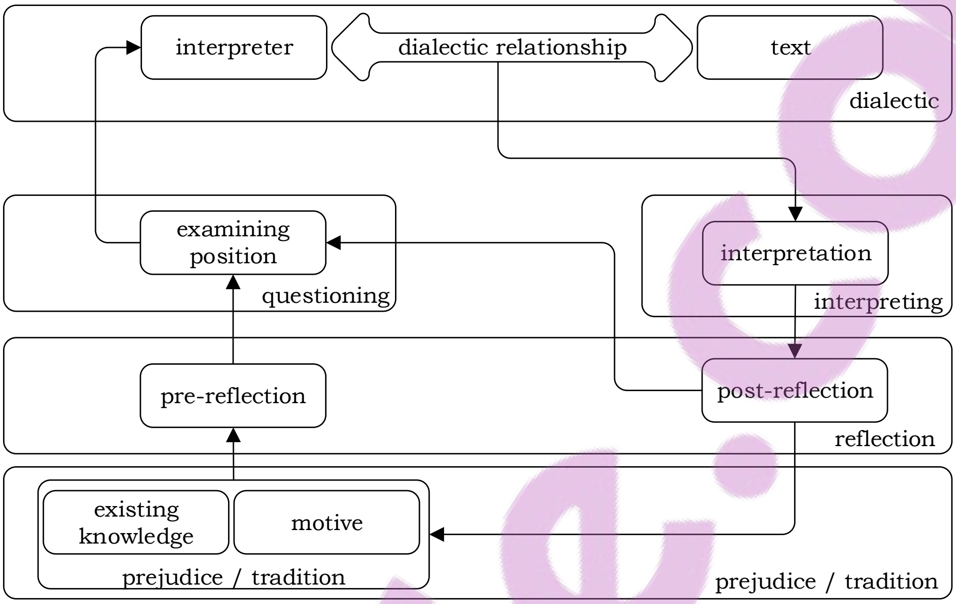


Figure 4.18: Converting the SIM to a Process

The overall process of applying the SIM to an interpretation of a text, is described in three phases:

a) Phase 1: Setup and preparation.
   During this phase, the necessary preparation needs to be made for the application of the SIM to an interpretation activity used in interpretive research. This phase includes the steps of a) *identifying the field of inquiry; b) identifying and collecting the text that will be interpreted; and, c) the clarification of a research question.*

b) Phase 2: Understanding and contextualisation.
   In this phase, the SIM is applied to interpret a text. The application of the SIM follows Gadamer's philosophy that a final understanding is not possible in interpretation. Knowledge evolves as more is known about a subject matter, and as such, the execution of the SIM could potentially continue as a never-ending interpretation loop. The mechanism to control the duration of the SIM is to limit the number of interpretive cycles, and is set prior to the execution of phase 2.

c) Phase 3: Write up and communicate.
   The final phase of the application of the SIM is a write-up of the understanding reached during phase 3.

Figure 4.19 shows a diagram that captures the sequential nature of executing the SIM as a part of a process:

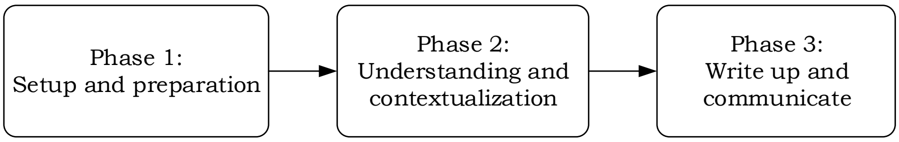


Figure 4.19: High- Level Process View of the SIM

By overlapping the high-level process described in Figure 4.19 onto the SIM, it becomes clear which of the SIM's steps is executed in the process (Figure 4.20):

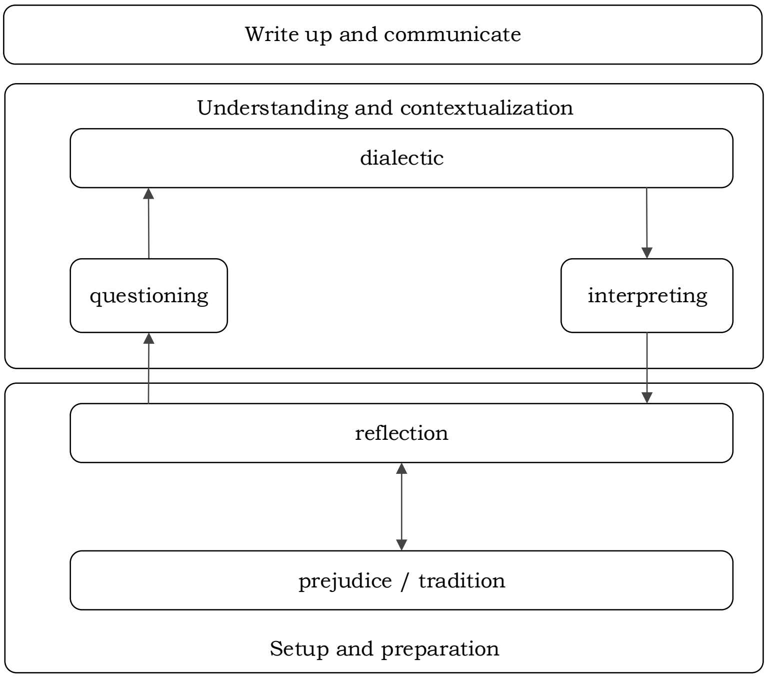


Figure 4.20: Detailed Process View of the SIM

4.4.8 The Limitations of the SIM

The application of the method demands intellectual honesty and integrity. The requirement of openness to being influenced by the phenomenon in letting it show itself, is critical to the effectiveness of the method. Figure 4.21 shows the inherent risk if the role of prejudice is underplayed (a direct consequence of not being open) in the application of the SIM. The tradition of the interpreter can *jump* over (indicated by way of a dashed line) the examining position, and, in so doing, obscure its role in the understanding of the phenomenon. Likewise, the motive of the interpreter can directly influence the examining position if the pre-reflection step is not followed. Both cases would negatively affect the conclusions drawn from applying the SIM.

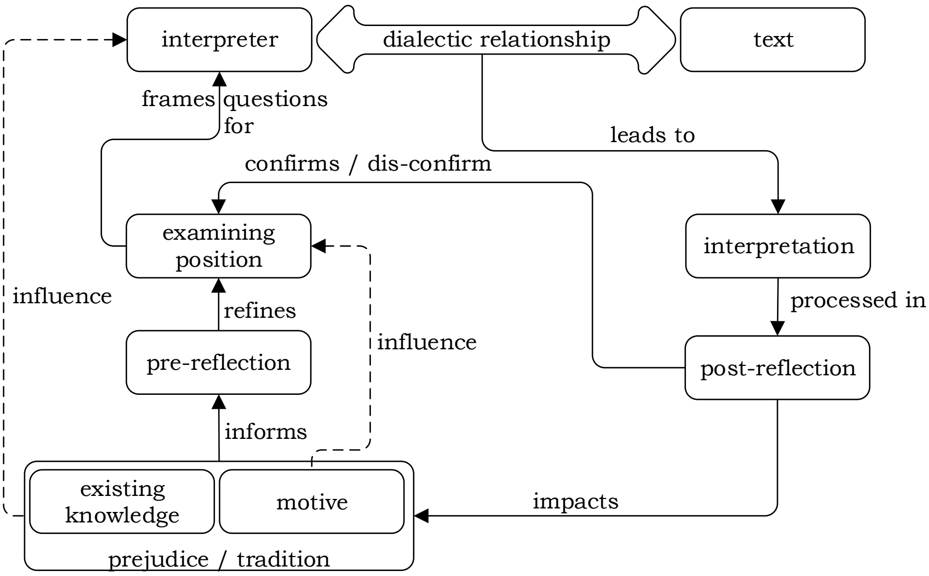
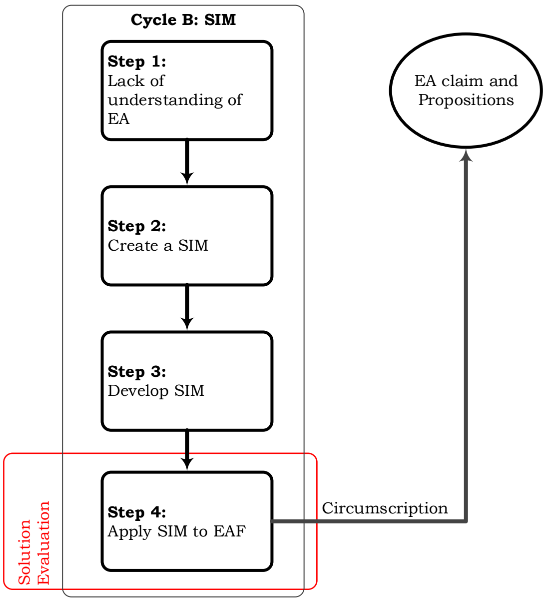


Figure 4.21: A Critique of the SIM

4.5 THE EVALUATION OF THE SIM



DSR Progress Map

In this section, the SIM was applied to the problem of understanding EA (section 4.2). By following the SIM's three-phase process (Figure 4.20), the sections to follow describe the setup and preparation phase (section 4.5.1), followed by the understanding and contextualisation phase (section 4.5.2) of the SIM. The section will conclude with the third phase of 'write up and communicate' (section 4.5.3).

4.5.1 Phase 1: Setup and Preparation

During the setup and preparation phase, the foundation for the interpretive undertaking towards understanding enterprise architecture, is laid out and made clear. This phase includes three important steps, namely –

1. The field of study is identified.
2. The text that will be interpreted is identified.
3. The context for the examining position is prepared.

4.5.1.1 Steps 1 and 2: Identify Field of Study and Select Texts

The contents of Step 1 and Step 2 are implied in the problem and suggestion steps (section 4.2) of the SIM's DSR process. The field of study is EA, and the EAFs consulted in the evaluation of the SIM have been identified and discussed in Chapter 2 (section 2.4). In order to make the research manageable, it was necessary to limit the text consulted for interpretation to those that most closely represented its core tenets. This means that for each of the frameworks, the text that serves as its seminal description was selected. Any secondary text – in other words, material written by the researcher or commentators about the frameworks, was excluded. The text that was interpreted by a demonstration of the SIM consisted of the foundational writings of the Zachman Framework, TOGAF Version 9.1 and DoDAF Version 2.02. The texts selected for each of the frameworks are listed in Table 4.2:

Table 4.2: Enterprise Architecture Framework Representative Texts

Framework	Selected text	Motivation
Zachman Framework	A framework for information systems architecture (Zachman, 1987)	Seminal paper
	Extending and formalising the framework for information systems architecture (Sowa & Zachman, 1992)	Seminal paper and significant formalisation of the framework
	The Zachman Framework for Enterprise Architecture: Primer for Enterprise Engineering and Manufacturing (Zachman, 2002)	Zachman eBook
	The Zachman Framework evolution (Zachman, 2009b)	Article on the Zachman Framework history and evolution
TOGAF	TOGAF Version 9.1 (The Open Group, 2011d)	TOGAF Version 9.1 – formal description available online
DoDAF	DoDAF Version 2.02, Volumes 1,2 and 3 (Department of Defense, 2010; DoD Chief Information Officer, 2009)	Formal description

4.5.1.2 Step 3 – The Context of the Examining Position

The significance of EA as a representation or description (blueprint idea) of the enterprise, suggests that the tradition in which EA stands is that of representing aspects of the enterprise (section 2.3). The aim of EA to represent the enterprise, upon reflection, can mean that any EA researcher, thinker or scholar comes to an interpretation of EA with the idea of *EA-as-blueprint* in mind. The pre-understanding of

EA-as-blueprint (see Heidegger's fore-structure discussion in section 4.3.3.1 and Figure 4.8) is an example of the interpreter's *prejudice* (refer to Gadamer's prejudice discussion in section 4.3.3.2), in that EA is already understood in a specific way. Furthermore, the idea of EA-as-blueprint can be understood as a holistic representation of the enterprise – in other words, as a representation of the whole enterprise and not just its parts. The EA-as-blueprint tradition (in the sense of a holistic representation), on the part of the interpreter, serves as a recognition of the tradition and prejudice that the interpreter brings to the act of interpreting EA. A theoretical standpoint that deals specifically with viewing things as wholes, is therefore in keeping with, and supportive of, the EA-as-blueprint tradition. Such a theory of wholes is important, because of the inherent risk of interpreting EA as that which the tradition already claims. The potential circular interpretation is not useful, as no new understanding about EA would be possible. The role of a perspective or theory that is not directly associated with EA, but that also deals with describing things as wholes, was needed for the analysis. Worldview theory provided such an external perspective, and will be discussed next.

4.5.1.2.1 Worldview Theory

Researchers, in general, solve the mysteries of the world by asking questions and formulating problems. These questions are rooted in a human desire to understand the world they occupy. One particular wording of such a general question is as follows: *What is the nature of external reality, that is, the world around us?* The researcher in this way takes a particular position relative to the world under examination; the world is, in a sense, viewed or observed. This approach can also be called a worldview, a term that has been used widely for over 100 years (DeWitt, 2004). As a topic, it has been discussed and examined by philosophers, theologians and scientists alike. What is of interest to the researcher is the possibility it poses, as a theory, to study views of wholes. This section will analyse worldview theory with a view of applying it to set up the examining position in the SIM's use to interpret EA. The worldview analysis is conducted along the lines of the *idea*, *description* and *the components* of worldview, as proposed by worldview theory.

4.5.1.2.2 The Idea of Worldview

A worldview, according to Cobern (1988), provides a non-rational foundation for thought, emotion and behaviour. Furthermore, it provides a person with presuppositions about what the world is really like, and what constitutes valid and important knowledge about the world. Heylighen (2000), in turn, argues for a conceptual framework of thought that ties all things together, so that we may understand society, the world and our place in it. The benefits of such a framework would help humanity to combine the wisdom gathered in the different scientific disciplines, philosophies and religions. Instead of small sectional views of reality, humanity would be equipped with a picture of the whole. This whole picture might be helpful towards understanding, and therefore coping with, complexity and change. Such a conceptual framework can be called a "worldview".

4.5.1.2.3 Description of Worldview Concept

Carvalho (2006:113) describes worldview as a "belief system concerning the nature of reality and how one acts as a subject in reality". Cobern (1988), writing from an educational perspective, understands worldview to be a *person's fundamental view of reality*. The theological perspective is described as a *set of presuppositions (assumptions which may be true, partially true or entirely false) which we hold (consciously or subconsciously, consistently or inconsistently) about the basic makeup of the world* (Sire, 2004). Worldview, in scientific terms, is held as *an intertwined, interrelated, interconnected system of beliefs* (DeWitt, 2004). These descriptions of the worldview concept show agreement, in basic terms, over a wide spectrum of study and research interest. Of particular interest is the aspect of a *belief*, suggesting a kind of knowledge that is organised in a system of thought. Another interesting aspect of worldview description is the idea of worldview as *global* in its scope, as it addresses a view of a world, and, finally, the view on *reality or world*, which suggests that the person holding the worldview treats the world as an object. For the purpose of this thesis, the definition proposed by the researchers from Centre Leo Apostle was accepted as representative. This definition states that a worldview is –

> *A coherent collection of concepts and theorems that must allow us to construct a global image of the world, and in this way to understand as many elements of our experience as possible* (Aerts et al., 2007).

4.5.1.2.4 Components of a Worldview

The various definitions of what a worldview is, highlight the common aspects that describe the structure of worldviews. In most cases, these aspects are expressed as questions that aim to cover the world or reality in as broad a scope as possible. The intent of a worldview description is to describe, in as complete a manner as possible, the knowledge that someone holds as a representation of their view of the world.

Sire (2004), in an attempt to capture the completeness, in scope, of a worldview, proposes the following list of questions:

- What is prime reality – in other words, the really real?
- What is a human being?
- What happens to a person at death?
- Why is it possible to know anything at all?
- How do we know what is right and wrong?
- What is the meaning of human history?

In addition to this list, Sire (2004) categorises the knowledge associated with worldviews as *pre-theoretical, pre-suppositional or theoretical*. The meanings of these are as follows:

- The *pre-theoretical* knowledge consists of those notions and their relationships that precede any reflective, theoretical thought.

- The *pre-suppositional* is those aspects of knowledge which people may be able to give reasons for, but cannot, strictly speaking, prove in a theoretical manner. (According to Holmes (1983), this is called a logical prior proposition).
- The *theoretical* is that knowledge which arises from the mind's conscious and rational activity.

The worldview components, as described by Aerts et al. (2007), accounting for the basic elements of every worldview, are expressed as the following list of questions:

- What is the nature of our world? How is it structured and how does it function?
- Why is our world the way it is, and not different? Why are we the way we are, and not different? What kind of global explanatory principles can we put forward?
- Why do we feel the way we feel in this world, and how do we assess global reality, and the role of our species in it?
- How are we to act and to create in this world? How, in what different ways, can we influence the world and transform it? What are the general principles by which we should organise our actions?
- What future is open to us and our species in this world? By what criteria are we to select these possible futures?
- How are we to construct our image of this world in such a way that we can come up with answers to the first three questions on the list?
- What are some of the partial answers that we can propose to these questions?

In philosophical terms, Vidal (2008) described a "procedural agenda" articulated as worldview questions:

- How should we act? Which is answered by *Praxeology (theory of actions).*
- What is good and what is evil? Which is answered by *Axiology (theory of values).*
- What is true and what is false? Which is answered by *Epistemology (theory of knowledge).*
- What is? Which is answered by *Ontology (model of reality as a whole).*
- Where are we going? Which is answered by *Prediction (model of the future).*
- Where does it all come from? Which is answered by *Explanation (model of the past).*

The proposed answers to Vidal's list of questions form a "substantive agenda", and, as can be seen in Table 4.3, are associated with the disciplines found in philosophy:

Table 4.3: Worldview questions relating to philosophical disciplines

Worldview Question	Philosophical Discipline
What is?	Ontology (model of reality as a whole)
Where does it all come from?	Explanation (model of the past)
Where are we going?	Prediction (model of the future)
What is good and what is evil?	Axiology (theory of values)
How should we act?	Praxeology (theory of actions)
What is true and what is false?	Epistemology (theory of knowledge)

4.5.1.2.5 Summary and Reflection

Researchers and thinkers making use of worldview theory, do so in an attempt to study the way humans view the world. With its roots in various human-oriented research fields such as sociology, theology, education and anthropology, it shows remarkable common ground. The common ground can be summarised as, firstly, an attempt to represent the world in its broadest conception possible, as seen from the human perspective. A second aspect of the commonality is the notion of coherence in the way that the elements of a worldview co-exist. Thirdly, and finally, worldview theory provides a useful set of questions that can be used to examine an object in terms of a wide conceptual scope. This last point allows for the application of this set of worldview questions to determine what worldview is held by any given thinker. The examining position of the SIM was therefore influenced by worldview theory as the meaning of EA is interpreted.

4.5.2 Phase 2: Understanding and Contextualisation

Phase 2 dealt with the process of interacting with the text and reflecting on the result. The interaction was in the form of a dialectical questioning of the text from the perspective of an examining position. The examining position was itself worded as a question that guided the interpretation of the text. The process of reflection was designed to examine whether the answers to the questions put to the text confirmed the examining position or not.

4.5.2.1 The Examining Position

In order to interpret EA from the perspective of EA-as-blueprint *fore-structure* (section 4.5.1) of understanding, the examining position for the execution of the SIM was stated as follows:

> *Enterprise architecture is similar in intent to the enterprise as a worldview is to the world.*

In order to engage with the text (from the selected EAFs, section 2.4.1 and Table 4.2), only the text that deals directly with an explanation of the selected EAF was examined. In the absence of such text, a representative selection of texts was analysed.

The examining position was clarified by the following goals based on worldview aspects (section 4.5.1.2.4), namely –

1. To describe the underlying knowledge base of EA in terms of the classification scheme described by Sire (2004) (*pre-theoretical, pre-suppositional and theoretical*), so that a picture of the development status of EA knowledge can be determined.
2. To explore the scope of an understanding of EA in terms of the worldview questions formulated by Vidal (2008) (Table 4.3).

Each of the goals was achieved by an iteration of the SIM's execution, thus limiting the execution of the SIM to two cycles. Each cycle was marked by a set of answers, recorded as secondary text, to the questions that were put to the primary text. The reflections (section 4.4.5) on the secondary text then either confirmed or disconfirmed the examining position.

4.5.2.2 Formulating Examining Questions

Due to the comprehensive character of the examining position, a set of associated questions were selected to be put to the text under interpretation. The set of questions formed part of the dialectical exchange with the text (section 4.4.1). The set of questions was worded to achieve the goal of each interpretation cycle (section 4.5.2.1), and was worded to produce a set of answers as the secondary text.

4.5.2.2.1 Cycle 1: Determine the Development Status of EA's Underlying Knowledge Base

In terms of underlying knowledge, Sire (2004) definitions of pre-theoretical, pre-suppositional and theoretical underpinning, are instructive. The knowledge types were used to discover the basic understanding of the knowledge underpinning a research topic. The development status of the underlying knowledge was determined by providing answers to the following questions:

- Are any assumptions in evidence that are not directly explained or justified, but are taken as a 'given' for the field of study?
- What aspects are put forth as accepted knowledge, but without any particular scientific or other research-related evidence or grounding?
- What explicitly referenced scientific theories form part of the knowledge of the object under examination?

By applying the above set of questions to EA, specifically, the set of questions was formulated in such a way that it was directed at the text that contains EA materials; this was done to focus the interpretation:

- Are any assumptions about EA in evidence that is not directly explained or justified, but is taken as a 'given' for the field of study?
- What aspects are put forth as accepted knowledge about EA, without any particular scientific or other research-related evidence or grounding?
- What explicitly referenced scientific theories relating to EA are listed in the text?

4.5.2.2.2 Cycle 2: Understand EA Holistically

The understanding of EA was examined in terms of the holistic scope provided by the worldview questions proposed by Vidal (2009) (section 4.5.1.2.4 and Table 4.3). Similar to the first Cycle, the set of Vidal's questions were also worded to focus the attention of the interpreter on the content of EA-specific text. These EA-specific questions are summarised in Table 4.4:

Table 4.4: EA Examining Position Questions

Worldview Question (Vidals' list)	Worldview question directed at EA text
What is? (ontology)	How is EA defined or described by the EAF? (Note that a limited view of ontology is used, due to the assumption that EA is already *real* in the ontological sense.)
Where does it all come from? (model of the past)	In what way does the EAF address the issue of time as it relates to EA? (Note that the aspect of past and future relates to time; only one question is thus relevant.)
Where are we going? (model of the future)	

What is good and what is evil? (theory of values)	In what way does the EAF address EA's relationship to the values of an enterprise?
How should we act? (theory of actions)	In what way does the EAF address EA's relationship with the actions/behaviour of the enterprise?
What is true and what is false? (epistemology)	In what way does the EAF address EA's ability to represent the knowledge about an enterprise? (Note that knowledge about the enterprise relates to epistemology in the sense of what can be known, rather than what is true or false.)

4.5.2.3 Dialectical Process and Interpretation

As part of the dialectical process of the SIM (section 4.4.1 and Figure 4.12), each set of questions was posed to the text, and the answers were recorded as secondary text. The posing of questions was executed by the interpreter, keeping the question in mind while reading the text. The answers were recorded as secondary text that fed into the interpretation step (section 4.4.2 and Figure 4.13). The interpretation of these answers (or secondary text) depended on the contents of each secondary text, as well as the prejudice and tradition (section 4.4.3, Figure 4.14 and Figure 4.15) of the interpreter. The examined text might not have produced clear answers to the questions posed to it, and this was where the interpretation came most to the fore. Gadamer (2004) stated that interpreters engage with the text through the structure of play; this was the aspect needed when answers did not at first seem to be clear. What was most important about the interpretation, and especially the dialectical exchange, was to stay open to what the text said. In the event that the text did not *respond* at all to the questions posed to it; the interpreter then looked for opportunities to explore the text on a deeper level.

4.5.3 Phase 3: Write Up and Communicate

During the third phase, the results (secondary text) of the interpretation were discussed. Due to the nature of hermeneutic interpretation, no direct answer for each question was necessarily available in the text under examination, and each answer was thus in itself an interpretation of what the text said in response to the question put to it. The secondary text of each cycle of the SIM's execution was recorded, and is shown in the following section. The interpretation is shown in the form of a summary.

4.5.3.1 Cycle 1: Secondary Text

The secondary text was captured in table format to facilitate the interpretation process. Each table represented the secondary text for the examined EAF. The table consisted of three columns, where the first column contained the examining question, the second column contained the answer, and the third column contained the reference to the primary text:

Table 4.5: Cycle 1 Results - The Zachman Framework for Enterprise Architecture (Zachman Framework)

Question	Answer	Reference
Are any assumptions about EA in evidence that is not directly explained or justified but is taken as a 'given' for the field of study?	The process of building complex organisations is similar to building complex engineered artefacts such as airplanes and buildings.	(Zachman, 1987); Chapter 1 of Zachman EBook (Zachman, 2002)
	Architecture and engineering are closely related.	Chapter 6 of Zachman EBook (Zachman, 2002)
	Architecting the enterprise is a process of reification of the things associated with the enterprise.	(Zachman, 1987; Sowa & Zachman, 1992) Chapter 1 of Zachman EBook (Zachman, 2002)
What aspects are put forth as accepted knowledge about EA, without any particular scientific or other research-related evidence or grounding?	All architects work in the same way.	Chapter 4 of EBook (Zachman, 2002)
	Architects operate from a universal discipline namely engineering.	
	Zachman draws parallel with physics, and highlights the following: • The models always exist • The system is the enterprise • Vertical slivers: narrow-in-scope descriptions are quick, but lead to stovepipes Horizontal slivers: high-level detail descriptions are good for planning, scoping, bounding, segmenting, etc., but are not good for implementation	
What explicitly referenced scientific theories relating to EA, are listed in the text?	Architecture and engineering disciplines Information System development theories such as entity relationship diagrams, etc. Classification theory based on the work of the ancient Greeks to the present.	(Zachman, 2002; Sowa & Zachman, 1992)

Table 4.6: Cycle 1 results - The Open Group Architecture Framework (TOGAF)

Question	Answer	Reference
Are any assumptions about EA in evidence that is not directly explained or justified but is taken as a given for the field of study?	An effort like TOGAF can be produced effectively as a participative process.	List of contributors in Front matter section of TOGAF website (The Open Group, 2011c)
	TOGAF considers the enterprise as a system, and endeavours to strike a balance between promoting the concepts and terminology of ISO/IEC 42010:2007 – ensuring that usage of terms defined by ISO/IEC 42010:2007 is consistent with the standard, and retaining other commonly accepted terminology that is familiar to the majority of the TOGAF readership.	Chapter 2: Core concepts (The Open Group, 2011c)
What aspects are put forth as accepted knowledge about EA without any particular scientific or other research-related evidence or grounding?	The current economic environment is termed the Information Age.	Chapter 1: Introduction (The Open Group, 2011c)

What explicitly referenced scientific theories relating to EA are listed in the text?	TOGAF acknowledges a long list of sources influencing its development, and consists of a mixture of IT, management and project management material. At least one volume on architecture written by Alexander.	List of referenced documents in Front matter section of TOGAF website. (The Open Group, 2011c)

Table 4.7: Cycle 1 results - The Department of Defense Architecture Framework (DoDAF)

Question	Answer	Reference
Are any assumptions about EA in evidence that is not directly explained or justified but is taken as a 'given' for the field of study?	Development of DoDAF V2.0 is guided by several assumptions. These are: • The DoDAF will continue to evolve to meet the growing needs of decision-makers in an NCE. • As capability development continues, and infrastructure continues to mature, architectures will increasingly be a factor in evaluating investments, development and performance, at the various portfolio levels. • As the DoD increases its use of architectural data and its derived information, for decision-making processes, architects will need to understand how to aggregate the data as useful information for presentation purposes at the enterprise level. • The DoDAF plays a critical role in the development and federation of architectures. It will continue to improve its support for the increasing uses of semantically linked and aligned architectural data. • Architectural data described in the DoDAF is not all-inclusive. Architectures may require additional data, and it is expected that architecture developers at all levels will extend the set of architectural data as necessary. • Prescription of required architectural data sets or views to be included in an architecture, is a decision made by process owners, based on the purpose of the architecture, not by DoDAF. Some specific minimum architectural data will be described in the DoDAF, for the exchange of architectural data in the federated environment, and will be included in the architectural data set supporting products required by the process owners.	(DoD Chief Information Officer, 2009):17)
What aspects are put forth as accepted knowledge about EA, without any particular scientific or other research-related evidence or grounding?	Not clear, will lead to subjective interpretation	

What explicitly referenced scientific theories relating to EA are listed in the text?	None	

4.5.3.2 Cycle 1: Summary of Results

All three the EAFs (Zachman Framework, TOGAF and DoDAF) submitted to the SIM for interpretation, originated from a practitioner's perspective, and were not developed by an academic institution, although, over the course of each EAF development, each enjoyed academic focus (section 2.2). According to the history of each EAF, the Zachman Framework is the oldest (if its inception is dated at 1987), with TOGAF second (TOGAF 1 was launched in 1995), and DoDAF third (DoDAF Version 1 was launched in 2003). TOGAF and DoDAF share early roots: TOGAF was influenced by TAFIM 2.0, and DoDAF grew out of C4ISR 2.0 (which was influenced by TAFIM 2.0) (Figure 2.1). The relative age of each EAF spans approximately 27 years for Zachman Framework, 19 years for TOGAF, and 18 years for DoDAF (inclusive of its earlier versions as C4ISR). Collectively, the three EAFS represent 64 years of active development and application.

The results from the first cycle of applying the SIM did not present a clear picture with regard to the underlying theoretical development of EA, as represented by the three EAFs, leading to the following points:

- The Zachman Framework understands EA as aiding the enterprise in building complex information systems. The modern era is represented and characterised as the Information Era, and enterprise systems, as a result, must ensure that systems effectively manage the information of an enterprise. The main assumption of the Zachman Framework is that the success in the construction of these complex information systems is linked to the success in disciplines that have solved the problem of building complex objects – such as the aircraft manufacturing industry.
- In the case of TOGAF, the inclusion of the ISO/IEC 42010:2007 standard as part of clarifying the architecture concept, indicates an assumption that EA addresses technological systems.
- DoDAF is explicit by its listing of the assumptions that guide the application and development of DoDAF. DoDAF also emphasises the role of IT systems in the management of an enterprise's decision-making process.

In summary, all three EAFs based their own development strongly on the role of technology in the effective running of the enterprise – a position that was taken as given, without the provision of scientific evidence to the fact.

In conclusion, the Zachman Framework is based upon the ideas of classification schemas, as was evidenced by the six interrogatives (columns), and, combined with the reification steps (rows), the theoretical base is rooted in an ontological approach to describing engineering artefacts (Figure 2.2). TOGAF lists a number of referenced theoretical resources, in acknowledgement of their influence in the development and evolution of TOGAF. The determination of where in the spectrum EA theoretical knowledge lies, as evidenced by the interpretation of the selected EAFs, was more towards a pre-suppositional state rather than a theoretical state.

4.5.3.3 Cycle 2: Secondary Text

The secondary text was captured in table format to facilitate the interpretation process. Each table represented the secondary text for the examined EAF. The table consisted of three columns, where the first column contained the examining question, the second column contained the answer, and the third column contained the reference to the primary text:

Table 4.8: Cycle 2 Results - The Zachman Framework for Enterprise Architecture (Zachman Framework)

Question	Answer	Reference
How is EA defined or described by the EAF?	*The Zachman Framework*™ *is* the fundamental structure for Enterprise Architecture and thereby yields the total set of descriptive representations relevant for describing an Enterprise.	(Zachman, 2008)
In what way does the EAF address the issue of time as it relates to EA?	The framework is the record of the enterprise, in terms of versions it is up to the tool used to store different as-is models	Where column (Figure 2.2) Chapter 5 of Zachman EBook (Zachman, 2002)
	Same answer as above, the future oriented view can be reflected in the framework but it depend on how the enterprise applies this.	Where and How column (Figure 2.2) Chapter 5 of Zachman EBook (Zachman, 2002)
In what way does the EAF address EA's relationship to the values of an enterprise?	Row 1 and 2 can relate to the vision and mission of the enterprise with the How, Who and Why columns dealing with values	Why column (Figure 2.2) Chapter 1 and 6 of Zachman EBook (Zachman, 2002)
In what way does the EAF address EA's relationship with the actions/behaviour of the enterprise?	The enterprise is captured in models that make a level of analysis possible and this is probably the greatest claim of EA thinkers; that it will directly impact the behaviour of the enterprise because it knows more of itself.	Why column (Figure 2.2) Chapter 8 of Zachman EBook (Zachman, 2002)
In what way does the EAF address EA's ability to represent the knowledge about an enterprise?	The Zachman Framework described the contents of the framework as the ontology of the enterprise	(Zachman, 2008)

Table 4.9: Cycle 2 results - The Open Group Architecture Framework (TOGAF)

Question	Answer	Reference
How is EA defined or described by the EAF?	ISO/IEC 42010:2007 defines "architecture" as: "The fundamental organisation of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution." TOGAF embraces but does not strictly adhere to ISO/IEC 42010:2007 terminology. In TOGAF, "architecture" has two meanings, depending upon the context: 1. A formal description of a system, or a detailed plan of the system at component level to guide its implementation. 2. The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time. In TOGAF it we endeavour to strike a balance between promoting the concepts and terminology of ISO/IEC 42010:2007 - ensuring that our usage of terms defined by ISO/IEC 42010:2007 is consistent with the standard - and retaining other commonly accepted terminology that is familiar to the majority of the TOGAF readership.	Chapter 2: Core concepts (The Open Group, 2011c)
In what way does the EAF address the issue of time as it relates to EA?	The phases of the ADM design as-is and to-be architectures.	Part II ADM (Figure 2.6) (The Open Group, 2011c)
In what way does the EAF address EA's relationship to the values of an enterprise?	Not directly clear, but if this knowledge (values) is encapsulated in the mission and vision of the enterprise, then the following phases of the ADM are relevant: • Preliminary • Phase A: architecture vision • Phase B: business architecture If values relate to requirements, then it is part of the whole ADM.	Part II ADM (Figure 2.6) (The Open Group, 2011c)
	If values relate to the vision of the Open Group (ex. Boundary less information flow) then EA (in terms of how TOGAF understands it) has this at its core.	Chapter 2: Core concepts (The Open Group, 2011c)
In what way does the EAF address EA's relationship with the actions/behaviour of the enterprise?	The ADM deals directly with the creation of the EA and, by extension, also how the enterprise does its business – perhaps most clearly reflected in the notion of architectural principles.	Part II ADM (Figure 2.6) (The Open Group, 2011c)
In what way does the EAF address EA's ability to represent the	TOGAF uses the Architecture Content Framework (ACF) to store architectural	Chapter 1: Introduction (Figure 2.5) (The Open Group, 2011c);

knowledge about an enterprise?	artefacts. The ADM is used to create the architectural artefacts.	Part II ADM (Figure 2.6) (The Open Group, 2011c)

Table 4.10: Cycle 2 results - The Department of Defense Architecture Framework (DoDAF)

Question	Answer	Reference
How is EA defined or described by the EAF?	In a generic sense, an enterprise is any collection of organisations that has a common set of goals and/or a single bottom line. An enterprise, by that definition, can encompass a Military Department, DoD as a whole, a division within an organisation, an organisation in a single location, or a chain of geographically distant organisations linked by a common management or purpose. An enterprise, today, is often thought of as an extended enterprise where partners, suppliers and customers, along with their activities and supporting systems, are included in the architectural description.	(DoD Chief Information Officer, 2009)
	Government agencies may comprise multiple enterprises, and there may be separate enterprise architecture, or Architectural Description projects. However, the projects often have much in common regarding the execution of process activities and their supporting information systems, and they are all linked to an enterprise architecture. Architectural description development, in conjunction with the use of a common architecture framework which describes the common elements of Architectural Descriptions, lends additional value to the effort, and provides a basis for the development of an architecture repository for the integration and re-use of models, designs and baseline data.	
In what way does the EAF address the issue of time as it relates to EA?	Architectural Descriptions may illustrate an organisation, or a part of it, as it presently exists; any changes desired (whether operational or technology-driven); and, the strategies and projects employed to achieve the desired transformation.	(DoD Chief Information Officer, 2009)
	Architectural Descriptions define a strategy for managing change, along with transitional processes needed to evolve the state of a business or mission to one that is more efficient, effective, current, and capable of providing those actions needed to fulfil its goals and objectives.	
In what way does the EAF address EA's relationship to the values of an enterprise?	An Architectural Description is a strategic information asset that describes the current and/or desired relationships between an organisation's business, mission and management processes, and the supporting infrastructure.	(DoD Chief Information Officer, 2009)

	Enterprise Architectures: A strategic information asset base which defines the mission, the information necessary to perform the mission, the technologies necessary to perform the mission, and the transitional processes for implementing new technologies, in response to changing mission needs. EA includes a baseline architecture, a target architecture, and a sequencing plan.	(DoD Chief Information Officer, 2009)
In what way does the EAF address EA's relationship with the actions/behaviour of the enterprise?	The DoD EA is an Architectural Description that is an enterprise asset used to assess alignment with the missions of the DoD enterprise, to strengthen customer support, to support capability portfolio management (PfM), and to ensure that operational goals and strategies are met.	(DoD Chief Information Officer, 2009)
In what way does the EAF address EA's ability to represent the knowledge about an enterprise?	Visualising architectural data is accomplished through models (e.g. the products described in previous versions of DoDAF). Models (which can be documents, spreadsheets, dashboards, or other graphical representations) serve as a template for organising and displaying data in a more easily understood format. When data is collected and presented in this way, the result is called a view. Organised collections of views (often representing processes, systems, services, standards, etc.) are referred to as viewpoints, and, with appropriate definitions, are collectively called the Architectural Description.	(DoD Chief Information Officer, 2009)

4.5.3.4 Cycle 2: Summary of Results

The second cycle of the SIM's execution produced a rich picture of the comprehensive nature of EA knowledge. Each of the EAFs that was submitted for interpretation, consisted of extensive descriptions of itself in either articles (academic and informal), websites or technical guidebooks. Each of the answers to the questions put to the text, were summarised as follows:

- How is EA defined or described by the EAF?
    - The Zachman Framework defines itself as the fundamental structure of the enterprise, and, as such, is the ontology of the enterprise.
    - TOGAF, on the other hand, bases its definition of EA on the ISO/IEC 421010:2007 standard by focusing on two meanings of architecture – namely as a) a description of the systems used in the enterprise (a system and its implementation view), and b) a structure of components and their relationships.
    - DoDAF understands EA as an architectural description of an enterprise, where an enterprise is defined as a collection of organisations that share a common set of goals.

- In what way does the EAF address the issue of time as it relates to EA?
  In all three cases (Zachman Framework, TOGAF and DoDAF), as interpreted by the SIM, the idea of an as-is and to-be architecture was either suggested or described. The storage of the EA artefacts that represent the enterprise is described as follows:
  - TOGAF defines an Architecture Content Framework (ACF) that describes types of architecture deliverables that are stored in the architecture repository.
  - The Zachman Framework in itself, as an enterprise ontology, contains the representation of the enterprise at any given point of time, and changes as it is updated or continually used in the enterprise.
  - DoDAF stores the architectural description in a repository.
- In what way does the EAF address EA's relationship to the values of an enterprise?
  The link between the interpreted EAFs and the values of an enterprise, was expressed as a relationship between the EA and the vision and strategic direction of the enterprise.
  - The Zachman Framework captures this information in the first two rows of the framework.
  - TOGAF capture strategy in the Preliminary Phase of the Architecture Development Method (ADM); this strategic information is carried throughout the cyclic execution of the ADM and forms the basis upon which architecture decisions are made.
  - DoDAF describes the architectural description as a strategic information asset that describes the relationship between strategy, management and supportive infrastructure.
- In what way does the EAF address EA's relationship with the actions/behaviour of the enterprise?

  This question was not answered directly by any of the EAFs interpreted by the SIM. The implication, however, of doing EA in an enterprise, addresses decision-making – such as, for example, how to stay relevant in the marketplace (as is demanded by agile practices). In all three cases, though, the emphasis of starting an EA practice was focused on the development of computerised systems that work with the processing of information (more formally known as information technology (IT)).

- In what way does the EAF address EA's ability to represent the knowledge about an enterprise?
  This answer was probably the most important point that EAFs made about the enterprise, namely that the representations (models) and the access to those representations (views or viewpoints) directly address what can be known about the enterprise.
  - The Zachman Framework captures this knowledge as an ontology that consists of architectural primitives.
  - TOGAF does so as a set of architectures and architectural artefacts.
  - DoDAF captures this knowledge as a set of architectural descriptions.

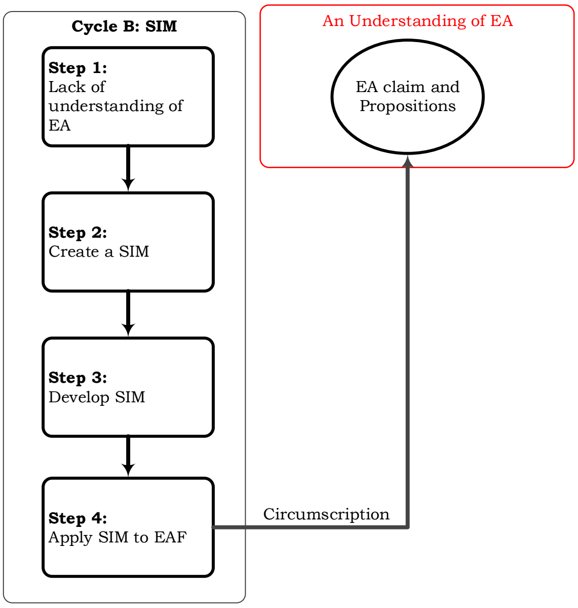
4.5.3.5 Reflection and Understanding

The set of questions that guided the reading of the EAF materials were all created to support the examining position of the SIM. The interpretation and reflection phases (Figure 4.16) of the SIM resulted in an interpretation of the selected EAF that confirmed (or disconfirmed) whether EA was similar in intent to the enterprise as a worldview is to the world. Upon reflection on the secondary text summarised in sections 4.5.3.2 and 4.5.3.4, the role of EA in representing the enterprise was established as the key purpose of the inner working of the EAF. The details about the enterprise that are captured in models or documents, serve to inform decision-making for the groups of people in the enterprise regarded as having a stake in the outcomes of good decisions. All of the questions derived from worldview theory were answered positively – in other words, the EAFs were able to provide an answer to each question. The examining position was therefore confirmed, and EA can be understood as acting in such a way as to describe the enterprise in a similar way that a worldview describes the world. The examining position as a confirmed position was used to serve as a claim of an understanding of EA, and is worded as follows:

Enterprise architecture is similar in intent to the enterprise as a worldview is to the world.

The EA claim is supported by a set of six EA propositions that elaborate and support the EA claim. Each EA proposition is a statement that captures the key ideas of the answers to the examining questions. The key ideas of each EAF contribute to a general answer that states the common ground shared by all the interpreted EAFS, as follows:

1. What is the development status of the underlying theory of EA?
   EA underlying theoretical knowledge is in a pre-suppositional state (section 4.5.3.2).
2. How is EA defined or described by the EAF?
   EA is a description of the structure of the systems of an enterprise.
3. In what way does the EAF address the issue of time as it relates to EA?
   EA represents the enterprise in time-oriented architectures such as an as-is, to-be and has-been architecture.
4. In what way does the EAF address EA's relationship to the values of an enterprise?
   EA translates the values/strategy of the enterprise into operational systems appropriate to the information society.
5. In what way does the EAF address EA's relationship with the actions/behaviour of the enterprise?
   EA provides a means to manage decisions about the IT/IS management and implementation in the enterprise.
6. In what way does the EAF address EA's ability to represent the knowledge about an enterprise?
   EA captures a representation of the enterprise in the form of a model or set of models.



DSR Progress Map

The understanding of EA consists of the combination of an EA claim and the supportive six propositions (Table 4.11):

Table 4.11: An Understanding of EA

The EA claim	EA Propositions	
Enterprise architecture is similar in intent to the enterprise as a worldview is to the world.	1	EA underlying theoretical knowledge is in a pre-suppositional state.
	2	EA is a description of the structure of the systems of an enterprise.
	3	EA represents the enterprise in time-oriented architectures such as an as-is, to-be and has-been architecture.
	4	EA translates the values/strategy of the enterprise into operational systems appropriate to the information society.
	5	EA provides a means to manage decisions about the IT/IS management and implementation in the enterprise.
	6	EA captures a representation of the enterprise in the form of a model or set of models.

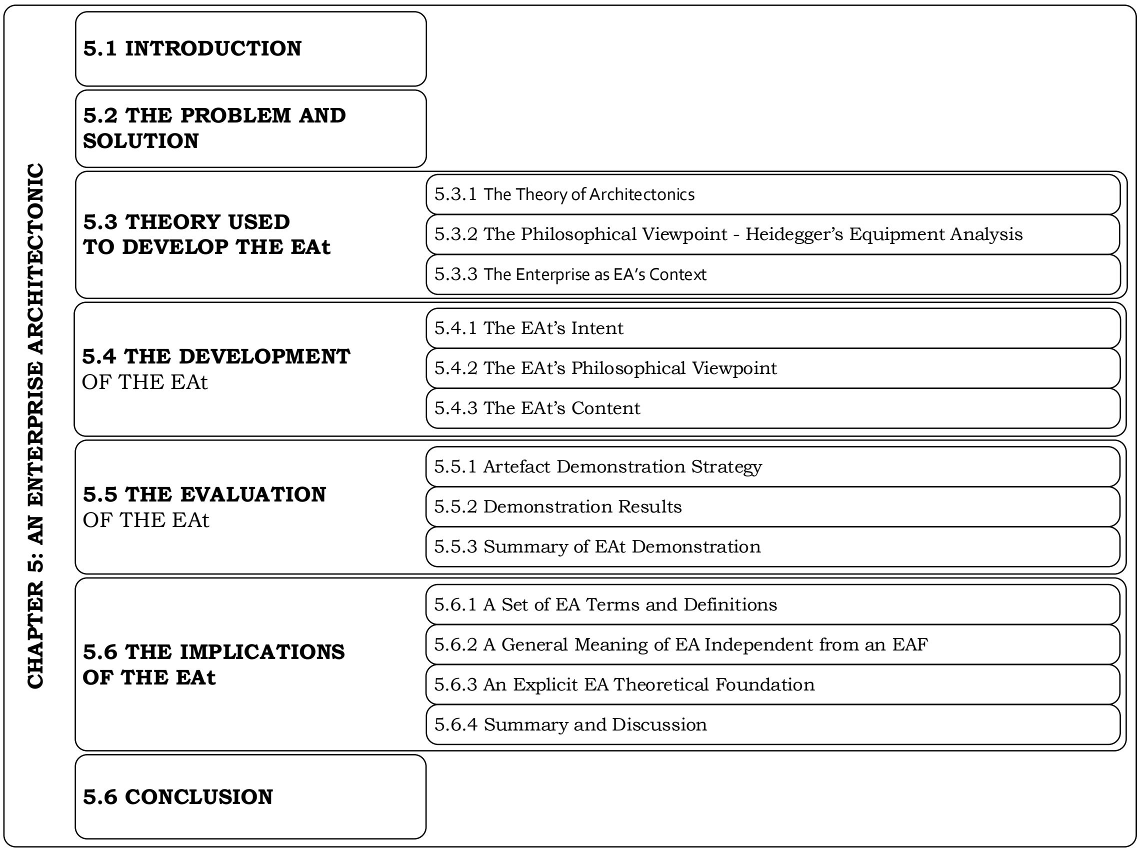
4.6 CONCLUSION

The view that EA is a comprehensive view of the enterprise, in a similar sense that a worldview is a view of the world, brought a unique perspective that a) was a statement of the obvious purpose of EA, and b) the EA view stated as a claim about the meaning of EA, be valued for its ontological implications. The SIM proved an effective artefact to identify an understanding of EA. The EA claim in itself adds a measure of explicitness and clarity to the underlying understanding of EA, but the addition of the six EA propositions enhanced this clarity.

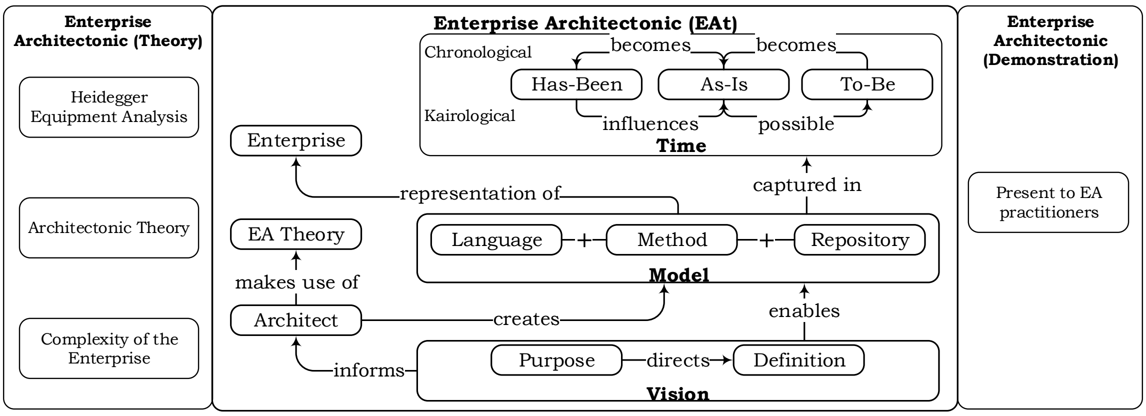
The research could not stop here, though. Another level of interpretation and discovery was needed to produce precise concepts that describe EA's underlying foundations with more precision than a proposition. This type of analysis also needed the kind of grounding that was an established view of the world. Heidegger's influence on humanity's understanding of the world provided for a philosophical foundation of the work to follow in Chapter 5.

CHAPTER 5: AN ENTERPRISE ARCHITECTONIC

Chapter Map



Chapter Summary



5.1 INTRODUCTION

The demonstration of the SIM in the preceding chapter resulted in an EA claim and six propositions that represent an understanding of EA as presented by three prominent EAFs – namely the Zachman Framework (Zachman, 1987; Sowa & Zachman, 1992; Zachman, 2008), TOGAF Version 9.1 (The Open Group, 2011c) and DoDAF Version 2.02 (DoD Chief Information Officer, 2009). The EA claim and propositions are useful in communicating a basic understanding (in terms of EA knowledge foundations) of EA, and represent a first step towards making the foundations of EA explicit. The organisation of the EA claim and propositions into a meaningful whole captured the foundational knowledge of EA, not only in terms of concepts, but also in terms of the relationships between them. The use of an architectonic is introduced in this chapter, as a systematic organising mechanism to structure the understanding of EA in terms of key concepts and their relationships. However, the task of constructing an EA architectonic is not trivial, and should be approached systematically, in order for it to serve as a theory that can explain the explicit foundational meaning of EA. In keeping with the DSR approach described in Chapter 3 (section 3.2.2), this chapter will focus on the development of the Enterprise Architectonic (EAt), as well as an evaluation of its use in addressing the EAF selection problem (section 2.5.1). The theories used to design the EAt address a) the context of the enterprise and its associated complexities, b) a philosophical approach to aid the interpretation of EA as a comprehensive representation of the enterprise, and c) the theory of architectonics.

This chapter describes the design and demonstration of the EAt and is structured according to the five process steps of the DSR model discussed in Chapter 3 (section 3.3). The awareness of the problem (Step 1) and solution suggestion (Step 2) is discussed in section 5.2. Section 5.3 and section 5.4 provides a discussion on the theories used in the design and development (Step 3) of the EAt. The EAt is evaluated (Step 4) in section 5.5 and contribution of the EAt is discussed in section 5.6. The chapter concludes in section 5.7.

5.2 THE PROBLEM AND SOLUTION

The awareness of the problem with EA's implicit foundations was highlighted in Chapter 2 (section 2.5.1), and led to the suggestion of using architectonics to solve the problem. Once the DSR process entered the development step of the process, another problem was identified (section 2.5.3). The second problem arose as a result of the need for architectonics to have conceptual contents to work with, in order to create the EAt. What was missing was an understanding of EA (section 2.5.3), and the awareness of the absence of a general understanding of EA led to the awareness of the second cycle of the DSR process (Figure 4.1). This cycle was executed in Chapter 4 (Figure 5.1), and resulted in an EA claim and six propositions that represent an understanding of EA (section 4.5.3.5 and Table 4.11). The EA understanding enabled the continuation of the EAt's development.

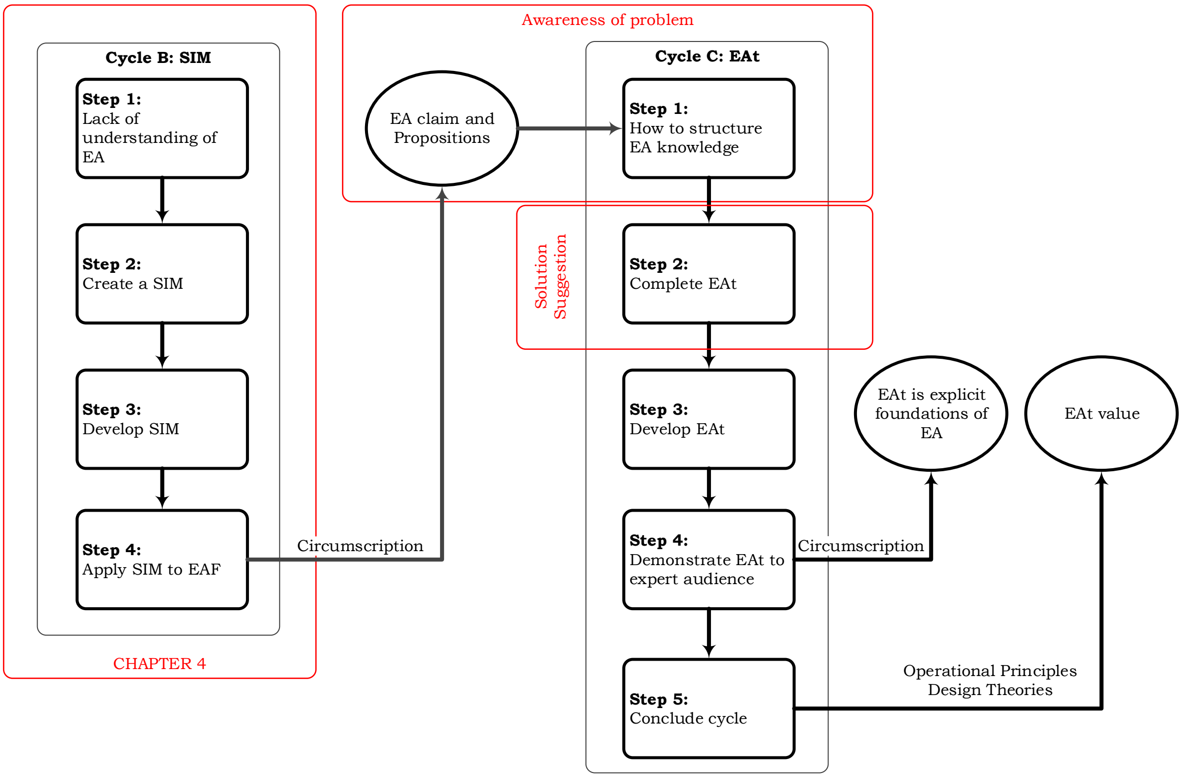


Figure 5.1: EAt Problem Awareness and Suggestion

The suggested solution to address the problem of implicit EA foundations, is to complete the design and develop the Enterprise Architectonic (EAt). The problem in the broad sense remains unchanged. However, with regard to the completion of the EAt according to the DSR process, the problem awareness were refined. The refinement was necessary, because an understanding of EA (Table 4.11) was available to form the contents of the EAt. The refined problem statement adheres to the EAt's goal (section 3.3.1) and is stated as follows:

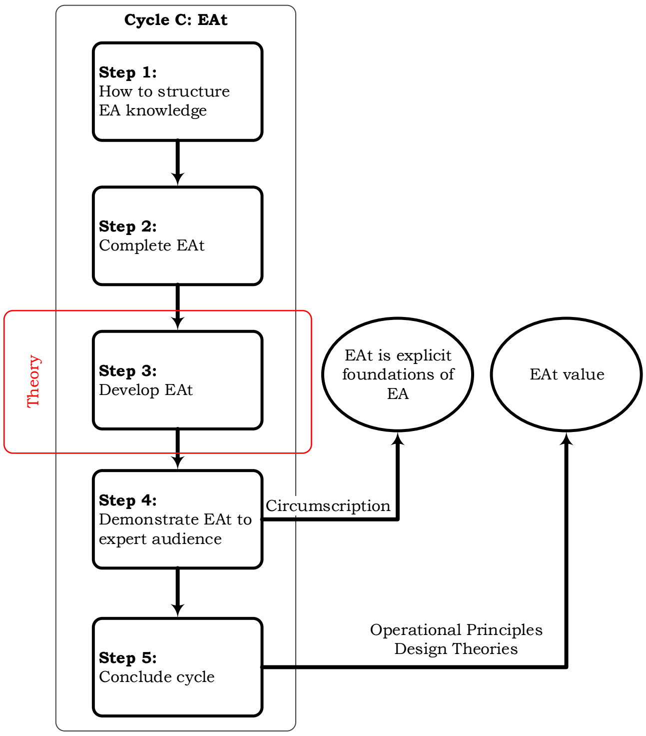
How to structure the understanding of EA in terms of fundamental concepts and their relationships.

The requirements of the EAt's design are as follows:

1. The desired functionality of EAt contains –
    a. A set of foundational EA concepts.
    b. A description of the relationships between foundational EA concepts.
    c. A graphical representation of the EAt to facilitate its use in explaining the foundational meaning of EA.
2. The architecture of the EAt embodies –
    a. A distinct representation of EA foundational concepts.
    b. A distinct representation of the relationships between EA foundational concepts.

The development plan of the EAt is discussed in section 3.3.2.2, and summarised in Figure 3.15.

5.3 THEORY USED TO DEVELOP EAt



DSR Progress Map

The design of a conceptual artefact, as described by Bereiter (2002), demands careful consideration in its construction. The EAt as an instance of a conceptual artefact, should be securely based on a collection of background theories that describe the following:

- The theory of architectonics to inform the purpose and construction of the EAt (section 5.3.1).
- A philosophical point of view from which to understand and interpret the way that humans interact with equipment; Heidegger's equipment analysis is used for this purpose (section 5.3.2).
- The context of EA, in terms of its role in managing the effects of appropriating information technology (IT) and information systems (IS) as key components of the operation of an enterprise (section 5.3.3).

This section will first discuss the theory of architectonics, then move on to discussing Heidegger's equipment analysis, and conclude with an overview of the context of EA.

5.3.1 The Theory of Architectonics

Architectonics as a term is defined by The American Heritage Dictionary (2009) as an adjective that relates to architecture or design, and, in philosophical terms, relates to the scientific systemisation of knowledge. Manchester (2003) notes that architectonics is a technical term used in philosophy, and references to it can be found in fields such as metaphysics, jurisprudence, political philosophy and ethics. Kant et al. (1998) described the term 'architectonic' as the art of constructing a philosophical system (or a system of thought), with the purpose of developing an aggregate of knowledge into a science. The purpose of providing an architectonic scheme is to classify different types of knowledge and explain the relationships that exist between these classifications (Atkin, 2005). Finally, Blackburn (2008) defines architectonics as the systematic structure or architecture of knowledge. In this role, architectonics serves as a blueprint for the sciences (Ferrater Mora, 1955).

In terms of a building's architecture, Bernstein (1999) declares architectonic the *transcendental correlate of architecture* with the purpose to *enfold the rules of buildings and materials that architecture deploys.* Fahmy (2004) furthermore describes the aim of post-modern architects as *establishing an analogy between the words of a language and architectural elements*. This idea suggests that architects make use of architectonic elements to convey the meaning of the building to observers in the same way that people make use of language to communicate with another person. The knowledge contained in an architectonic (Del Río-Cidoncha et al., 2007) is described as –

- *Knowledge about domain:* Architectonic objects and architecture in general.
- *Knowledge about representation:* The methods of making graphical representations of the object being designed.
- *Knowledge about the design process:* Strategies and criteria used in the decision process relating to the architectural shape.

Although the creation of architectonic schemes enjoys a close relationship with philosophy as well as architecture, it is also applied for the same purpose to research in the computing and engineering disciplines. In information systems research, for example, Richmond (2007) calls for a new architectural paradigm that meets the expectations of overarching design principles for creating and assembling all the components in an enterprise systems landscape. His construction of an inter-enterprise architectonic (I-EA) aims to be capable of guiding the development of new architectures, to bring about the coherence of all key components, processes and user functions in a larger project. These components can also be referred to as architectonic elements, since they are represented (for example as an abstract concept) as the contents of the architectonic. The I-EA is based on Charles Sanders Peirce's Trichotomic Category Theory (Richmond, 2007). Other examples of the application of architectonics are found in the systems engineering architectonics of Hitchins (2005), a software architectonic that is based on a layered architectural scheme (Galal-Edeen, 2002; Del Rosso & Maccari, 2007) and a software architectonic viewpoint (Maccari & Galal, 2002).

There are no specific rules that guide the construction of an architectonic. Purpose (or intention) plays a significant role in the creation of an architectonic, since the understanding of an architectonic is primarily focused on what it intends to achieve. Another aspect that is important to its construction is the philosophy that it is based on, as is evident in the I-EA (Richmond, 2007). Finally, the most important part of an architectonic is its contents. The key aspects that was be considered in the creation of an architectonic are illustrated in Figure 5.2:

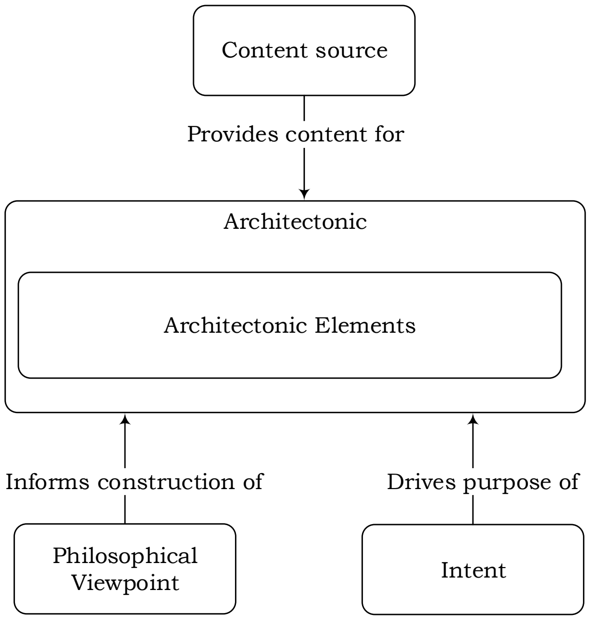


Figure 5.2: The Design Influences on an Architectonic

5.3.2 The Philosophical Viewpoint - Heidegger's Equipment Analysis

Heidegger's examination of the meaning of *being* provides an attractive philosophical lens for the development of an enterprise architectonic. Those features, in particular, of his philosophy, that show promise, are the relatedness of the *question of being* to human thought and action, the examination of the *being-there* in the context of everyday life, his exploration of *equipment*, and finally, the *horizon of time*. These aspects are used in the analysis of the EA understanding (Table 4.11), to produce the architectonic elements for the EAt, and will be briefly discussed next.

5.3.2.1 Dasein

In *Being and Time*, Heidegger (2000) states the question of the *meaning of being*, and proceeds to describe a way to answer that question. Heidegger argues that a question, in general, consists of three parts, namely –

- That which is asked about.
- That which is found out by the asking.
- That which is interrogated.

For Heidegger, human beings are available to be interrogated, because, for humans, their own being is an issue, and as a result, only humans have the capacity to ask (and answer) the question of the *meaning of being*. The kind of being that designates humans in this way, for the purpose of the interrogation, is *dasein*, a German term which, when literally translated, means *there-being*.

Dasein is not an object based on a substance[10], as has been proposed by philosophers such as Kant and Husserl; rather, it is the kind of *being* that through its concern-full engagement with the world, discloses the world (Cooper, 1996). Inwood (1997) describes dasein as being at the centre of the world, *drawing together its threads*. More specifically, dasein is to be thought of as the unique kind of *being* (also referred to as a *way of being*) that humanity possesses (Inwood, 1999).

5.3.2.2 Dasein's Being-In-The-World

Heidegger describes dasein as being-in-the-world, a unitary concept with three distinct perspectives – namely *in-the-world*, the *entity (who) is in the world,* and *being in the world* as such (Heidegger, 2000). Dasein exists or *is* in a world described by King (1964) as a relational complex that forms its coherence structure. This kind of world, in turn, does not and cannot exist without dasein (Morriston, 1972) as its *worldhood* – i.e. what makes the world a *world*, is the characteristic of being tied up in a referential totality that exists for the sake of dasein. The multiple ways of being in the world – for example, *having to do something*, *producing something*, *making use of something,* are tied together in the collective way of being known as *care*. Heidegger (2000) explores the meaning of care by looking at dasein's dealings with things in everyday life.

5.3.2.3 Dasein and Equipment

According to Heidegger (2000), the things that dasein encounters in the world are designated as equipment that forms part of a relational structure with other equipment. This relational structure is an *in-order-to* that describes the kind of existence of equipment. For example, a hammer exists in order to hammer, a pen exists in order to write, and so on. These relational structures do not occur in isolation from each other; it always *is* in terms of other equipment. In so doing, it forms a whole of relations that is a *towards-which* kind of relational structure, the meaning of which is that the interaction of dasein with this relational whole of equipment is for the completion of some task for dasein itself. The *way of being* of equipment is designated as a *readiness-to-hand,* which indicates that equipment as such is not encountered on a theoretical level, but in a practical way, in that it is used to accomplish a task. The *way of being* of things that are examined in a theoretical way, is termed *present-at-hand*.

5.3.2.4 Heidegger's Threefold Structure of Life

Heidegger set the examination of *being* against the *horizon of time*, that is described by Harman (2007) as a threefold structure of life. This structure, as rooted in time, is denoted as past, present and future (Table 5.1):

[10] Hubert Dreyfus refers to this as a substance ontology. (DREYFUS, H. L. 1991. *Being-in-the-world: a commentary on Heidegger's Being and time, division I*, MIT Press.)

Table 5.1: Heidegger's Threefold Structure of Life

Time structure	Explanation
Past	We find ourselves delivered to a situation that must be dealt with somehow.
Future	Yet we are not mere slaves to this situation, since we go to work on our current situation by glimpsing possibilities in it that we can try to actualise.
Present	Finally, every moment of life is a profound tension between what is given and how we confront it.

In Heidegger's scheme, the future is resolved in the present by means of the possibilities that are available to dasein. Time, in this sense, is not the chronological time of passing seconds and days, but rather the time of the *appropriate moment,* as expressed in *kairos* (Greek word for time) time. As dasein, we are thus constantly, in the present, faced with the consequences of the possibilities from the past, while we weigh up the possibilities for the future, in response. In a simplified way, this idea can be expressed as dasein being constantly confronted with making decisions about what to do next. The decision is between the possibilities that the future holds, but our decision in the end is influenced by those decisions that we have already made (the past). As a decision between possibilities is made, so the future becomes the present, and more possibilities open up for dasein to decide.

5.3.2.5 Discussion

Heidegger contributes two important aspects to the creation of an architectonic:

- The idea that time plays an important role in the daily existence of human beings.
- Human beings do not at first (or in the average everyday situation) interact with the world and its objects (equipment) in a scientific or theoretical manner. Humans are thrown into a world already full of meaning, and, in interacting with equipment, humans understand the world by a process of continual interpretation.

The link between EA and IT/IS is very well established (section 2.2.3), and it is tempting to think of EA as a kind of technology. However, by following the lead of IT researchers (Riemer & Johnston, 2011; Riemer & Johnston, 2013), EA is seen, rather, as equipment used by dasein in the everyday context of the enterprise. The first EA proposition (Table 4.11) states that EA's underlying theoretical knowledge is in a pre-suppositional state. The pre-suppositional state of EA's underlying theoretical knowledge suggests that EA as such is not used in a way that is characterised as theoretical (in other words *present-at-hand*), but rather as pre-theoretical (in other words *readiness-to-hand*), and therefore supports the view of EA as equipment, in the Heideggerian sense.

5.3.3 The Enterprise as EA's Context

The term *enterprise* is a multifaceted concept that points towards the ideas of scale, organisation, business and activity (Crowther, 1989). The combination of the terms 'enterprise' and 'architecture' paints a powerful word picture, since 'architecture' invokes images of building, design and artefacts, whereas 'enterprise' invokes images of people working towards a collective goal. The following discussion emphasises the complexity inherent in the enterprise, as a result of the introduction of computing technologies such as IT and IS. EA's relation to enterprise complexity is also explored, due to the link between EA and IT/IS (section 2.2.3).

5.3.3.1 The Enterprise in Conceptual Terms

An organisation is defined as 'a manifold of elements, each element being distinct, in a set of relations forming a whole' (Krikorian, 1935:122). Daft (2001:11) states that organisations are 'social entities that are goal directed, are designed as deliberately structured and coordinated activity systems, and are linked to the external environment'. From the perspective of organisation theory, the organisation is viewed as a social entity that is consciously coordinated and which functions on a continuous basis to achieve a set of common goals (Robbins, 1987). An enterprise, therefore, for the purpose of this chapter, is described as –

> *an organised environment where people engage in activities that serve the purpose of reaching one or more common goals.*

5.3.3.2 The Information Worker

The enterprise has been studied by multiple disciplines such as management science, organisation theory and organisational behaviour. As a result of this research interest, many unique problems have been examined, that include the shape of the enterprise (i.e. how it is organised), its leadership and management, and many more. Drucker (1994) describes the assumptions that shape the behaviour of the organisation and that dictates its decisions as a *theory of the business*. A theory of the business consists of three sets of assumptions that cover the following aspects:

- The environment of the organisation (in terms of society and its structure, the market, the customer and technology).
- The organisation's specific mission.
- The core competencies needed to accomplish the mission.

The theory of the business is furthermore measured by four specifications:

- The assumptions about environment, mission and core competencies must fit reality.
- The assumptions in all three areas have to align with each other.
- The theory of the business must be known and understood throughout the business.
- The theory of the business has to be tested constantly.

Drucker's influence on business has been widely recognised (Linkletter & Maciariello, 2009) over a variety of topics, including the practice of management (Kurzynski, 2009) and the creation of the term *knowledge worker* (Davenport, 2008). The modern societal context of organisations, according to Drucker (1992), is mainly driven by knowledge as a resource, and organisations should be geared for constant change, since it is the nature of knowledge to change fast. The pressure of this constant change is felt most directly in the quest for a suitable structure for the enterprise.

5.3.3.3 Organisational Structures

Mintzberg (1991) describes the effective organisation as an interplay of seven fundamental forces, namely *direction, efficiency, proficiency, concentration, innovation, cooperation and competition* (Figure 5.3):

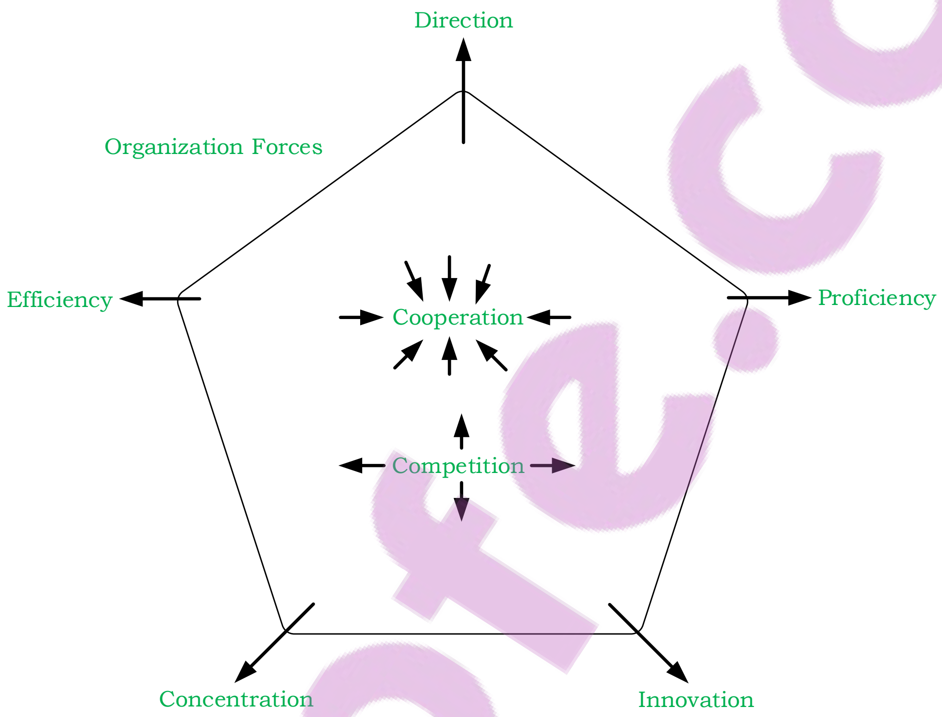


Figure 5.3: Mintzberg's Seven Fundamental Forces

The meaning of each of these forces is as follows:

- Direction: Represents a sense of where the organisation should go – also referred to as strategic vision.
- Efficiency: Describes the attempt to ensure a viable ratio between benefits gained and costs incurred.
- Proficiency: Represents the organisation's ability to carry out tasks with high levels of knowledge and skill.
- Concentration: The focus of particular units to serve specific markets.
- Innovation: Represents the discovery of new things for customers and themselves.
- Cooperation: A catalytic force that pulls the organisation together in terms of an organisational ideology.

- Competition: A catalytic force that pushes the organisation apart by means of organisational politics.

In Mintzberg's scheme, a *configuration* is described as a form of organisation that is consistent and highly integrated. A *configuration* is the result when any one of the seven organisational forces (Figure 5.3) is dominant (Mintzberg, 1991). As a result of the seven organisational forces, seven organisational forms (Figure 5.4) are possible, namely –

- Entrepreneurial: Tends to occurs when the force for *direction* is dominant, such as when the leaders of the business take personal control.
- Machine: Tends to appear when the force for *efficiency* is dominant, and occurs typically in mass production companies.
- Professional: This form arises when *proficiency* is the dominant force, such as in hospitals or engineering practices.
- Adhocracy: This form occurs when the *innovation* force is dominant.
- Diversified: Tends to occur when the *concentration* becomes dominant.
- Ideological and political: These forms are the result of dominant *ideological* or *political* forces.

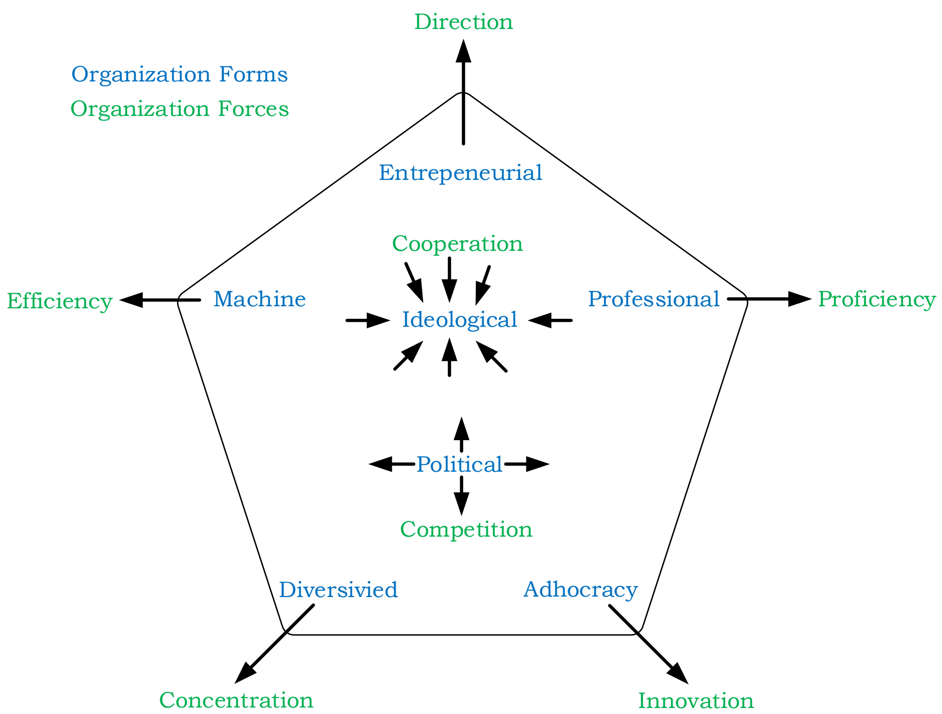


Figure 5.4: Mintzberg's Organisational Forms

Mintzberg (1981) work on organisational forms (Figure 5.4) is based on his earlier work on the configuration of the organisation in terms of organisational structures (Figure 5.5):

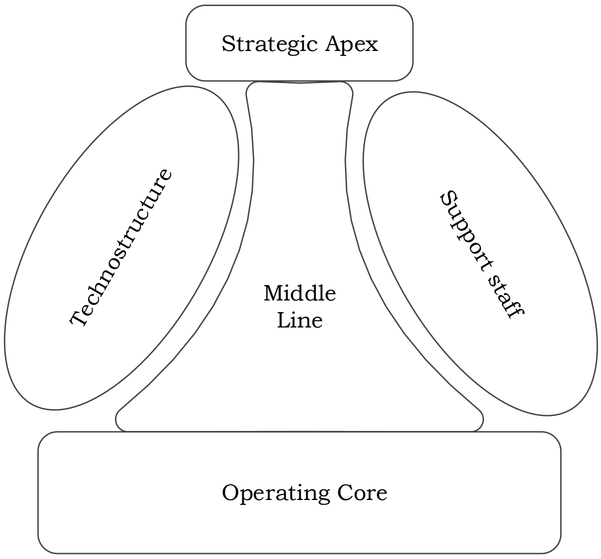


Figure 5.5: Mintzberg's Organisational Structures

The five basic parts of an organisation are described as follows (Gould, 1999):

- Operating core: the operators (people) that do the work of the organisation.
- Technostructure: shapes and moulds the work of the operators.
- Strategic apex: carries out direct supervision, manages relationship with environment, and directs strategy.
- Middle line: middle management and supervisors.
- Support staff: staff that support the working of the organisation.

This model served as a diagnostic tool for managers to aid the difficult task of designing an organisational structure (Mintzberg, 1981). The purpose of using Mintzberg's work is to illustrate the inherent complexity in the effort to design an effective structure for an organisation.

5.3.3.4 The Role of IT/IS in the Enterprise

The discussion that follows uses the terms IT and IS interchangeably. This is done to facilitate the flow of the discussion, although cognisance is taken of the subtle and specific differences between them. The design of an organisation affects all aspects of the business. The task is made increasingly difficult, due to the role of IT in business operations. Laudon and Laudon (2006) note the interdependent nature between an enterprise's IS and its business capabilities. The nature of this relationship, studied for example as business-IT alignment (Chan & Reich, 2007) and business-IT value (Kohli & Grover, 2008; Cao, 2010), has enjoyed considerable attention from researchers. The evolution of IT and IS spans over sixty years of history (O'Brien, 2004). A history that started with basic data processing in the 1950s has grown to what is called e-business in the new millennium. One of the unique characteristics of this history is that the internal capability of an organisation to process its internal data has grown to inter-organisational processing, with technologies such as service-oriented architecture and cloud computing

(Hayes, 2008). IT and IS can, in a sense, said to be everywhere where there are business activities (Eiras & Scott, 2010). With the rise of Web 2.0 and applications such as, for example, Facebook, the statement can be extended to say that IT is everywhere where there are people[11]. The centrality of IS (and by implication IT) to the business is illustrated in Figure 5.6:

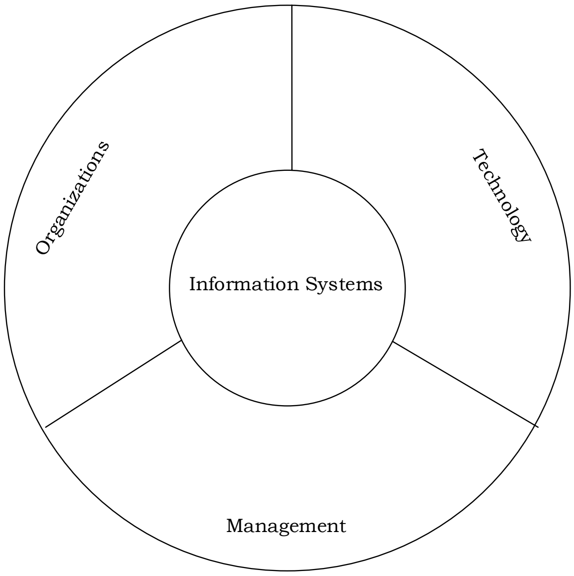


Figure 5.6: The Centrality of IS to the Enterprise

An aspect of information systems research is the examination of the process of designing and building systems that are appropriate for business use. Alter (2002), for example, developed an approach called the Work Systems Method (Alter, 2002) encapsulated in the Work Systems Framework (WSF) (Alter, 2006). A work system is defined as a system in which humans and machines perform work, using information, technology and other resources to produce products or services for customers. The framework is illustrated in Figure 5.7, and shows the position and interrelations of the nine system elements. The arrows signify the balance that should exist between the elements. The elements of *processes and activities, participants, information* and *technologies* constitute the system that is doing the work (Alter, 2002) and is comparable to Mintzberg's *operating core* (Figure 5.5):

[11] This, of course, is a generalisation but is made to impress upon the reader the point that IT is closely related to humanity. The phenomenon described here is probably more visible in developed countries than in developing countries. The research area designated as the Digital Divide looks more closely at this issue.

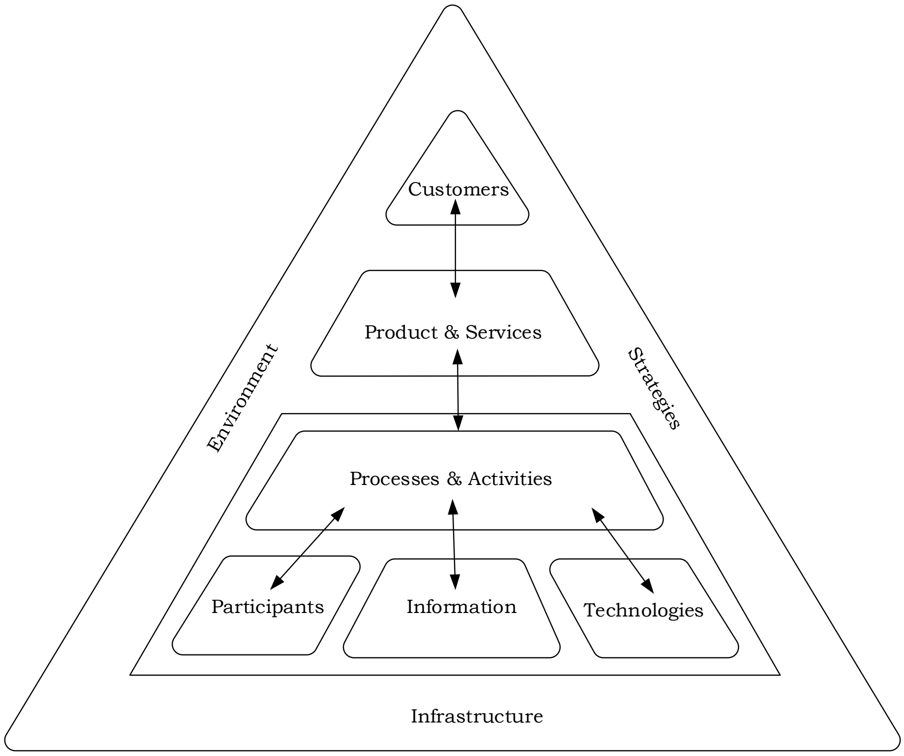


Figure 5.7: The Work Systems Framework (Alter, 2002)

The combination of *environment, strategies and infrastructure* are elements that the work system relies on to perform its work, and is comparable to the elements in Minztberg's model (Figure 5.5). The element of *infrastructure* (WSF) links with *technostrucure* and *operating core* (Mintzberg model) while *strategies* and *environment* (WSF) can be linked with *strategic apex* and *middle line* of Mintzberg's model.

5.3.3.5 The Complexity of the Enterprise

The research results from both management science and information system research indicate that people take centre stage as the ultimate users of technology to perform tasks in an enterprise. The strategic direction and positioning of the business determines the nature of the product or service manufactured for the marketplace. The lessons learned from both management science and information system research are that complexity increases as markets grow and technology changes. The business, as such, needs to adjust easily to these changes – an adaptability termed 'agile business' (Tallon, 2007). This leads to a complex situation for managers, strategists and workers to deal with (Haugen, 2006), and leads to a state of uncertainty (Lissack, 1999).

The current business environment is marked by a lack of predictability, increased complexity and volatility (McGrath & MacMillan, 2009). The enterprise is also experiencing environmental uncertainty, in terms of managing the enterprise and information technology (Patten et al., 2009). The main result of this uncertainty is that business leaders and managers cannot know everything about their environment at any given time, and this leads to increased complexity in the decision-making process. Complexity theory, in conjunction with studies in chaos, has been applied to problems in the organisational context (Anderson, 1999; Haugen, 2006), and is of ongoing concern (Butler et al., 2010; Dotlich et al., 2009).

Complexity theory is the result of the study of chaotic systems, which has its roots in the study of nonlinear dynamic systems (Thietart & Forgues, 1995). Nonlinearity means that a small change in a system variable can have a disproportionate effect on another variable in the system (Tsoukas, 1998), even to the degree that the resultant change is unpredictable and thus uncertain. Dent (1999) describes complexity science as –

> *an approach to research, study, and perspective that makes philosophical assumptions of the emerging worldview and then lists these assumptions as holism, perspective observation, mutual causation and relationship as unity of analysis.*

Vasconcelos and Ramirez (2009) distinguish between *algorithmic complexity*, called complication, and *natural complexity*. Natural complexity is characterised by a lack of information about the outcome of a problem situation, while complication is resolved by the execution of a predefined set of procedures.

5.3.3.6 Enterprise Architecture and Reducing Complexity

The relationship between complexity and the enterprise is rooted in the evolution of technology used to do the work of the enterprise. Ross et al. (2006), for example, describe a *foundation of execution* that consists of the key disciplines of *operating model*, *enterprise architecture* and *IT engagement model*. The foundation of execution is briefly defined as the 'IT infrastructure and digitized business processes automating a company's core capabilities.' (Ross et al., 2006:3). One of the principal roles of EA is the alignment between the implementation of a technology and the strategy of the business (Chorafas, 2001). The alignment of technology, specifically IT, and the business, is a recurring theme in the EA literature (Theuerkorn, 2004; Lankhorst, 2005; Wagter et al., 2005), and suggests that the particulars of complexity reside in the design of complex technology systems (Goikoetxea, 2007) expressed as internal drivers for EA (Lankhorst, 2005). Apart from the internal technological complexity, a measure of external legislative pressure and therefore also a source of complexity, is recognised (Laverty, 2003; Wagter et al., 2005).

In order to reduce, or at the least to address, this complexity, EA is proposed as a holistic mechanism to record information of the enterprise (Schekkerman, 2006). The enterprise information is an integration of the business, its strategy and technology (Bernard, 2005), and is expressed in the form of models (Lankhorst, 2004). The mechanism to create an EA is that of the decomposition (Whittle & Myrick, 2005) of the whole into primitive parts (Zachman, 1996), in the same way that complex engineering artefacts such as buildings and airplanes, are described.

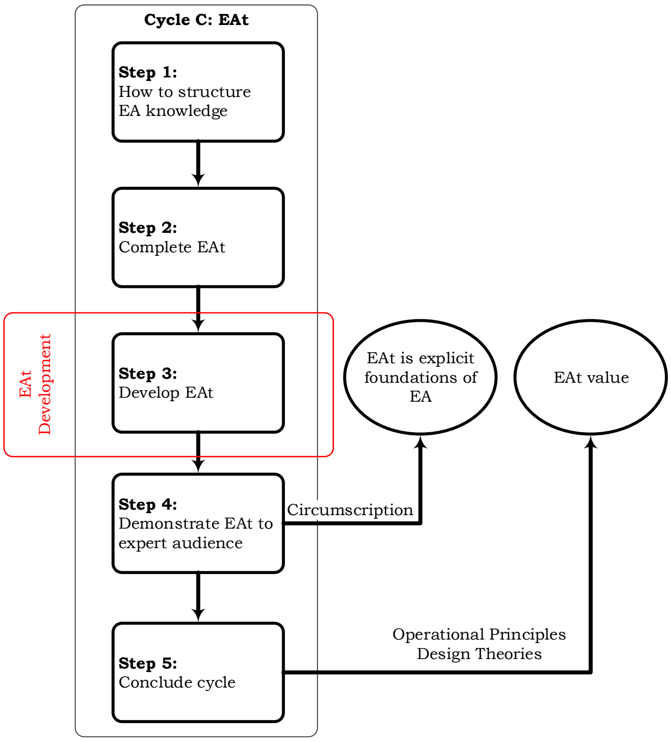
5.3.3.7 Discussion

Drucker (1992) emphasised the economic environment as mainly information driven, and designates this as the Information Age. The workers in this environment need information literacy skills (Eisenberg, 2008). According to Dufour and Lamothe (2009), Mintzberg contributed, to management studies, an informative way of understanding the form of an organisation, as well as its influencing forces. Laudon and Laudon (2006) show the centrality of the information system to the operation of an enterprise – a status that is described as the ubiquity of IT (Pal, 2008; Li, 2009). Alter (2006) research on the work systems framework shows the connection between technology, work and people, in IS.

The science of chaos and complexity that, among others, has the lack of long-term forecasting and prediction as an issue, is firmly rooted in the sciences and mathematics. Its application to the problems faced by organisation theorists, in turn, has had mixed results, with most of its lessons applied in the area of structuring businesses, to be optimal in their performance. The enterprise is inherently complex in its behaviour, due to factors such as size, rate of market and technology change – and perhaps simply because people are involved (Tsoukas, 1998). The growth in the use of IT to do business, is reflected in research areas such as return on investment, IT value to business, and business-IT alignment. The evolution of IT and IS has also been marked by the matter of complexity. What started as a homogenous mainframe environment, has grown into a heterogeneous web of computing, with multiple possibilities of its application. Complexity arises, as a result, from many sources, and takes on various forms.

The EA approach to the solution of this problem with complexity, depends on the belief that the enterprise can be described and made known to its stakeholders. EAFs serve the purpose of realising an EA by providing methods to develop models and associated viewpoints. The methods used to create these models originated from the world of IT, and especially software development, where a complex problem is decomposed into manageable pieces so that complex information systems can be constructed.

5.4 THE DEVELOPMENT OF THE EAt



DSR Progress Map

Various sources can be used to generate the elements to populate the architectonic. The architectonic elements are associated with the intent of the architectonic (Figure 5.2), in that the sources for elements are constrained by what the architectonic is supposed to achieve. This scope can be as wide as a philosophical attempt at organising the sciences (as was the case with Pierce (Atkin, 2005)), or it can be narrow, such as, for example, describing how software changes (as was the case with software architectonics (Galal-Edeen, 2002; Del Rosso & Maccari, 2007)). In the case of the EAt, the scope was narrow, as it only related to the topic of EA and, more specifically, its intent was to communicate the fundamental meaning of EA. The EA understanding (Table 4.11) that resulted from the SIM was the source of the EAt's content, but had to be analysed to determine the set of fundamental EA concepts as well as their relationships. The EAt's philosophical viewpoint, Heidegger's equipment analysis (section 5.3.2.3), guided the construction of the architectonic (Figure 5.2) by providing an interpretive lens from which to analyse the EA understanding.

5.4.1 The EAt's Intent

The intent of the EAt is to communicate the fundamental meaning of EA – which was expressed as a problem in Chapter 2 (section 2.5.1), where the awareness for the explicit EA foundations was argued. After the understanding of EA was established in Chapter 4 (section 4.5.3.5 and Table 4.11), the problem statement (section 2.5.1) was refined to become an awareness of how to determine the architectonic elements of the EAt (section 5.2 and Figure 5.1) from the EA understanding. The intent of the EAt is therefore similar to the overall design goal of the EAt, namely –

> *to structure the understanding of EA in terms of fundamental concepts and their relationships so that the conceptual foundation of EA is made explicit.*

5.4.2 The EAt's Philosophical Viewpoint

The philosophical viewpoint used to guide the EAt's construction, was Heidegger's equipment analysis (section 5.3.2.3). The architectonic elements of the EAt were derived by analysing the EA understanding (Table 4.11) through the lens of the philosophical viewpoint. The process of analysis depended on a set of Heideggerian concepts derived from the equipment analysis (Table 5.2):

Table 5.2: Heidegger's Key Concepts

Heidegger concept	Description
Dasein	The kind of being that designates humans; it is a German term, literally translated meaning 'being-there' (section 5.3.2.1).
Equipment	The things that dasein encounters and engages with in the world. Equipment's relational structures do not occur in isolation from one another; it always *is* in terms of other equipment, and in so doing forms a whole of relations (section 5.3.2.3).
In-order-to	The relational structure that describes the kind of existence of equipment – for example, a hammer exists in order to hammer (section 5.3.2.3).
Towards-which	The interaction of dasein with the relational whole of equipment is for the completion of some task for dasein itself (section 5.3.2.3).
Readiness-to-hand	The way of being of equipment that indicates that equipment, as such, is not encountered on a theoretical level but in a practical way, in that it is used to accomplish a task (section 5.3.2.3).
Present-at-hand	The way of being of equipment that indicates that equipment, as such, is encountered or examined on a theoretical level (section 5.3.2.3).
Worldhood	The idea that the aspect that makes the world a *world*, is the characteristic of the world being tied up in a referential totality that is for the sake of dasein (section 5.3.2.2).
Time	Past, present and future in the sense of moment (kairological time) (section 5.3.2.4).

The list of Heideggerian concepts was transformed into a set of architectonic elements to serve as the viewpoint through which the EA understanding could be interpreted (Table 5.3):

Table 5.3: Heideggerian Architectonic Elements

Heidegger Concept	Architectonic element
Dasein	Architect
In-order-to	Definition
Towards-which	Purpose
Worldhood	Enterprise
Time	Time

The list of elements in Table 5.3 related most closely to a representation of Heidegger concepts in the EAt as follows:

- Architect: *Dasein* denotes the way of being that is associated with human beings that is engaged with the world (section 5.3.2.1). Human beings are responsible for creating and using the EA (section 2.2.3). The EA claim (Table 4.11) that EA acts like a worldview on the enterprise, requires an actor responsible for the creation of the EA. Dasein is therefore translated into the architectonic element called *architect*.
- Definition: The *in-order-to* is a specific description of the *type of being* of equipment, in such a way that the equipment is defined according to *what it is* for (section 5.3.2.3) – in other words, its *definition*.
- Purpose: The *towards-which* relational structure speaks of the way dasein engages with equipment (section 5.3.2.3). This way of engagement is towards the completion of a task that is aimed at achieving Dasein's goals. Towards-which is therefore translated into the architectonic element called *purpose*.
- Enterprise: *Worldhood* refers to what makes a world a *world*, and is marked by a referential totality that exists because of dasein. The *enterprise* is a representation of the idea of *worldhood*, due to the number of aspects involved in creating an EA (section 2.4). Based on the EA claim's (Table 4.11) reference to a worldview, and its clarification of the relationship between the enterprise and EA, the concept of *worldhood* was translated into the architectonic element called *enterprise*.
- Time: *Time* dominates Heidegger's philosophy, as it is understood as the *background* (section 4.3.1 and Figure 4.2) of being (Heidegger, 2000). Time features prominently in EA thought, due to the creation of time-bound architectures called *as-is* and *to-be* (section 2.2.2.2 and section 2.4). *Time* is therefore included as an architectonic element.

The *equipment*, r*eadiness-to-hand* and *present-at-hand* concepts (Table 5.2) did not translate into architectonic elements, due to the understanding of equipment in the context of the EA understanding. As discussed in section 5.3.2.5, EA is interpreted as equipment rather than a technology. The EAt aim was to make the fundamental meaning of EA explicit, and was therefore about EA. The equipment concept was thus a contextual element of the EAt, and as such, was not included as an architectonic element. The *readiness-to-hand* and *present-at-hand* concepts described how equipment is used by dasein (section 5.3.2.3), and formed the viewpoint of EA, namely as equipment that addresses how EA is used in the enterprise. The EAt focuses on the fundamental meaning of EA; as a result, the *readiness-to-hand* and *present-at-hand* concepts were regarded as out of scope, and not translated into architectonic elements.

5.4.3 The EAt's Content

The EA understanding (Table 4.11) from the SIM's evaluation (section 4.5) served as an instance of the fundamental knowledge about EA that needed to be structured in the EAt. The approach followed in the construction of the EAt's content, included the following steps:

- The identification of representative keywords that captured the core concepts of the EA understanding (Table 4.11). The list of keywords constituted the first set of potential architectonic elements, and is listed in Table 5.4.
- An analysis of the list of core concepts (Table 5.4) through the philosophical lens (Figure 5.2) of Heidegger's equipment analysis (section 5.3.2.3), produced a second set of candidate architectonic elements. The list of Heidegger's architectonic elements (Table 5.3) was used in the analysis of the second set of concepts listed in Table 5.5.
- Finally, the two sets of candidate architectonic elements (Table 5.4 and Table 5.5) were compared (Table 5.6), to create the final set of architectonic elements that was used to represent the foundational concepts of EA in the EAt. The final list was captured and is described in Table 5.7.

Once the list of architectonic elements (section 5.4.3.1) were established in terms of concepts, their relationships had to be established, this process is described in section 5.4.3.2.

5.4.3.1 Architectonic Elements

Table 5.4 shows a summary of the keyword analysis of the EA propositions. An architectonic element is understood as the content of the architectonic that will most closely represent an understanding of the knowledge of EA, as represented in the seven EA propositions. Each proposition was represented with the keywords that captured core meaning, and this was done by highlighting either a noun or a verb. In the case of proposition two, for example, the emphasis was on a noun, in that the proposition referred to a thing, while proposition five focused attention on a verb:

Table 5.4: Candidate Architectonic Elements – Set A

EA Propositions		Key concept
1	EA's *underlying theoretical knowledge* is in a pre-suppositional state.	EA Theory
2	EA is a *description* of the structure of the systems of an enterprise.	Representation
3	EA represents the enterprise in *time-oriented architectures* such as an as-is, to-be and has-been architecture.	Time-based architecture
4	EA *translates* the values/strategy of the enterprise into operational systems appropriate to the information society.	Method to create EA
5	EA provides a *means to manage* decisions about the IT/IS management and implementation in the enterprise.	Method to use EA
6	EA captures a *representation* of the enterprise in the form of a *model or set of models*.	Model of enterprise

The propositions in the EA understanding (Table 4.11) each represent a key idea about EA. The key idea is captured in a descriptive phrase, as follows:

- EA Theory: The first EA proposition established the development status of the underlying theory of EA as pre-suppositional. The key idea was identified as speaking of *EA theory,* and served as a candidate architectonic element.
- Representation: The second proposition stated that EA is a description of the enterprise's systems and, as a result, was a *representation* of the enterprise.
- Time-based architecture: The use of as-is and to-be architectures captured the enterprise in *time based architectures*.
- Method to create EA: The fourth proposition identified a translation between values/strategy and the IT/IS in the enterprise. The idea of translation was captured in a *method to create the EA*. The reason for this translation was the prominent relationship between EA and IT/IS (section 2.2.3) that led to the concept of the creation (or updating) of the EA as a result of creating IT/IS systems in the enterprise.
- Method to use EA: The sixth proposition identified the role of EA in managing IT/IS-related decisions. Due to the relationship between EA and IT/IS, and the *method to create EA* element, the management idea was captured as the *method to use EA* architectonic element.
- Model of enterprise: The sixth proposition was explicit about the representation of the enterprise in *models of the enterprise*.

Some interrelationships between the EA propositions were suggested by the use of the key term *method* to capture the essence of the fourth and fifth propositions. The next step was to analyse the candidate list of architectonic elements (Table 5.4) through the lens of Heidegger's candidate architectonic elements (Table 5.3), to produce a second set of candidate architectonic elements (Table 5.5):

Table 5.5: Candidate Architectonic Elements – Set B

EA Propositions		Key concept
1	EA's underlying theoretical knowledge is in a pre-suppositional state.	None
2	EA is a *description of* the structure of the systems of an enterprise.	Purpose
3	EA represents the enterprise in *time-oriented architectures* such as an as-is and to-be architecture.	Time
4	EA *translates* the values/strategy of the enterprise into operational systems appropriate to the information society.	Purpose
5	EA provides a *means to manage* decisions about the IT/IS management and implementation in the enterprise.	Purpose
6	EA *captures a representation* of the enterprise in the form of a model or set of models.	Definition

The second set of candidate architectonic elements as interpreted through Heidegger's set of architectonic elements, is discussed as follows:

- Purpose: The analysis showed that the concept of purpose (associated with Heidegger's *towards-which* in Table 5.3 and explained in Table 5.2) related to EA Propositions 2, 4 and 5.

Accordingly, *purpose* as a potential architectonic element could be defined as a concept that addressed *descriptions of systems*, *translation of value/strategy into systems* and the *means to manage these systems*.

- Time: The time element was prominent in both the EA understanding and Heidegger's thought. Heidegger's notion of time includes *past*, *present* and *future* (Table 5.1), and was explained in two senses, as follows:
    - Time as moment: In this sense, time is understood in the Greek conception of *kairos* (section 5.3.2.4), where past, present and future are all part of the same moment (Heidegger, 2000).
    - Time as sequential flow: Time is also experienced chronologically, from one moment to another; Heidegger calls this *ordinary time* (Heidegger, 2000).

  The EA understanding of *time-oriented architectures* (EA Proposition 3, Table 4.11), as expressed in the ideas of a *to-be* and an *as-is* architecture, suggested a link to the present and the future, with the implication of a type of architecture linked to the past. EA also seemed to consider the creation of *time-oriented architectures* as a chronological flow, rather than as a moment. Nevertheless, the idea of time was core, and was captured in the second list of candidate architectonic elements.
- Definition: Heidegger's architectonic element of *definition* (associated with Heidegger's *in-order-to* in Table 5.3 and explained in Table 5.2), was linked to the statement of EA Proposition 6 as EA *capturing the representation* of the enterprise in a model.

EA Proposition 1 was not associated with a Heideggerian architectonic element. A possible explanation for this occurrence is that the concept of theoretical knowledge becomes visible in the discussion of the way dasein uses equipment (section 5.3.2.3).

The final step in the process was a comparison between the two candidate lists (Table 5.4 and Table 5.5), to establish the final set of candidate architectonic elements:

Table 5.6: Candidate Architectonic Elements – Set C

EA Propositions	Set A	Set B	Final candidates
1	EA Theory	None	EA Theory
2	Representation	Purpose	Purpose
3	Time-based architecture	Time	Time
4	Method to create EA	Purpose	Purpose
5	Method to use EA	Purpose	Purpose
6	Model of enterprise	Definition	Definition, Model

By adding Heidegger's architectonic elements of *architect* and *enterprise* (Table 5.3), the final set of candidate architectonic elements was determined and is presented as follows:

- EA Theory: EA Proposition 1 addressed the issue of an underlying theory of EA. The need for a source of reference to enable the activity of creating an EA is recognised by the Zachman Framework (section 2.4.2), DoDAF Version 2.02 (section 2.4.3) as well as TOGAF Version

9.1 (section 2.4.4). EA theory was therefore included in the final list of architectonic elements, because of the need for a reference body of knowledge that will enable the creation of an EA. The architectonic element analysis was not specific about what the content of EA theory was or could be (refer to Hagan (2004) for an example of a formal attempt at codifying an EA body of knowledge).

- Purpose: The purpose element expressed the idea that EAs are created (by dasein) to fulfil the ends of human intention. These ends included the task of *representing the enterprise*, as well as methods to *create and use* the *EA*. The context of these tasks is the enterprise, which is characterised by a complexity that stems from its dependence on technology to exist in the information age (section 5.3.3). The purpose of EA can therefore be summarised as the intention of dasein to *solve the problem of complexity that arises from technology use in the enterprise*.
- Time: The element of time as the context for architectures developed in EA, implied different types of architectures that exist (or are created) in time. The prominent types of architectures that describe time are the as-is and to-be architectures that respectively exist in the present and the potential future. The occurrence of architecture in time was a manifestation of the creation of the EA. TOGAF Version 9.1 refers to the creation of *to-be* architectures as part of a project to implement future systems in the enterprise, and the *as-is* architecture is created to establish a base line so that a gap analysis can be made (The Open Group, 2011c). The gap analysis is used as a decision tool to make systems development decisions (described in the TOGAF ADM), and as such, the *to-be* architecture presents a possibility of the future. The future possibility (or possibilities, depending on the number of to-be architectures) represented a type of time that deals with the moment of decision-making (an example of *kairos*-type time). A *to-be* architecture, therefore (once the system development is completed), is absorbed into the *as-is* architecture, thus creating a kind of flow from the future to the present (an example of chronological time). The architecture was therefore captured in time in two important ways:
    - Chronologically: In this sense the architecture changes as part of the absorption of the to-be architectures in the as-is architectures, as system development projects run to completion. An implied type of architecture that is not directly mentioned in the EA literature is that of a type that deals with the past – in other words, a *has-been* architecture to keep a historical record of changes in the EA over time. With such a type of architecture, every change in the architecture would be recorded historically, as the *as-is* architecture is absorbed into the *has-been* architecture.
    - Kairologically: In this sense, the architecture that exists in the present is used as a baseline to gauge the impact of new systems in the enterprise. The *to-be* architecture represents a possible new system, and by comparing it to the *as-is* (a gap analysis), important lessons can be learned about the impact of the new system on the enterprise. The *as-is* architecture is also impacted by previous system developments (a phenomenon known as the legacy system) that implies a type of architecture that

represents the past in some way. The *has-been* architecture, as the representation of the historical record of the enterprise, therefore also plays a role in the kairological sense.

Time was therefore a key architectonic element, and, if understood in Heidegger's sense, has important implications for the EAt.

- Definition: The *definition* element captured the *what-it-is-for* notion of Heidegger. Equipment is said to exist for a specific reason (section 5.3.2.3) in the *world.* The architectonic element analysis has shown that the *definition* element expressed the idea of a *representation of the enterprise*.
- Model: The model element was linked to the definition element, in the sense that the representation of the enterprise manifests in a *model*. The concept of a model was specifically addressed in the discussion of the selected EAFs (section 2.4) and summarized in section 2.4.5. The Zachman Framework identified a primitive as well as a composite model (section 2.4.2 and Zachman, 2002). TOGAF Version 9.1 described models as representations, and allows for the creation of views to enable seeing parts of the architecture (The Open Group, 2011c). DoDAF described a model as anything in the enterprise that represents the data as part of an architectural description (DoD Chief Information Officer, 2009:EA-2). The model was therefore the kind of representation that conveys meaning about the enterprise, and entails three important aspects, as follows:
    - The model as a *representation* is closely linked with *time,* in that architecture consists of models and as such forms part of the *has-been*, *as-is* or *to-be* architectures. A model must therefore be stored in a *repository* for recall by the architect, during the execution of the purpose of an EA.
    - In its role as a representation, the model also needs an expression and, therefore, a *language.*
    - If the model is expressed in a language, then it will also need a *method* that leads to its creation.

  The model architectonic element was therefore a complex element that introduced the three related elements of *language*, *method* and *repository*.
- Architect: The EA is created by dasein, and this role was allocated to the *architect* element. The architect therefore creates the EA.
- Enterprise: The enterprise element represented the context of EA and, therefore, the *thing* that is represented.

The discussion of the third and final candidate list (Table 5.6) led to the final list of architectonic elements. The elements are representative of the EA understanding (Table 4.11), as analysed through the philosophical lens of Heidegger's equipment analysis. The final list with descriptions is presented in Table 5.7:

Table 5.7: Final List of Architectonic Elements

Architectonic element	Description
Purpose	The purpose element recognises that humans operate with a purpose in mind. In the context of the EAt, the purpose of EA is summarised as *solving the problem of complexity that arises from technology use in the enterprise*.
Definition	This element describes EA as what it is in terms of its purpose. In order to fulfil the EA purpose, EA is defined as being *a representation of the enterprise*.
Model	The model element is described as the embodiment of the representation of the enterprise, based upon the purpose and definition of EA. To enable the creation of the model, it must be expressed in a *language*, created by means of a *method*, and stored in a *repository*.
Language	Language enables the representation of the enterprise in the form of a model. The EAt does not prescribe what language to use in creating a model, and is therefore language agnostic. ArchiMate (Lankhorst et al., 2009) is an example of a modelling language developed for creating EA models.
Method	The method element provides the means to create the model. The EAt is not specific about how to create the model. The EAF, as the entity that realises the EA, also contains methods to create models. TOGAF's ADM (The Open Group, 2011c) is an example of a method used to create architectures and models.
Repository	The model as a representation is closely linked with time. In order to make the storage and recall of the model possible, it needs to be stored. The ability to store and recall the model is achieved by the *repository* element. The EAt is not specific about what the repository should be, but in the information age it would probably be a type of data storage system.
Architect	The human element as the actor that is responsible for creating the EA by making use of EA theory.
Enterprise	This element captures the idea that the enterprise represents a world that exists as a for-the-sake of dasein.
EA Theory	This element captures the formal knowledge directly related to EA, and serves as the reference from which to do EA. The EAF references the EA theory as reference frameworks or meta models (section 2.4).
Time	This element captures the kairological moment of the model as it exists in time. In the chronological sense, the architecture develops sequentially as the to-be is incorporated into the as-is, and the as-is is incorporated into the has-been architecture. In the kairological sense, any decision about which to-be architecture to choose is dependent on the role of the past (has-been) and the present (as-is architecture).

5.4.3.2 Relationship between Architectonic Elements

The relationships between architectonic elements was implied in the results of the equipment analysis (Table 5.7). The nature of each relationship was determined by the combination of the intent (section 5.4.1) and philosophical viewpoint (section 5.4.2) of the EAt (Figure 5.2). The relationships between elements were indicated as a directional arrow, and labelled to show their meaning. The meaning of a relationship between elements is then read in the direction of the arrow.

The architectonic elements of Purpose and Definition serve to give *direction* to the creation of an EA. The verb *direct* means that an *object controls the operations of another object* (The New Oxford Dictionary of English, 1998:524). In the context of the EAt, therefore, the Purpose element controls the operation of the Definition element in the EAt, where the Purpose element is described as follows:

The purpose of EA is to solve *the problems that arise from technology use in the enterprise.*

The Definition element, in turn, is described as –

EA is a representation of the enterprise.

Once combined in its relational form, the meaning becomes clear that –

EA aims to solve problems that result from the complexity that is generated by the introduction of IT/IS, by creating a representation of the enterprise.

The combination of Purpose and Definition creates a *Vision* for EA where *Vision* is understood as the 'ability to think about or plan the future with imagination and wisdom' (The New Oxford Dictionary of English, 1998:2066). The *directs* relationship is graphically represented in Figure 5.8, and forms the visionary elements of the EAt. The *vision* of EA captures Propositions 2, 4, 5 and 6 of the EA understanding (Table 4.11):

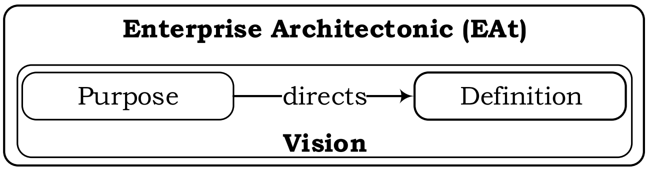


Figure 5.8: The EA Vision

The *vision* of EA is in relationship with the model element in such a way that the creation of the Model is enabled. The Model element is described as the –

Embodiment of the representation of the enterprise.

The Model is furthermore described (Table 5.7) as consisting of the following elements:

- Language: A language is needed to create a symbolic representation of the enterprise.
- Method: The method element is the mechanism used to achieve the symbolic representation.
- Repository: The repository element is needed to enable the permanent storage of the model, so that it can be used in EA work.

The verb *enable* is defined as *making something possible* (The New Oxford Dictionary of English, 1998:606). The Vision of EA therefore makes the Model possible. This relationship is illustrated in Figure 5.9. These elements capture the meaning of EA Propositions 2, 4, 5 and 6 of the EA understanding (Table 4.11):

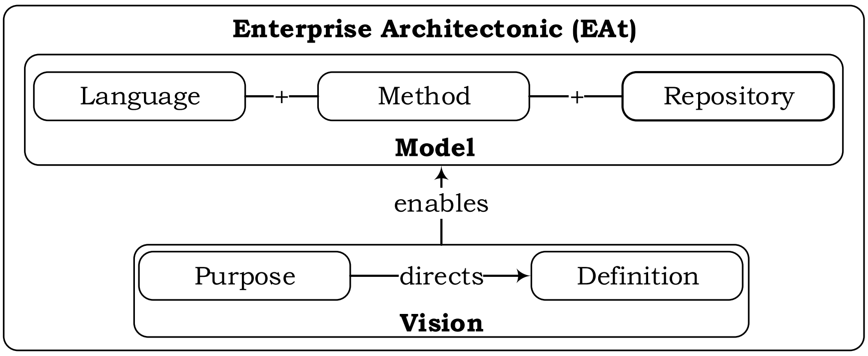


Figure 5.9: The EA Vision Enables the EA Model

Time is a key concept in both Heidegger's philosophy and the EAt. Time expressed in the EAt, as discussed and summarised in Table 5.7, namely–

- Chronological: The types of architectures (*as-is* and *to-be*) are incorporated in chronological direction (*as-is* into the *has-been* and the *to-be* into the *as-is*), moving from the future towards the past. The movement is described as an architecture *becoming* another architecture.
- Kairological: The types of architectures (*has-been*, *as-is* and *to-be*) have an impact on each other as EA decisions are made. The has-been *influences* the as-is, while the to-be presents a number of *possibilities* of future as-is architectures.

The Time element in the EAt captured these senses of time in Figure 5.10. The relationship between Model and Time showed that the EA model is *captured in* time. The Time elements captures the meaning of EA Proposition 3 of the EA understanding (Table 4.11).

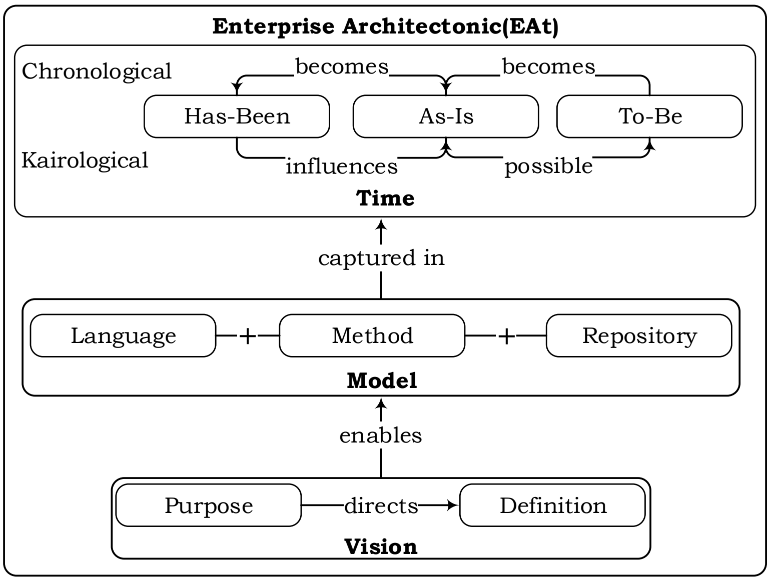


Figure 5.10: The Role of Time in the EAt

The Architect element represents the human aspect in the architecture as the agent that does the work of creating an EA. In order to be enable the Architect to effectively do EA work, a relationship with the EA Theory needed to be established. The relationship was simply expressed as the Architect *makes use of* EA Theory to do EA work. The relationship between the Architect and the Model (as the result of EA work) is shown as *create*. The Enterprise element is understood as the world wherein the relationships between the other elements are tied together. The Enterprise is also the world that is *represented* by the Model element. Finally, the work of the Architect in creating the Model is *informed by* the EA Vision. The *EA Theory* element captures Proposition 1 of the EA understanding (Table 4.11). The completed EAt diagram is illustrated in Figure 5.11:

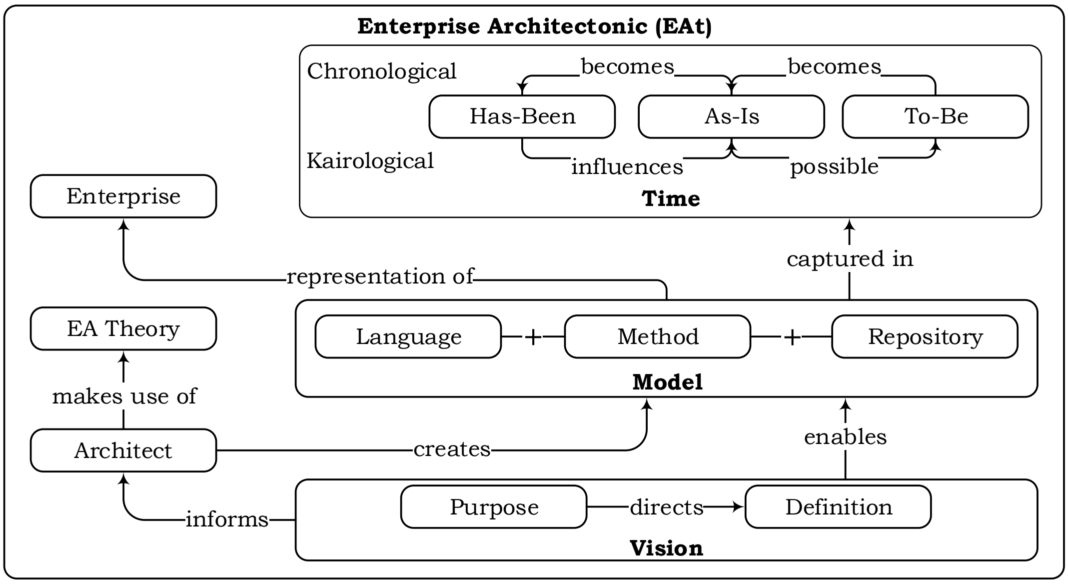
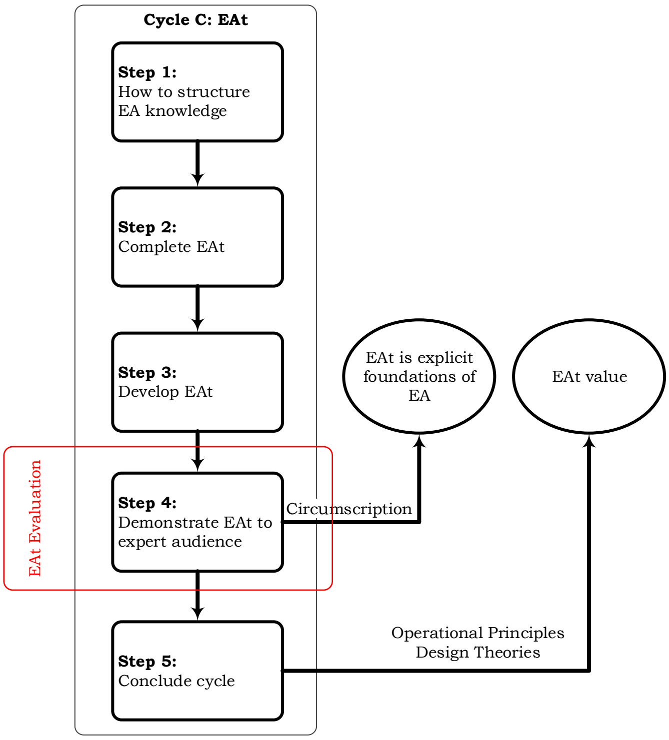


Figure 5.11: The Complete EAt Diagram

5.4.3.3 Discussion

The role of the Model element as the Representation of the Enterprise, positioned the EA model as the core artefact of EA. The introduction of a *has-been* architecture was not directly addressed by any of the prominent EAFs (section 2.4), but was implied if a Heideggerian approach were followed in understanding EA. The next section discusses the results of the EAt's demonstration to a group of enterprise architects.

5.5 THE EVALUATION OF THE EAt



DSR Progress Map

The aim of the EAt's evaluation is to determine the artefact's efficacy in solving the problem it was designed to solve (section 5.2). The problem that the EAt is designed to solve is primarily to –

> *Make the conceptual foundation of EA explicit to promote universal agreement on terms and definitions.*

The process of making EA's foundations explicit involved the establishment of an understanding of EA (Table 4.11) by –

> *Structuring the understanding of EA in terms of fundamental concepts and their relationships.*

The evaluation of the EAt is, as a result, twofold in nature, and expressed in the following two goals:

- Demonstrate the structure of the EAt as a set of concepts and relationships.
- Demonstrate the efficacy of the EAt to present an explicit meaning of EA.

To achieve both these goals, an EAt demonstration instrument was designed, and tested on a group of EA experts. The rest of this section discusses the EAt instrument (section 5.5.1 and Appendix D), as well as the results of its execution (section 5.5.2).

5.5.1 Artefact Demonstration Strategy

The strategy followed in the demonstration of the EAt consists of three steps:

- Step 1: Each participant had to complete a questionnaire to determine a baseline participants' opinion on EA concepts, before being shown the EAt. The questionnaire consisted of a basic set of open-ended questions, as follows:
    - Question 1: How long have you been involved in the EA discipline? (Options: not involved, 1-5 years, 5-10 years, more than 10 years).
    - Question 2: How would you describe your current role in the EA discipline? (Options: researcher, practitioner, no specific role).
    - Question 3: What is your understanding of what EA is, in terms of a short description or a definition? (Write down your definition/description).
    - Question 4: What is your understanding of what an EAF is, in terms of a short description or definition? (Write down your definition/description).
    - Question 5: List, according to your opinion/experience, the fundamental concepts of EA. (Write down your list of terms; try to list no more than 10 fundamental concepts).
    - Question 6: Describe either by way of a diagram, or in words, how the fundamental concepts of EA relate to each other. (Write down your description or draw a diagram.).
- Step 2: This included the demonstration of the EAt in the form of a presentation (Appendix D). The presentation was designed to be delivered in a formal setting, or as part of an informal conversation. The presentation showed a detailed breakdown of the construction of the EAt.
- Step 3: This concluded the demonstration session with another questionnaire. The intention of the post-presentation questionnaire was to gather insight about the value of the EAt, to make EA's foundations explicit. The set of questions are similar to the first questionnaire, and are as follows:
- Question 1: What is your understanding of enterprise architecture (definition or description) after viewing the presentation, has your understanding/opinion changed in any way?
- Question 2: What is your understanding of enterprise architecture framework (definition or description) after viewing the presentation, has your understanding/opinion changed in any way?
- Question 3: After viewing the presentation, has your list of fundamental enterprise concepts changed in any way?
- Question 4: After viewing the presentation, has your diagram or wording of the relationships between the enterprise fundamental concepts changed in any way?
- Question 5: Would you change the enterprise architectonic in any way (add/delete/change)?
- Question 6: Write down any additional comments about your impression of the enterprise architectonic, in the space provided.

The target audience consisted of a number of experienced EA practitioners, as well as researchers interested in EA as a topic of study.

5.5.2 Demonstration Results

In total, six interviews in five sessions were conducted. Four of the six participants reported over ten years of experience as EA practitioners, while two reported five to ten years' experience. One participant reported a dual role of both EA researcher and practitioner, with one reporting no specific role in EA. The group of participants collectively represented between ten to 40 years of experience in dealing with issues that pertain to EA practice in the workplace. The interviewees did not report any specific change in their definitions for EA and EAFs, but commented positively on the value of the EAt to describe EA in terms of fundamentals. What follows is a summary of the results of the EAt demonstration.

5.5.2.1 EA and EAF Definition

The sources for an EA and EAF definition included TOGAF (The Open Group, 2011c), Zachman Framework (Zachman, 2002), and the ISO42010 standard (IEEE, 2011), as well as the Generalised Enterprise Reference Architecture and Methodology (GERAM) (IFIP-IFAC Task Force, 1999). The participants also had their own formulations of EA – for example,

> *'The practice of supporting business change in an organisation, including the alignment of information systems with business objectives' and 'Making explicit the things that are important to the enterprise.* (Participant 3)*'*

Likewise, an EAF is described as –

> *'A frame of reference that allows for a consistent way in which to understand and/or describe the enterprise architecture space*. (Participant 2)*'* And *'Best practice guide on how to apply EA practices within an organisation.* (Participant 3)*'*

The practitioners interviewed reported no particular change to their use of a reference source to define EA and EAF, but with one exception reporting that –

> *'The presentation (of the EAt) adds value by providing context to elements previously mentioned.* (Participant 6)*'*

5.5.2.2 Fundamental concepts and their relationships

The questions that explored the participants' personal lists of fundamental EA and EAF concepts, showed a variety of terms that are drawn from TOGAF (The Open Group, 2011c), Zachman Framework (Zachman, 2002), GERAM (IFIP-IFAC Task Force, 1999), ISO42010 (IEEE, 2011) and ArchiMate (The Open Group, 2011b). The explicitly listed concepts were the following:

- EA Domains
- Meta-Model
- Business Architecture
- Application Architecture
- Technology Architecture

- Data/Information Architecture
- Repository
- Architecture Design Principles
- Strategy/Business Model
- Organisational Architecture

In terms of relationships, the respondents made use of meta-models such as those described by GERAM (IFIP-IFAC Task Force, 1999), ISO42010 (IEEE, 2011) and TOGAF (The Open Group, 2011c). Three of the participants stated that there was no change in their opinion about the relationship of fundamental concepts. The comments of the remaining participants are listed in Table 5.8:

Table 5.8: Responses on Relationship between Fundamental Concepts (step 3, question 3)

Participant	Opinion
1	Finding vision, model and time very useful in organising ideas of fundamental concepts. These concepts are not really captured in current frameworks.
2	The EA Theory and has-been concepts are new to me.
3	The time element supports the concepts of as-is, should-be and to-be. As a practitioner, it is not a necessary concept for the customer, but for internal verification of concepts it is valuable to the subject experts in Business Process Management consultancy groups.

A number of suggestions (Table 5.9) were made that the participants thought could improve the EAt:

Table 5.9: Suggested Improvements to EAt (step 3, question 5)

Participant	Suggestion
1	Enterprise complexity is inherent in the organisation, and not necessarily caused by IS/IT. IS/IT allows for enterprises to produce more inherently complex products/solutions for their customers. Reword Proposition 5 to: EA translates the values/strategy of the enterprise into operational systems (leave out IT/IS).
2	Definition - change role of IT/IS to information in the enterprise. Complexity not a technology problem; it is an organisational communication problem. Think of the vision of EA as 'the insightful ability to thinking and planning the future of the enterprise'. Vision - remove the word "imagination"; architecture is a planned, not a random, operation.
3	Add the relationship 'Enterprise *directs* EA Theory'. Repository is too technical a word; it has a very specific meaning, change to *memory*. There is a point where the *has-been* becomes too static i.t.o. its fluidic nature; maybe add 'static architectonic element'; see Foucault's The Archaeology of Knowledge.
4	Consider a higher concept (i.t.o. abstraction) for the word 'Model' – possibly *Representation*. Consider changing Repository to *Memory* or *Enterprise/Corporate Memory*.

5.5.2.3 Value of EAt

All of the participants expressed agreement that the EAt can be used as a tool to explain the fundamental meaning of EA. Each of the participant's comments relating to using the EAt as an explanation tool, are presented in Table 5.10:

Table 5.10: Comments on Value of EAt (step 3, question 6)

Participant	Comment
3	Architectonic supports GERAM's component thinking. Has-been concept links to GERAM life history concept.
4	Novice architect with a bit of EA knowledge would find value in the EAt to crystallise ideas and understanding.
5	Appears to be of practical value.
6	If architectonic is described in academic paper, I would certainly recommend it to other practitioners. There is also potential for the concepts of an architectonic to be used for other disciplines – for example EA vs Business Process Management vs Business Analysis.

5.5.3 Summary of EAt Demonstration

The following points summarise and discusses the demonstration of the EAt:

- In all but one case, the interviews were conducted 'one-on-one', with the possibility of discussion during the presentation (Part 2 of the demonstration strategy).
- The drawback of the EAt's demonstration in the form of a presentation was that the contents covered a large amount of conceptual information that needed to be grasped by the interviewee. This potential cognitive overload might have negatively impacted on the responses given to each question.
- It appears as though the EAt, in itself, seemed to hold value for the interviewees, but it did not essentially change any existing opinion about an EA definition and concepts. A potential reason for this phenomenon is that experienced architects already have an established reference point for understanding EA in terms of concepts, and would therefore view the EAt as an addition to understand EA.
- The architectonic was well received, and the general opinion was that it is helpful as a tool for explaining what EA is. In terms of what the EAt was designed to do, it is evident from its demonstration to an audience of experienced architects, that there is significant explanatory value in the artefact.

The goals for the evaluation of the EAt are achieved in the following way:

- Demonstrate the structure of the EAt as a set of concepts and relationships:
  The EAt graphic (Figure 5.11) is a visible demonstration of the fundamental concepts of EA as well as their relationships. The contents of the EAt were determined by applying a Heideggerian equipment analysis (section 5.4.3) to the EA understanding (Table 4.11) produced in Chapter 4 (section 4.5). As far as the EAt represents a structured set of concepts and relationships, the goal is regarded as adequately achieved.

- Demonstrate the efficacy of the EAt to present an explicit meaning of EA.

  The EAt's graphic (Figure 5.11) also serves the role of an explicit formulation of the meaning of EA. The meaning of EA was derived as follows:

  - Interpreting (section 4.4) prominent EAFs (section 2.4) to determine an understanding of EA (Table 4.11).
  - Analysing the EA understanding through Heidegger's equipment analysis, to create the contents of the EAt.

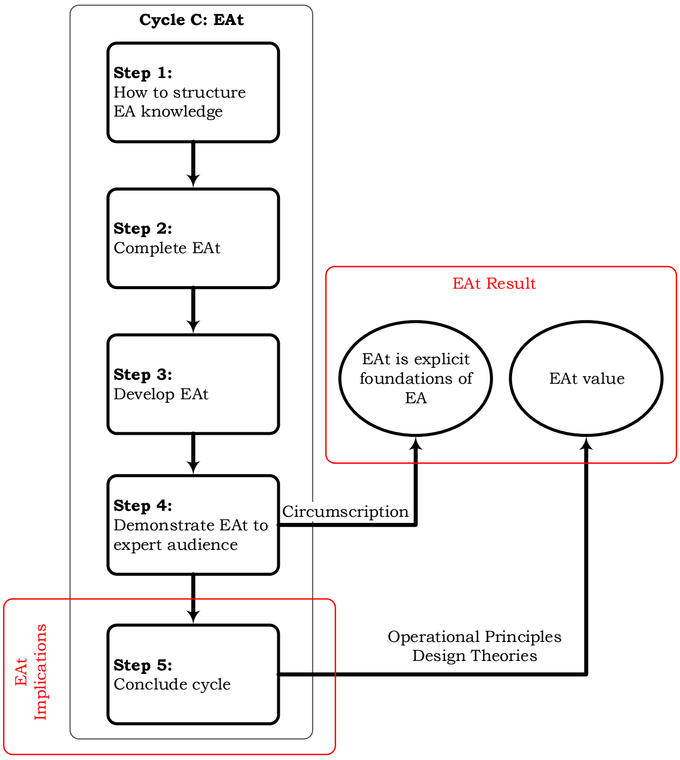
  The EA meaning is therefore based upon an interpretation of three prominent EAFs, namely–

  - The Zachman Framework (Zachman, 2002).
  - TOGAF Version 9.1 (The Open Group, 2011c).
  - DoDAF Version 2.02 (DoD Chief Information Officer, 2009).

  The popularity of the selected EAFs was determined through a careful analysis (section 2.4.1) of the research literature. The interpretation (and therefore meaning) of EA rests on the interpreted EAFs, and therefore allows for the potential of some fundamental aspect being excluded from the EAt. The goal of making the EA foundations explicit is therefore acknowledged as reached, but with consideration of the limitations inherent to the process followed.

Finally, it is evident that the EAt performed as it was intended. The EA understanding is structured in the EAt graphic, and the meaning of EA is made explicit. The evaluation of the EAt concludes at this point, but the implication of the EAt still needs to be discussed. This will be done in the next section.

5.6 THE IMPLICATIONS OF THE EAt



DSR Progress Map

The research problem was stated in Chapter 1 (section 1.3.2.4) as a lack of clarity on the conceptual foundation (Figure 1.1) of EA thinking and practice. The awareness of this problem in EA's foundations (section 2.5.1) resulted in the statement of five key points (section 2.5.1) that emphasises the context of the research problem. These are summarised as follows:

1. The academic literature states that EA does not have a universal set of terms and definitions.
2. The different attempts at creating a universally accepted EA definition did not achieve their intended purpose.
3. The role of an EAF as realising the EA, depends on a local (inside the EAF) expression of EA meaning.
4. The adaptability of EAFs (to create new EAFs) suggests the existence of common ground in terms of EA meaning, and highlights EA's implicit theoretical foundations.
5. The specific context of an EA practice impacts the meaning of EA, due to a localised (to the enterprise) understanding of the meaning of EA, in combination with localised (to the enterprise) needs.

The diversity in EAFs, and the absence of a universal acceptance of the conceptual meaning of EA, leads to a problem, because of the implicit conceptual foundation of EA.

The measurements that assess the degree to which the EAt resolves the research problem, must therefore address the five key points (section 2.5.1) in such a way that the implication of an explicit EA foundation can be determined. The EAt's impact is measured in qualitative terms, by measuring the following aspects (derived from the five key points summarised in section 2.5.1):

1. A set of EA terms and definitions
2. A general meaning of EA independent of an EAF
3. An explicit EA theoretical foundation

The results of the EAt evaluation lead to input for further development of the EAt artefact. The cyclical nature of design science research, and, in particular, the 'learn by making' approach to research, makes a complete and perfect artefact unnecessary. The EAt was presented to five experienced enterprise architects and academics (section 5.5.1). The results from the EAt demonstration resulted in a set of opinions that serve as qualitative data for the EAt evaluation. The EAt is measured against the implications that an explicit EA foundation (in the form of an architectonic) has for existing EAFs.

5.6.1 A Set of EA Terms and Definitions

The EAt was designed with the specific intention to serve as a mechanism to explain the fundamental meaning of EA, in terms of concepts and their relationships (section 5.4.1). Based on the responses from an experienced audience, the EAt fulfilled its explanatory intent (Table 5.8). Improvements can be made to the EAt, following the suggestions for changes (see Table 5.9) – such as, for example, adding a relationship between the architectonic elements of *Enterprise* and *EA Theory*.

The efforts to explain the meaning of EA, as discussed in Chapter 2 (section 2.3), focused attention on the role of the definition as a mechanism to explain what EA is (see, specifically, the approaches by practitioners, in section 2.3.2). The efforts of academia are distributed among a categorisation scheme for EA definitions (Dankova, 2009), section 2.3.1 and Table 2.1), a selection of key terms based on a linguistic approach (Buckl et al., 2010), section 2.3.1 and Table 2.2), EA schools of thought (Lapalme, 2012), section 2.3.1 and Table 2.3), and an application of 'pattern thinking' (Kotzé et al., 2012), section 2.3.1, Table 2.4 and Table 2.5). With the exception of Kotzé et al. (2012), the EA description efforts focused attention on the role of *definition* to explain the meaning of EA. Buckl et al. (2010) listed four key concepts, two (EA vision and EA strategy) of which corresponded to the *vision* element in the EAt.

The architectonic nature of the EAt solved the research problem by providing an artefact dedicated to explaining the foundational concepts of EA. As such, it was not constructed purely from a synthesis of EA definitions, as was the case with Dankova (2009) and Lapalme (2012), nor was it based on a comparison of various EAFs to find common ground. In intent, the EAt was designed to be an interpretation of the implicit meaning of EA, as found in the prominent EAFs identified in section 2.4.1. The fundamental purpose of an architectonic was to serve as a knowledge-structuring mechanism (section 2.5.2), and in that sense it is related to the work of Buckl et al. (2010) and Kotzé et al. (2012).

Finally, the EAt achieved the aim of creating a set of EA terms and definitions. The EAt's unique characteristic of a structured set of concepts and relations, allows for argument and debate on the issue of EA's fundamental meaning.

5.6.2 A General Meaning of EA, Independent of an EAF

The EAF is said to realise the EA in an enterprise (Namkyu et al., 2009; Kozina, 2006; McCarthy, 2006). Each of the EAFs summarised in section 2.4, provides not only a definition of EA but also a unique set of EA terms. The key descriptive element of each EAF is a model or set of models. The Zachman Framework describes the enterprise in terms of primitives (Zachman, 2002) that, in combination, form an ontology (Zachman, 2008) of the enterprise. TOGAF Version 9.1 defines EA in two senses, and identifies different types of architectures – namely business, data, application and technology (The Open Group, 2011d). DoDAF Version 2.02 describes the enterprise by making use of architectural data and descriptions (DoD Chief Information Officer, 2009). The meaning of EA is therefore dependent on the EAF.

The EAt provides a mechanism to explain the meaning of EA, independent from an EAF. The content of the EAt is based on an interpretation of the knowledge contained in three prominent EAFs (section 2.4), but in itself it is separate in type from what an EAF is. The purpose of the EAt is narrow and specific, in that it only explains the conceptual foundations of EA. As such, it serves as an explicit description of the underlying concepts needed to understand EA on a fundamental level. The value of the EAt is that it precedes any realisation of an EA from the perspective of the meaning that an EAF prescribes. In the role of explaining the EA foundations, it also serves the role of a general understanding of the meaning of EA.

5.6.3 An Explicit EA Theoretical Foundation

In keeping with the conceptual character of the EAt, and keeping in mind that its purpose is to explain the meaning of EA, the EAt achieved a unique milestone in that the implicit knowledge about EA was presented explicitly. The explicit EA knowledge served as important EA theory about how to understand EA, in terms of key concepts and their relationships. TOGAF Version 9.1 credits an extensive list of reference sources consulted during its development (The Open Group, 2011d). These sources can be seen as the theoretical foundation to TOGAF. The Zachman Framework is described as a schema (Zachman, 2008) and classification theory (Zachman, 2009b) rooted in linguistics. The underlying theory of the Zachman Framework, therefore, is classification theory with a matrix where the column headings are organised according to the six interrogatives, namely what, how, where, who, when and why. The rows are, in turn, organised according to levels of reification, from abstract idea to concrete implementation. An intersection of the matrix contains a unique description of the enterprise, in terms of the particular interrogative (for example, why) and its level of reification (for example, row 1 or scope).

5.6.4 Summary and Discussion

With regard to measuring the EAt's performance against its design objectives and requirements, some observations are made in Table 5.11:

Table 5.11: Demonstration of Performance of EAt Against Design Objectives

Design objective	Observation
To interpret the results of the SIM (EA understanding) by making use of Heidegger's Equipment Analysis.	The range of architectonic elements derived from the six EA propositions are adequate to describe the fundamental concepts of EA. The concept that gathered the most interest was the interpretation of time, in terms of its context for the existence of the model. The introduction of the has-been concept reflected an implied aspect of the interaction between the as-is and to-be model. This objective has been adequately achieved in the EAt's design.
To construct an enterprise architectonic to structure EA's foundational knowledge as reflected in the EA understanding (Table 4.11).	The structure of the EAt, in terms of concepts and relationships, provides a straightforward arrangement of EA's fundamental concepts. This objective is regarded as being met.
To demonstrate the usefulness of the enterprise architectonic to EA practitioners and researchers.	The demonstration of the EAt resulted in an agreement by all the interviewees that the EAt has value, in terms of its ability to describe the meaning of EA in terms of fundamental concepts and their relationships.

The conclusion drawn from the demonstration and evaluation of the EAt, is that the EAt, as a conceptual artefact, reached its intended purpose, and therefore solved its design problem with some qualification, namely –

- A number of suggestions have been made that can be incorporated into another cycle of the EAt's design as per the DSR methodology and philosophy.
- The unfamiliarity of the idea of an architectonic, as well as the conceptual nature of the EAt, necessitate further testing and demonstration to fully explore their potential and evolution.

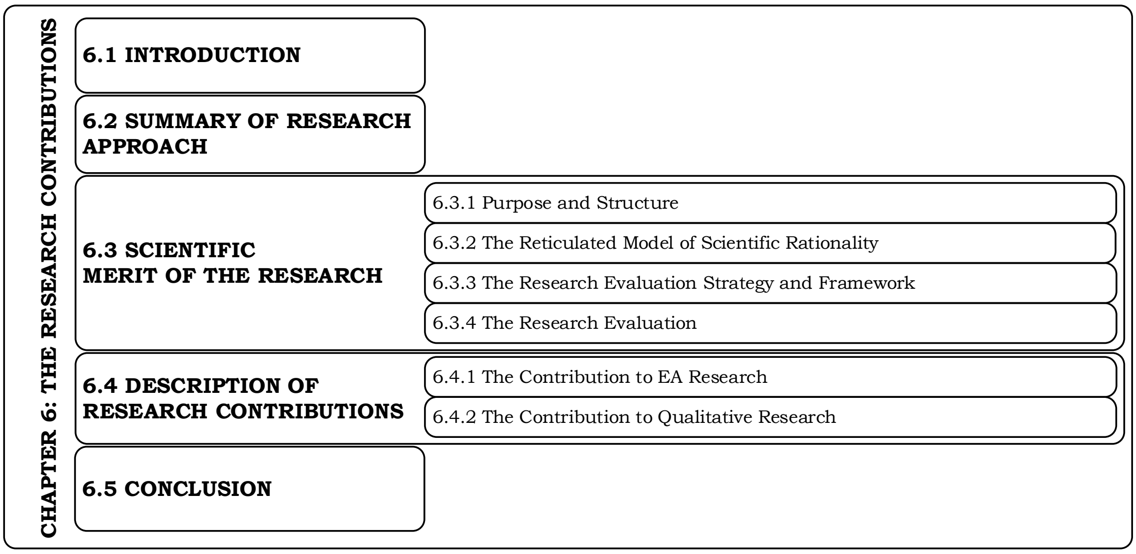
5.7 CONCLUSION

The complex nature of the enterprise, in terms of its operational pressures, creates fertile ground for a range of solutions to problems directly related to complexity. The introduction of IT/IS in the enterprise changed not only the way that business is conducted, but also changed the very nature of the most important member of the enterprise – namely the worker. If EA is to be the solution to the complexities of managing IT/IS in the enterprise, then it should be well understood. The risk inherent in EA is that it is just another technology applied to problems that result from the introduction of technology. The EAt is a tool and a means to bring about an understanding of what EA is in the enterprise. This tool is a conceptual artefact that contains the essential concepts and their relationships, that aims at giving an explanation of EA in terms of not only precisely defined concepts, but also the relationships between them. The demonstration of the EAt to an audience of experienced enterprise architects and researchers, showed that it was successful in its explanatory aim.

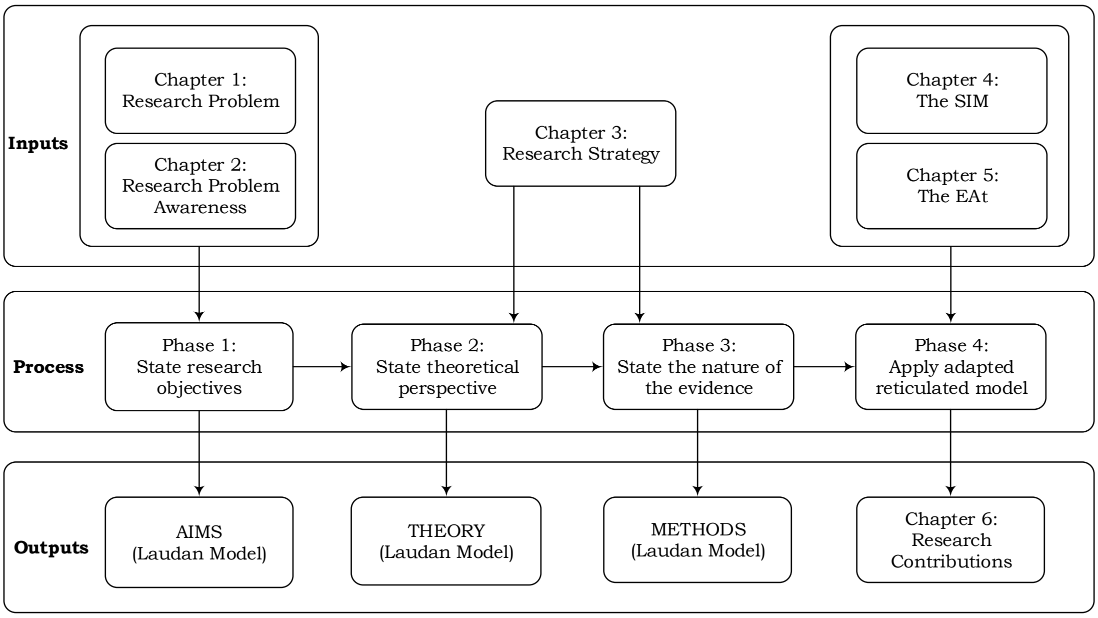
The research plan, as far as the construction of the artefacts goes, is completed at this point. What remains is a detailed discussion on the ways in which the research goals were met. This is the task of the next chapter: to show the scientific relevance and value of the research, as well as the contributions to the field of EA research.

CHAPTER 6: THE RESEARCH CONTRIBUTIONS

Chapter Map



Research Evaluation Process



6.1 INTRODUCTION

The value of research is appreciated to the extent that its results solve problems or answer questions. The magnitude of this value depends on the quality of the research effort. As such, research is, in general, measured according to its validity and reliability, in terms of the knowledge claims that result from the research effort. The context of the research effort plays an important role in the process of establishing the validity of the research results produced. Results, in essence, contribute to the existing body of knowledge, so that the understanding of the field of study can move forward. This chapter highlights the contributions that the research reported in this thesis brings to the field of EA research.

The claims of contribution to the EA body of knowledge are made in accordance with the aims and objectives set out in Chapter 1 of this thesis. DSR was used as a methodology to execute the research plan, whereas the research strategy was based on a subtle realist position (section 3.2.1). The evaluation of each artefact, according to the approach described by Vaishnavi and Kuechler (2013), was discussed in chapters 4 and 5 (section 4.5 and section 5.5). This chapter is concerned with the scientific merit of the study as a whole, and employs Laudan's Reticulated Model of Scientific Rationality. Section 6.2 presents a summary of the research approach (Chapter 3), section 6.3 discusses the scientific merit of the research, and section 6.4 discusses the research contributions. The chapter concludes with section 6.5.

6.2 SUMMARY OF RESEARCH APPROACH

Philosophically, the results of the research discussed in the thesis up to this point, should be understood in the context of an interpretivist epistemology (section 3.2.1 and Figure 3.5) that informs a *science of the artificial* inspired theoretical perspective (Simon, 1996). The knowledge claim in this thesis is based on an understanding (interpretation) of what can be learnt by making and using a conceptual artefact (science of the artificial). The artefact is the solution to a research problem as described in Chapter 1 (section 1.4) and Chapter 2 (section 2.5.1). The ontological basis of the research approach is described by Iivari (2007) (section 3.2.1) as a combination of Popper's World 3 theories (containing the products of the human mind) and IS artefacts that result in new types of theories (Table 3.1). Epistemologically, the type of knowledge achieved in this thesis is conceptual (section 3.2.1) in nature. The research method followed was based on the design science research model described by Vaishnavi and Kuechler (2013) (section 3.2.2), and was aimed at producing the type of knowledge classified as better theories. The research contribution described in this chapter is therefore of a conceptual and theoretical nature.

6.3 SCIENTIFIC MERIT OF THE RESEARCH

Without a certain measure of rigour, the results of a research effort are said to be worthless (Morse et al., 2002). The issue of measurement is widely debated along the lines of the type of research (Rolfe, 2006; Golafshani, 2003) and its underlying philosophical paradigm (Stige et al., 2009). A correlation exists between the *what* (i.e. the problem or question) and the *how* (i.e. the approach to find a solution or answer) of research projects. The remainder of this section presents the evaluation of the research results reported in this thesis, in order to shows their validity and trustworthiness as scientific research.

6.3.1 Purpose and Structure

The purpose of this section is to design and execute a research evaluation strategy of the results of the research reported in this thesis. Since the research strategy is based on an interpretivist epistemology (section 3.2.1), the evaluation of the research results is also an interpretation, and forms part of the research process. The evaluation approach is based on the work of Landry and Banville (1992), who adapted the Reticulated Model for Scientific Rationality developed by Laudan (1986).

6.3.2 The Reticulated Model of Scientific Rationality

Laudan (1986) stated that researchers, in general, aim to reach an agreement on their results and claims. This desire for consensus is believed to be an indication of the quality scientific practice. Laudan's contribution to this drive is the Reticulated Model of Scientific Rationality (Figure 6.1). The model shows that a research method is justified by the aims (or goals) of a research project, while the aims must be realisable by the methods used. The methods are constrained, in how they are used, by the underlying theory, and the theory justifies which methods are available for use in the research project. Finally, good quality science means that the aims and theories of a research project must harmonise.

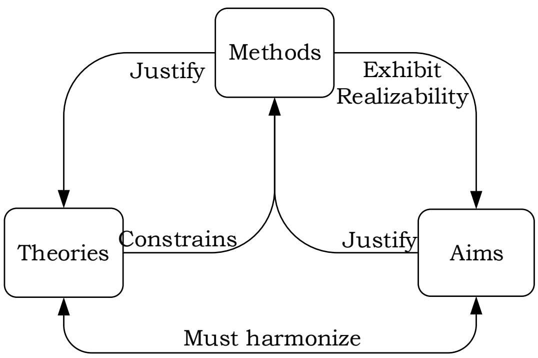


Figure 6.1: Laudan's Reticulated Model of Scientific Rationality (Laudan, 1986)

Landry and Banville (1992) applied Laudan's model, to examine the possibility of using research methods from different philosophical traditions, in management information systems research. Landry and Banville (1992) produced a set of questions that examined the aspects, as well as relations, between *theory*, *aims* and *method*. A combination of Landry and Banville (1992) and the paradigmatic analysis (section 3.2.1) of Iivari (2007), was used as the foundation for the evaluation framework, to determine the scientific quality of the research reported in this thesis.

6.3.3 The Research Evaluation Strategy and Framework

According to Mouton (2001) the ProDEC framework of social scientific reasoning, consists of four elements that are standard in all forms of research, namely –

- A research problem
- A research design
- Evidence
- The conclusions

The four elements can be translated into a sequential research process as follows:

- Phase 1: Identify a research problem.
- Phase 2: Designing the approach by which the problem will be addressed.
- Phase 3: Decide on the nature and extent of evidence.
- Phase 4: Draw conclusions as a result of an analysis of the evidence.

The final product of the research is a written thesis that serves as a communication mechanism of the research results to the wider research community. The research process is used to establish the phases in the research evaluation framework. Each phase in the process produces outputs that can be measured by the elements in Laudan (1986) Reticulated Model of Scientific Rationality (Figure 6.1), as follows:

- Phase 1: Stating the research problem also includes stating the research objectives, and this aligns with the *Aims* component.
- Phase 2: The research design includes the research theoretical framework, as well as a research plan. The theoretical framework of the research aligns with the *Theories* component.
- Phase 3: The research plan addresses the research methods used to gather evidence, and aligns with the *Methods* component of Laudan's model.
- Phase 4: The adapted reticulation model for scientific rationality (Table 6.1) is applied to gather answers to be analysed, and concludes the evaluation process.

Landry and Banville (1992) set of evaluative questions guide the evaluation of the aims, theory and method, as well as their relationships (Table 6.1). The answers to each question show the appropriateness of the research design applied to obtain the results in this thesis. The process is illustrated in Figure 6.2.

Table 6.1: Evaluative Questions (Adapted from Landry & Banville, 1992)

Aspect	Evaluative questions
Aims	What are the explicit aims of the research project? Who are the stakeholders to be considered for this research? What would progress mean, relative to the research aims?
Theories	Are the theoretical foundations of the project adequately expressed? What are the explanatory or predictive virtues of the theory?
Methods	Is the method clearly elaborated and viable? Does the method relate to orthodox methods? Is the method empirically sound? Is the research design feasible? Which scientific aims does it promote?
Theories constrain methods	What general constraints does the theory put on methods? Is the method adapted to the nature of the theory?
Theories must harmonise with aims, and aims must harmonise with theories	Relative to the stated aims, how can progress be defined? Does the theory support the stated aims, and are the stated aims congruent with the theory? Is the theory congruent with the aims? Are the theory and goals of the same nature?
Methods must exhibit realise-ability of aims	Is the method well adapted to the aim(s)? Can the method assess the viability of the aim(s)? Would another method be more appropriate to the aims?
Methods justify theories	Is the theory *in line* with the method? Can the theory be verified through this method? Can this method be complemented?
Aims justify methods	Is the method needed? Is the method a way of attaining the goals? Is it rational, in the sense that it incorporates whatever procedures are most likely to facilitate or guarantee the achievement of one's ends?

The application of the adapted reticulation model for scientific rationality (Table 6.1) produces answers to the evaluative questions from the perspective of the research. The conclusions drawn from this set of answers are an interpretation of the quality of the scientific value of the research project.

6.3.4 The Research Evaluation

What follows is a discussion of the results of each phase of the evaluation process (Figure 6.2), with emphasis on the results drawn from the application of the adapted reticulated model of scientific rationality (Table 6.1).

6.3.4.1 Phase 1: State Research Objectives

The research objectives were justified and listed in Chapter 1 (section 1.4.3). The primary research question addressed by the research project was:

> *In what way can architectonics contribute to a foundational understanding of enterprise architecture?*

The research objectives in support of this research question, were as follows:

1. *Describe the theoretical background of EA research, in terms of EA definition efforts as well as issues in EAF selection.*
2. *Determine an understanding of EA by interpreting the key works of three prominent EAFs.*
3. *Organise the concepts derived from the EA understanding, in an EAt.*

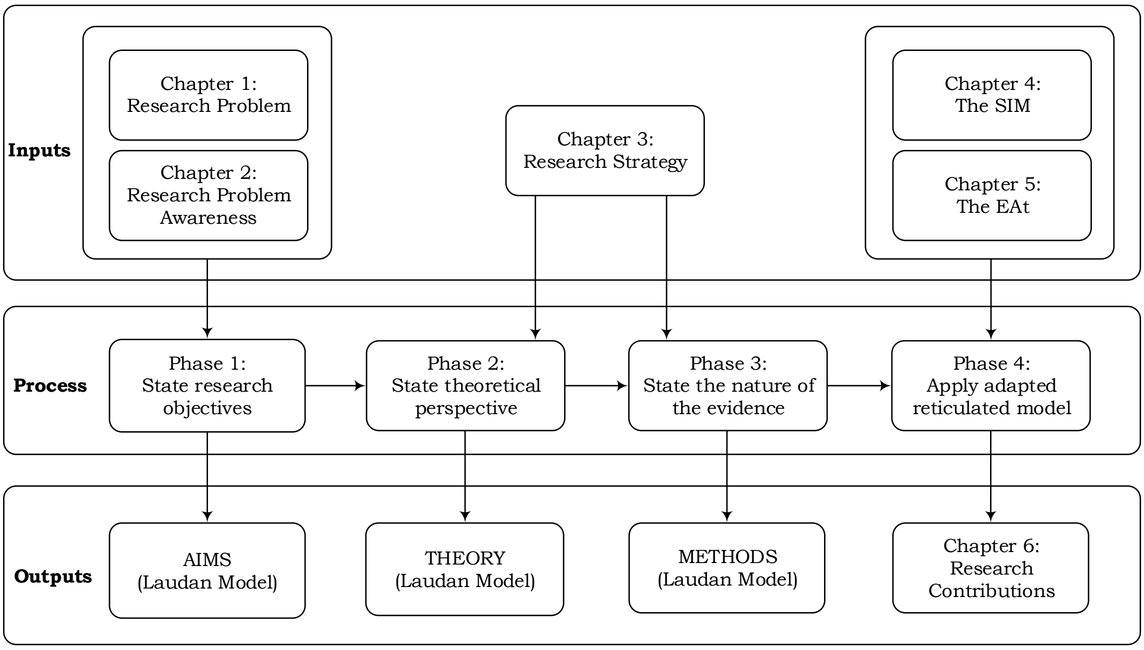


Figure 6.2: The Research Evaluation Process

The aims derived from the listed objectives related to the products of each objective, and are summarised as follows:

1. Describe the theoretical background of EA research in terms of EA definition efforts and the difficulties with EAF selection.
2. Determine an understanding of EA by interpreting the key works of three prominent EAFs.
3. Construct an enterprise architectonic (EAt) to structure the core concepts of EA, in terms of fundamental concepts and their relationships.

The combination of research question, objectives and aims resulted in a description of the aims of the research, and were representative of the intended value of the research. The evaluation of these elements is summarised according to the adapted model in Table 6.1.

6.3.4.2 Phase 2: State Theoretical Perspective

The theoretical perspective of the research was discussed in detail in Chapter 3 (section 3.2.1), as part of the research strategy. The philosophical foundation of the research as a whole was characterised as *subtle realist* that informed an *interpretive theoretical perspective*. The primary theories used in this research were *phenomenological hermeneutics*, as described by Heidegger (2000), *philosophical hermeneutics,* as developed by Gadamer (2004) and *architectonics* (section 5.3.1).

6.3.4.3 Phase 3: State Nature of Evidence

The DSR model (Vaishnavi & Kuechler, 2013) was used to create the research plan. Two conceptual artefacts (Bereiter, 2002) were proposed, to address the research aims. The first step in the DSR process was an awareness of the problem, which was established by making use of a literature review (section 2.2). The SIM artefact was a method to interpret prominent EAF texts (section 2.4.1) (Table 4.2), and resulted in an EA understanding (Table 4.11). The EAt artefact made use of Heidegger's equipment analysis (5.3.2.3) as an analysis method to determine the fundamental concepts from the EA understanding (Table 4.11).

6.3.4.4 Phase 4: Apply the Adapted Reticulated Model

The model was applied in two parts, where the first part answered the questions relating to the aim, theory and method of the research (Table 6.2), after which the second part answered the questions about interconnections in Laudan's model (Table 6.3).

Table 6.2: Aims, Theory and Methods Evaluation

Aspect	Evaluative questions	Answers
Aims	What are the explicit aims of the research project?	1. Describe the theoretical background of EA research in terms of EA definition efforts and the difficulties with EAF selection. 2. Determine an understanding of EA by interpreting the key works of three prominent EAFs. 3. Construct an enterprise architectonic (EAt) to structure the core concepts of EA in terms of fundamental concepts and their relationships.
	Who are the stakeholders to be considered for this research?	Enterprise architects and EA researchers.
	What would progress mean, relative to the research aims?	Progress is measured by how explicit the EA foundations are after completion of the research. Explicit foundations can lead to progress in the debate on universal understanding of EA.
Theories	Are the theoretical foundations of the project adequately expressed?	Yes, phenomenological hermeneutics, philosophical hermeneutics and architectonics.
	What are the explanatory or predictive virtues of the theory?	The theories used have explanatory value in the sense that the issue of meaning and understanding is important. The predictive aspect of theory is not included, since the emphasis of the research is conceptual understanding.
Methods	Is the method clearly elaborated and viable?	Yes (section 3.3), the research method used is DSR (Vaishnavi & Kuechler, 2013).

	Does the method relate to orthodox methods?	DSR, although new to IS research, is growing in being accepted by IS researchers (Vaishnavi & Kuechler, 2013).
	Is the method empirically sound?	Yes, every artifact is evaluated against performance expectations (section 4.5 and section 5.6)
	Is the research design feasible?	Yes (section 5.6)
	Which scientific aims does it promote?	Understanding and clarification of concepts.

Table 6.3: Interrelationship Evaluation

Aspect	Evaluative questions	Answers
Theories constrain methods	What general constraints does the theory put on methods?	The theory limits the methods, in that the results of the methods should produce conceptual knowledge.
	Is the method adapted to the nature of the theory?	Yes, the SIM is designed to produce an EA understanding (Table 4.11), while the EAt makes EA foundations explicit (Figure 5.11). DSR allows for the creation of artefacts to solve problems (Vaishnavi & Kuechler, 2013). The artefacts created in the research are a method and a conceptual artefact (Bereiter, 2002).
Theories must harmonise with aims, and aims must harmonise with theories	Relative to the stated aims, how can progress be defined?	Progress is measured by how explicit the EA foundations are after completion of the research. Explicit foundations can lead to progress in the debate on universal understanding of EA.
	Does the theory support the stated aims, and are the stated aims congruent with the theory?	Yes.
	Is the theory congruent with aims?	Yes.
	Are theory and goals of the same nature?	Yes, both address meaning and understanding, and are on a conceptual level.
Methods must exhibit realise-ability of aims	Is the method well adapted to the aim(s)?	Yes.
	Can the method assess the viability of the aim(s)?	Yes.
	Would another method be more appropriate to the aims?	Unknown. Method such as grounded theory or action research could also have produced an explicit understanding of EA.
Methods justify theories	Is the theory *in line* with the method?	Yes.
	Can the theory be verified through this method?	Unknown.
	Can this method be complemented?	Unknown.
Aims justify methods	Is the method needed?	Yes, the DSR model (Vaishnavi & Kuechler, 2013) is effective in terms of following a disciplined approach to solving problems.

	Is the method a way of attaining the goals?	Yes.
	Is it rational in the sense that it incorporates whatever procedures are most likely to facilitate or guarantee the achievement of one's end?	Yes.

6.3.4.5 Phase 5: Discuss Results

Overall, the results in Table 6.2 and Table 6.3 indicated coherence between the elements described in Laudan (1986) reticulation model for scientific rationality (Table 6.1). As interpretive research essentially deals with interpretation and not truth, any evaluation of scientific validity is also an interpretation. Even so, no claims are made for the correctness or truth value of the claims of the research. Instead, the results showed that the aims of the research had been successfully met. The theories used, and the research process addressed, meaning and understanding, and there is, therefore, alignment with the aims and methods. The EAt is seen as the main contribution to EA research, and the SIM is viewed as a contribution to IS research. The specific contributions of the research are discussed next.

6.4 DESCRIPTION OF RESEARCH CONTRIBUTIONS

The contribution of a research project indicates the way in which the outcomes of the research added value and knowledge to the body of knowledge of the research domain. In the case of the research reported in this thesis, the main research contribution is to the body of knowledge that addresses the theoretical and conceptual understanding of EA. A secondary research contribution is to the broader field of qualitative research methods and approaches that specifically deal with the aspect of interpretive research. This section will discuss the specific research contribution to each of the research domains, starting with enterprise architecture's theoretical and conceptual understanding, and then moving on to the methods of interpretive qualitative research.

6.4.1 Contributions to Enterprise Architecture Research

As discussed in Chapter 1 (section 1.3) and elaborated on in Chapter 2 (section 2.5.1), the problem addressed (by way of creating an artefact) is that the foundational concepts of EA remain unstated – and therefore unclear. Numerous discussions (section 2.3) addressed this problem by way of EAF comparisons and an EA definition attempt. This thesis participated in the attempts to clarify the meaning of EA, and did so from a conceptual perspective. The results of this effort led to a number of significant research contributions to the fundamental conceptual understanding of the meaning of EA.

6.4.1.1 The EA Understanding

The evaluation of the SIM (section 4.5) resulted in an understanding of EA expressed as a claim that –

> *Enterprise architecture is similar in intent to the enterprise as a worldview is to the world.*

The EA claim was supported by six propositions as follows:

1. EA underlying theoretical knowledge is in a pre-suppositional state.
2. EA is a description of the structure of the systems of an enterprise.
3. EA represents the enterprise in time-oriented architectures such as an as-is, to-be and has-been architecture.
4. EA translates the values/strategy of the enterprise into operational systems appropriate to the information society.
5. EA provides a means to manage decisions about the IT/IS management and implementation in the enterprise.
6. EA captures a representation of the enterprise in the form of a model or set of models.

The EA understanding described the meaning of EA from a holistic perspective. While these propositions were not intended to represent an exhaustive understanding of EA fundamentals, it was a useful starting point – as was demonstrated with the development of the EAt (section 5.4.3). The literature review in Chapter 2 showed that the efforts to understand the meaning of EA were mainly focused on framework comparisons, literature reviews and surveys (section 2.2.1). The results from EAF comparisons led to the creation of EAF characterising ontologies (Ohren, 2005), a framework to aid EAF comparisons (Abdallah & Galal-Edeen, 2006), and observations (Greefhorst et al., 2006). The published literature reviews, among others, resulted in a suggestion for common EA terminology (Schönherr, 2008). Further research into the meaning of EA led to the three schools of EA thought (Lapalme, 2012) and a classification of EA definitions (Dankova, 2009). All of these examples served as evidence (section 2.2) that the meaning of EA remained unsettled, and part of a continual debate among scholars and practitioners.

The EA understanding (Table 4.11) was a contribution to the debate on the meaning of EA, in a number of ways:

1. The EA claim and propositions were the result of an interpretation of three prominent EAFs, (section 2.4.1) namely –
    a. The Zachman Framework (Zachman, 1987; Sowa & Zachman, 1992; Zachman, 2002).
    b. DoDAF Version 2.02 (DoD Chief Information Officer, 2009).
    c. TOGAF (The Open Group, 2011d).

    The EAF is responsible for the realisation of the EA in the enterprise (Kozina, 2006; McCarthy, 2006; Namkyu et al., 2009). In this role, the EAF contains the meaning of EA, and is usually provided as a set of formal definitions and terminology. The net result of EAF's role as the context of the definition of EA, is that the meaning of EA becomes localised to the EAF (section 2.5.1). Producing an EA understanding that is not contained or directly connected to an EAF, is a significant contribution to the EA research domain. For the newcomer to EA, the EA understanding will present an answer to the what-is-EA question, without the need to study all the available EAFs first.

2. The EA claim and EA propositions are descriptions of fundamentals; in other words they can be used as the basis for further debate on the meaning of EA. The advantage of having access to an EA understanding, is that the debate on a universal understanding of EA can potentially be brought to a conclusion.
3. The means by which the EA understanding was derived were based on recognised interpretation theory, which was organised in a structured method (SIM) that makes the position of the examiner explicit (section 4.3.2). The advantage of such an approach is that the researcher and practitioner can trace whence the EA understanding originated. The SIM can be applied to a different set of texts or text analogues, to determine the meaning of EA.

In conclusion, the application of a structured hermeneutic method (section 4.5) to explore the meaning of EA is unique, in that nothing similar could be found in the formal research literature, to date. The closest formal attempt at formalising the body of EA knowledge, was left incomplete in 2004 (Hagan, 2004).

6.4.1.2 The Set of Architectonic Elements

The list of architectonic elements (section 5.4.3.1 and Table 5.7) is the result of applying a philosophical lens to interpreting the meaning of EA. Heidegger (2000) equipment analysis of the EA understanding (Table 4.11) produced a set of concepts and relationships that, to date, was assumed and implicit to the meaning of EA. Heidegger (2000) has been appropriated by other researchers as a means to understand the role of IT as the core artefact in IS research (Riemer & Johnston, 2011; 2013). In similar fashion EA is understood as tool in use by IS workers towards some purpose related to human activity.

The contribution of the set of architectonic elements to the domain of EA research, is that it is a unique set of fundamental concepts drawn indirectly from three prominent EAFs (Zachman Framework (Zachman, 1987; Sowa & Zachman, 1992; Zachman, 2002), TOGAF Version 9.1 (The Open Group, 2011d) and DoDAF Version 2.02 (DoD Chief Information Officer, 2009)) through a sound philosophical lens (Heidegger's equipment analysis). Similar attempts to create lists of concepts include the use of ontologies Ohren (2005) and a set of key EA terms (Buckl et al., 2010).

The list (Table 2.2) produced by Buckl et al. (2010) compares with the list of fundamental EA concepts in the following way:

- The list created by Buckl et al. (2010) consists of four entries, namely –
  - EA vision: a distant target representing an ideal state – i.e. an implicit model and understanding of a target state of an EA.
  - EA principle: the constraints and guides of the design of the EA, and might, in turn, provide justification for decision-making throughout an EA.
  - EA strategy: outlines a series of means (activities) to pursue a desired end – i.e. a dedicated target state of an EA.
  - Conformance to EA vision: describes an intuitive understanding for the degree to which the current or a planned state of the EA matches the EA vision.
- By contrast, the list in Table 5.7 contains 10 entries that address Buckl et al. (2010) as follows:
  - *EA vision* and *EA strategy* entries in the Buckl et al. (2010) list correspond to the combination of the *Purpose* and *Definition* elements on the architectonic list.
  - The *Conformance to EA vision* entries in the Buckl et al. (2010) list correspond to the *Model* and *Time* architectonic elements.
  - The *EA principle* entry on the Buckl et al. (2010) list corresponds potentially with the *EA Theory* architectonic element.
- The list of architectonic elements is more complete, and more fundamental, in terms of identifying foundational concepts to describe EA.

Greefhorst et al. (2006) made a number of observations about the use of EA terms, after comparing EAFs to the IEEE 42010 standard (IEEE, 2011), namely –

1. EAFs make use of different terms for similar aspects, and similar terms for different aspects.
2. EAFs often define terms informally, making it difficult to demarcate boundaries clearly.
3. EAFs often do not name dimensions explicitly, leaving their interpretation up to the reader.
4. EAFs sometimes do not distinguish clear values within the dimensions, hindering effective communication.
5. EAFs often have slightly different sets of values for particular dimensions.
6. EAFs sometimes have dimensions with values that do not have a clear relationship – which makes it hard to understand the dimension altogether.

The set of architectonic elements address these observations by providing a set of clearly defined concepts of the meaning of EA. Observations 1, 2 and 3 highlight the implicit EA foundations, and are resolved by a list that is clearly defined. The remainder of the observations (4, 5 and 6) of Greefhorst et al. (2006) are addressed indirectly by the list of architectonic elements.

In addition to providing a unique list of descriptive EA concepts, the list of architectonic elements (Table 5.7) contributed a sense of clarity to the conceptual meaning of EA. Clarity in concepts are advantageous to those who are new to the EA domain, by providing a starting place to learn about the meaning of EA.

6.4.1.3 The Enterprise Architectonic (EAt)

Architectonics, as a theory or science of architecture, enjoys a limited role in IS and related research (section 5.3.1). The work of Richmond (2007) on the Trikonic Inter-Enterprise Architectonic (I-EA) was the only published research that could be found that addresses EA specifically. The I-EA aims to produce an architectural development paradigm to aid in the development of architectures suitable for a diverse computing environment populated by diverse distribute users and interconnected services. Galal-Edeen (2002) proposed a software architectonic to address the impact of changes on a software system. The software architectonic categorises the software system in layers designed to deal with the level of change the system experiences during its evolution. In contrast, the EAt aims to make foundational knowledge explicit (section 1.4), and serves the purpose of explaining a concept, rather than developing a system.

The EAt is composed of the architectonic elements list (Table 5.7), and therefore shares its advantages. The aspect that makes the EAt unique is the arrangement of the architectonic elements in terms of relationships. The feature of relating two or more architectonic elements adds to the meaning of EA by not only giving meaning to the EA concept, but also stating how the EA concepts relate. The contribution of the EAt to EA research is to provide the means to explain the fundamental meaning of EA. The advantage of the EAt's ability to explain EA's fundamental concepts allows for the creation of a tool that focuses specifically on explaining the meaning of EA. The tool can take a number of forms:

- A presentation in the form of a slide show: The EAt is already in presentation form as part of the evaluation instrument (section 5.5.1) created for the purpose of demonstrating the EAt to an audience of EA experts. The advantage to a presentation tool is that the presentation could be automated and distributed to various locations where there is a need to understand EA fundamentals.
- An interactive program: The EAt could be converted into a program that will allow the user to interact with the EAt by enabling the selection of concepts (or relationships) in order to learn more about each concept. The program could be made to execute on various platforms such as, for example –
    - The Internet as a website.
    - A mobile platform such as IOS or Android.
    - Desktop systems such as Microsoft Windows.
- A training course: Creating a set of training materials, including a student workbook, trainers' guide and teaching materials, will allow the EAt to be taught in a classroom situation.
- Posters and pamphlets: The EAt's graphic (Figure 5.11) can be read in the same way as a conceptual map that indicates what the concepts are and how they relate, enabling the creation

of a poster. A pamphlet or booklet can be designed to accompany such a poster, to provide further explanations on the meaning of concepts and their relationships.

6.4.1.4 Summary and Discussion

The contribution of the research reported in this thesis, with regard to the EA discipline, is manifold, and is summarised as follows:

- The EA understanding (Table 4.11), in terms of the EA claim and supportive propositions, contributes and promotes debate on the fundamental meaning of EA. The EA understanding is based on an interpretation of EAFs, but is not in itself a kind of EAF.
- The use of a structured interpretation method (SIM) results in clear results, and can also be repeatedly executed on various problems that call for interpretation.
- The list of architectonic elements (Table 5.7) leads to a set of unique EA fundamental concepts.
- The application of architectonics to the structuring of the architectonic elements, results in making the fundamental knowledge of EA explicit.
- The enterprise architectonic (EAt) can be converted into a tool that can be used to explain the fundamental understanding of EA, in terms of concepts and their relations

6.4.2 Contribution to IS Qualitative Research Methods

Interpretive research, and its relation to qualitative research methods, is a growing concern for information systems researchers (Mingers, 2001). Methods based on hermeneutic theory are regarded as relatively new to information systems research (Webb & Pollard, 2006; Cole & Avison, 2007). Butler (1998) and Lukaitis and Cybulski (2005) pioneered hermeneutic methods, and Klein and Myers (1999) proposed principles for the use of hermeneutic methods and theory in fieldwork. More recently, hermeneutic theory has been proposed as a method to conduct literature reviews (Boell & Cecez-Kecmanovic, 2014). Hermeneutics is listed as a theory that can be used in IS research (Larsen et al., 2014), and is described as both a philosophical basis for interpretive research and a research method by Meyers (2014).

6.4.2.1 The Structured Interpretation Method (SIM)

Although hermeneutics has been widely applied in information systems research by numerous researchers (see list of papers in Larsen et al. (2014), its application has been in the form of a process (Boland, 1991), an interpretation framework (Davis et al., 1992) and as a means to interpret qualitative data, guided by guidelines and principles. The SIM (section 4.4.7) is a structured approach to show how to apply hermeneutic theory in the task of interpretation. The contribution of the SIM to IS qualitative research methods is that of a structured set of steps, arranged in a process (section 4.4.7), that facilitate an ordered execution of the interpretation process. The SIM also makes the role of the interpreter in the act of interpretation, explicit (section 4.4.3).

6.4.2.2 Summary and Discussion

The contribution of the SIM is thus an expansion of existing efforts to make use of hermeneutics as a research method in the constellation of research methods available to interpretive researchers.

6.5 CONCLUSION

The application of an adaptation of Laudan's Reticulated Model of Scientific Rationality to evaluate the scientific merit of this research, resulted in an analysis of the scientific value of the research. This laid the foundation for an evaluation of the research results, relative to the field of EA research and qualitative inquiry. The contribution of the EAt is towards understanding EA fundamentals in terms of concepts and relationships. The SIM, in turn, contributes a means to apply hermeneutic theory in a structured manner, in qualitative research.

Research, quite part from its purpose to create new knowledge, is also a journey, and interpretive research allows for the researcher to be visible in the research process. There remains, in the task set out in the thesis, a critical reflection on lessons learned during the research journey. That is the task of the next and final chapter. What also needs to be done is to conclude the process by clearly showing how this research and its contributions answered the main research question, and, in so doing, solved the main research problem.

CHAPTER 7: CONCLUSION AND FURTHER WORK

Chapter Map

CHAPTER 7: CONCLUSION AND FURTHER WORK

- **7.1 INTRODUCTION**
- **7.2 RESEARCH SUMMARY**
  - 7.2.1 The Research Problem and Purpose
  - 7.2.2 The Research Question
  - 7.2.3 The Research Goals and Objectives
- **7.3 THE RESEARCH RESULTS**
  - 7.3.1 Research Objective 1 Results
  - 7.3.2 Research Objective 2 Results
  - 7.3.3 Research Objective 3 Results
  - 7.3.4 The Answer to the Research Question
  - 7.3.5 The Solution to the Research Problem
- **7.4 FURTHER WORK**
  - 7.4.1 Further Research on the SIM
  - 7.4.2 Further Research on the EAt
- **7.5 PERSONAL REFLECTIONS**
- **7.6 CONCLUSION**

7.1 INTRODUCTION

This thesis reported on the creation of an artefact, called an EAt, to make the implicit foundations of EA explicit. The EAt was designed by making use of architectonic theory (section 5.3.1) and Heidegger (2000) equipment analysis, to explain the concept of EA in terms of concepts and their relationships. This chapter concludes the research process by summarising the research problem, question, objectives and results.

The structure follows accordingly, by giving an overview of the research problem and question in section 7.2, followed by a summary of the answers to the research question in section 7.3. Further work that follows from the contributions of this research is discussed in section 7.4. The chapter concludes with personal reflections on the research journey, in section 7.5.

7.2 RESEARCH SUMMARY

The context of the research problem (section 1.3 and section 2.5.1) is the multitude of EAFs in existence, that serve to realize an EA. EA researchers and practitioners have made many attempts (section 2.3) to clarify the meaning of EA. Their attempts have not produced a universally accepted EA meaning, and the temptation to judge EA adherents for not understanding EA, is acutely felt. The analysis of the problem of understanding EA, in Chapter 2 (section 2.3), revealed a different reality.

7.2.1 The Research Problem and Purpose

The research problem identified in section 1.3, and elaborated on in section 2.5.1 was that the conceptual foundation of EA is implicit, as opposed to explicit. The problem was graphically represented in Figure 1.1 and illustrated the unclear conceptual foundations of EA. The research problem was, accordingly, stated as –

> *The implicit conceptual foundation of enterprise architecture thinking and practice leads to a lack of universal agreement on EA terms and definitions.*

The research purpose anticipated the solution to the research problem, by stating the following:

> *The purpose of this research is to explore the meaning of enterprise architecture by using the results of a structured interpretation method (SIM) to construct an enterprise architectonic (EAt) to organise the foundational understanding of enterprise architecture in terms of concepts and relationships.*

7.2.2 The Research Question

The identification of the research problem and purpose paved the way for the statement of the main research question:

> *In what way can architectonics contribute to a foundational understanding of enterprise architecture?*

7.2.3 The Research Goals and Objectives

The research goals (section 1.4.1) were stated as research objectives, to enable a research strategy to be formulated, as follows:

- Research Objective 1: Describe the theoretical background of EA research, in terms of EA definition efforts, as well as issues in EAF selection.
- Research Objective 2: Determine the meaning of EA by interpreting the key works of three prominent EAFs.
- Research Objective 3: Organise the concepts derived from the interpreted meaning of EA, in an EAt.

Each research objective was clarified with an associated purpose, as well as specific sub-objectives that, once achieved, showed that the objective was reached and, ultimately, to what degree the main research question was answered. The sub-objectives are summarised as follows:

- Research Objective 1:
    - Describe the historical development of EA.
    - Discuss the attempts that have been made to clarify the EA concept.
    - Identify the three prominent EAFs cited in the academic literature.
- Research Objective 2:
    - Design and implement an interpretation method to establish an understanding of EA.
    - Record the results of applying an interpretation method to three prominent EAFs.
- Research Objective 3:
    - Describe the meaning of architectonics, and discuss its role in the structuring of the conceptual understanding of EA.
    - Derive the core concepts of EA in such a way that the concepts can be arranged in an architectonic.
    - Describe the context of the modern enterprise and its relationship to IT/IS and complexity.

7.3 THE RESEARCH RESULTS

The research was designed in such a way that a chapter was dedicated to the achievement of each of the research objectives. The chapters associated with each objective are listed in Table 7.1:

Table 7.1: Research Objectives and Chapters

Objective	Chapter
Research Objective 1: Describe the theoretical background of EA research, in terms of EA definition efforts as well as issues in EAF selection.	Chapter 2: The Problem With Understanding Enterprise Architecture.
Research Objective 2: Determine the meaning of EA by interpreting the key works of three prominent EAFs.	Chapter 4: A Structured Interpretation Method (SIM).
Research Objective 3: Organise the concepts derived from the interpreted meaning of EA, in an EAt.	Chapter 5: An Enterprise Architectonic (EAt).

7.3.1 Research Objective 1 Results

The research design made use of a DSR model described by Vashnaivi and Kuechler (2013). This approach created the need for the theoretical framework of the research to emphasise the problem in need of a solution, by artefact creation (Figure 3.6). In DSR terms this is called *creating an awareness* of the problem, and was the main goal of Chapter 2. Creating awareness of a design problem needs background, and this need for context led to the second goal of Chapter 2 – namely to provide a historical overview of EA. The sub-objectives associated with the first objective were therefore answered in the following way:

- Describe the historical development of EA.

  Chapter 2 provided an overview of the history of EA in section 2.2. The historical review was based on analysis of the EA concept as reported in EAF comparison literature (section 2.2.2.1), as well as EA literature reviews (section 2.2.2.2). The Zachman Framework is generally regarded as the start of the EA discipline. The first paper discussing the Zachman Framework was published by Zachman in 1987 (Zachman, 1987) and was later elaborated by Sowa and Zachman (1992). The historical development of EA is tracked from 1987 to the present (2014), in terms of published literature reviews and EAF comparisons.

  The early years (1987-2004) of published EA research was relatively quiet, when compared to the period 2004 -2009 and beyond. The initial discussions on the EA concept focused on the relationship between EA and IT/IS. The value of EA was explored in enterprise architecture management research as early as 2006. A specific aspect of EA's value is its promise to align the business with IT. The trend, according to Simon et al. (2013b), is that the number of academic publications is increasing. The number of EAFs also increased over the historical development of EA (Figure 2.1).

  Finally, the consensus in the published EA literature is that there is still a lack of general agreement on terms and definitions (section 2.2.3).

- Discuss the attempts that have been made to clarify the EA concept.

  Attempts to define and clarify the EA concept were attempted from the academic sphere, as well as by EA practitioners. The academic efforts resulted in various solutions such as the following:

  - A categorisation scheme for EA definitions ((Dankova, 2009), section 2.3.1 and Table 2.1).
  - A selection of key terms based on a linguistic approach ((Buckl et al., 2010), section 2.3.1 and Table 2.2).
  - EA schools of thought ((Lapalme, 2012), section 2.3.1 and Table 2.3).
  - An application of 'pattern thinking' ((Kotzé et al., 2012), section 2.3.1, Table 2.4 and Table 2.5).

  The attempts to define EA by EA practitioners are mainly as follows:

  - Gartner Research: Gartner's enterprise definition and clarification efforts is the result of the importance of EA to their clients. The importance of EA is consistently described in the Gartner Hype Cycle reports (Burton & Allega, 2010; 2011; 2012; 2013) were the renewed business interest in EA is described as a move away from IT and closer to business. The attempt to establish an EA definition was explicated in three key papers, namely-
    - Gartner Defines the Term 'Enterprise Architecture' (Lapkin, 2006).
    - Gartner Clarifies the Definition of the Term 'Enterprise Architecture' (Lapkin et al., 2008).
    - Myth Busting: What Enterprise Architecture Is Not (Lapkin & Burton, 2008).

    What was significant from Gartner's publications was that the initial EA definition had to be clarified in two subsequent publications.
  - TOGAF: The TOGAF intuitive to define EA, with the view to incorporating the definition in the TOGAF Version 9 release, took three years (2008 – 2010) to run its course. The process resulted in a shortlist of five EA definitions (Table 2.7) that was said to be synthesised into a final definition, but unfortunately this final synthesised definition could not be found in the research literature and TOGAF Version 9 was launched with tis original EA definition intact.
  - LinkedIn and by researchers. The challenge to attempt the definition of EA in 160 characters was met with great enthusiasm on the LinkedIn social media site (Smith, 2010b). During the duration of the challenge 308 participants made proposals that was eventually synthesised into a final EA definition (section 2.3.2.3.)

  In conclusion, the review of the literature (section 2.3) produced evidence of a number of significant activities to address the definition of EA.

- Identify the three prominent EAFs cited in the academic literature.

  Section 2.4.1 discussed the process that led to the identification of three prominent EAFs, these are as follows:

  - The Zachman Framework (Zachman, 2002).
  - TOGAF Version 9.1 (The Open Group, 2011c).
  - DoDAF Version 2.02 (DoD Chief Information Officer, 2009).

In conclusion, Research Objective 1 was achieved by providing a historical overview of EA (section 2.2), reporting on the attempts to define EA (section 2.3) and by selecting three prominent EAFs (section 2.4). Chapter 2 concluded with an awareness of the problem (section 2.5.1) in understanding EA and therefore successfully achieved the first research objective.

7.3.2 Research Objective 2 Results

The DSR model states that a solution should be proposed, once an awareness of a problem has been created (Vaishnavi & Kuechler, 2013), Research Objective 2 was stated in response to the problem that the EA understanding is unclear (section 2.5.3). The solution proposed to address the lack of clarity, was the development of a method to interpret the prominent EAFs. The sub-objectives related to Research Objective 2 was achieved as follows:

- Design and implement an interpretation method to establish an understanding of EA.

  The structured interpretation method (SIM) was proposed (section 4.2) as a solution to the lack of clarity in the understanding of EA. The SIM was developed (section 4.4) by making use of the theory of hermeneutics (section 4.3) to interpret the key texts of the prominent EAFs. The SIM was represented in graphical format (Figure 4.17) and converted to be executed as a process (Figure 4.18).

- Record the results of applying an interpretation method to three prominent EAFs.

  The demonstration of the SIM resulted in an EA understanding (Table 4.11) that consist of an EA claim and six supportive EA propositions. These are as follows:

  - EA claim: Enterprise architecture is similar in intent to the enterprise as a worldview is to the world
  - EA propositions:
    - Proposition 1: EA’s underlying theoretical knowledge is in a pre-suppositional state.
    - Proposition 2: EA is a description of the structure of the systems of an enterprise.
    - Proposition 3: EA represents the enterprise in time-oriented architectures such as an as-is, to-be and has-been architecture.

- Proposition 4: EA translates the values/strategy of the enterprise into operational systems appropriate to the information society.
- Proposition 5: EA provides a means to manage decisions about the IT/IS management and implementation in the enterprise.
- Proposition 6: EA captures a representation of the enterprise in the form of a model or set of models.

In conclusion, Research Objective 2 was met by the creation of the SIM. The theoretical basis of the SIM addressed the theory of interpretation directly. The EA understanding that resulted from the execution of the SIM produced an understanding of EA.

7.3.3 Research Objective 3 Results

The Achievement of Research Objective 2 enabled the achievement of Research Objective 3. Research Objective 3 represented the final cycle in the DSR model. The SIM produced a clear understanding of EA that was used as a basis to make the implicit EA conceptual foundations (Figure 1.1) explicit. The objective was reached by achieving the following sub-objectives:

- Describe the context of the modern enterprise and its relationship to IT/IS and complexity.

  The use of IT/IS as essential tools to enable the work of the enterprise, was discussed in section 5.3.3. One of the key issues that led to the development of EA was the inherent complexity of IT/IS in terms of its design, development and implementation. In addition to this inherent complexity, the rate of change in IT/IS leads to problems with legacy systems and the challenges faced when new systems replace older systems. EA was intended to act as a mechanism to coherently manage the complexities that resulted from a dependence on IT/IS in the operations of the information age organisation.

- Derive the core concepts of EA in such a way that the concepts can be arranged in an architectonic.

  The set of core concepts (Table 5.7) that represented the conceptual aspect of the EA understanding (Table 4.11) was determined by analysing the six propositions through the philosophical lens of Heidegger's equipment analysis (section 5.4.3). The set of core concepts served as the set of architectonic elements used to create the explicit conceptual foundation for EA.

- Describe the meaning of architectonics, and discuss its role in the structuring of the conceptual understanding of EA.

  Architectonics is a theory of architecture and is used to structure conceptual knowledge. In this research it was used to organise the fundamental meaning of EA in terms of concepts and relationships. An enterprise architectonic (EAt) was developed (section 5.4) based on the theory of architectonics to represent (Figure 5.11) the foundational concepts EA in terms of architectonic elements and their relationships.

In conclusion, Research Objective 3 was met by the creation of the EAt. The EAt was evaluated by demonstrating it to EA experts. The achievement of Research Objective 3 brought the research process to a conclusion, by providing an artefact that serves as an explicit EA conceptual foundation.

7.3.4 The Answer to the Research Question

The answer to the research question is the EAt. Based on the definition of a conceptual artefact (Bereiter, 2002) and the DSR model (Vaishnavi & Kuechler, 2013), Heidegger's equipment analysis was applied to the EA understanding (Table 4.11) to derive a set of fundamental concepts that describe the meaning of EA. Architectonics was then used to construct the EAt to show the arrangement of the set of fundamental concepts as well as their relationships (section 5.4). The EAt is designed as a graphical representation and shown below (Figure 7.1).

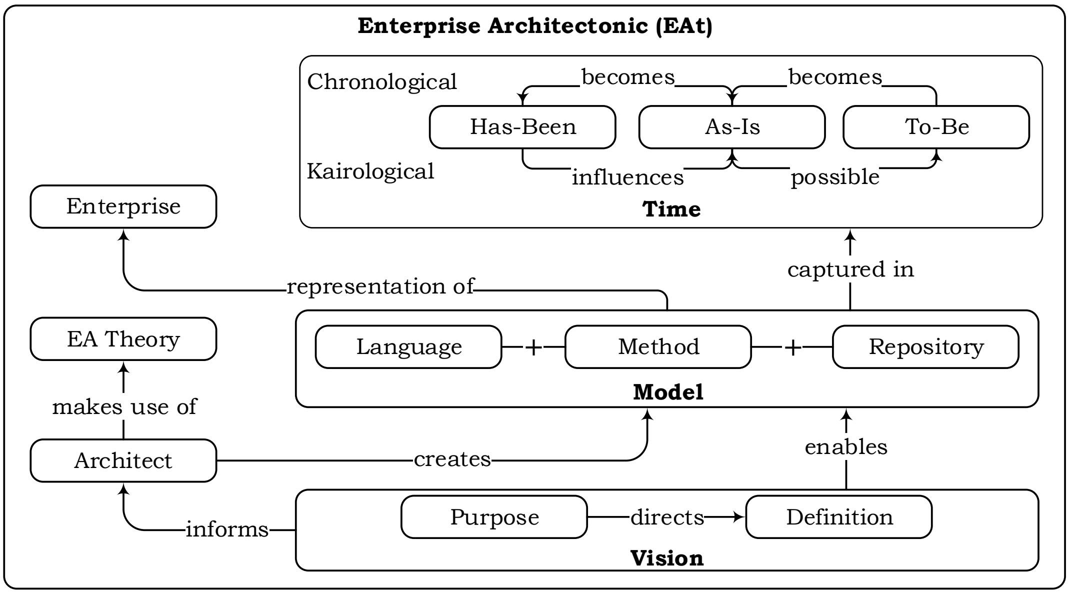


Figure 7.1: The Solution to the Research Problem

In conclusion, the answer to the main research question is that architectonics can be used to create an enterprise architectonic (EAt) conceptual artefact that captures the fundamental meaning of EA.

7.3.5 The Solution to the Research Problem

The solution to the research problem is twofold: firstly, the lack of clarity in the foundational knowledge of EA is addressed by the EA claim that EA is similar in intent to the enterprise as a worldview is to the world. This claim is supported and elaborated by the EA understanding (Table 7.2):

Table 7.2: The Research Solution - An EA Understanding

The EA claim	EA Propositions	
Enterprise architecture is as similar in intent to the enterprise, as a worldview is to the world.	1	EA underlying theoretical knowledge is in a pre-suppositional state.
	2	EA is a description of the structure of the systems of an enterprise.
	3	EA represents the enterprise in time-oriented architectures, such as an as-is, to-be and has-been architecture.
	4	EA translates the values/strategy of the enterprise into operational systems appropriate to the information society.
	5	EA provides a means to manage decisions about the IT/IS management and implementation in the enterprise.
	6	EA captures a representation of the enterprise, in the form of a model or set of models.

Secondly, the creation of the EAt identifies the set of fundamental EA concepts, and arranges them in such a way as to make explicit the underlying conceptual foundation of EA. This solution was illustrated in Figure 7.2.

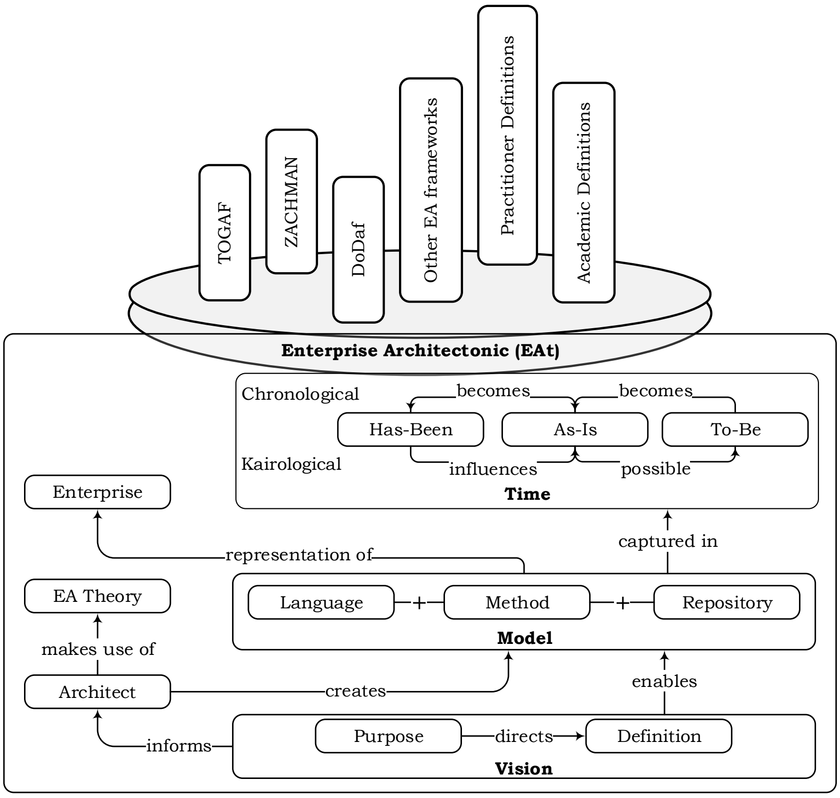


Figure 7.2: Explicit EA Conceptual Foundations

In conclusion, the problem of lack of clarity in the foundational understanding of EA is solved by a clear and succinct conceptual description of EA's foundations.

7.4 FURTHER WORK

The EAt could not have been created without the creation of the SIM, because a structured interpretation was necessary to provide the material for conceptual analysis. The contribution of this research is therefore rooted in EA research, as well as in qualitative research methods (section 6.4). Although the research problem was stated in the domain of EA research, further work is needed on both the EAt as well as the SIM.

7.4.1 Further Research on the SIM

The SIM is a unique mechanism that brings the potential of an ordered and structured approach to interpretive research. That does not mean that the SIM is complete. More work is needed to do the following:

- Clarify the role of the interpreter in the interpretation process. As it stands, the SIM recognises, from the philosophical hermeneutic standpoint, that the interpreter is part of the interpretation process. What is unclear, however, is how to ensure that the interpretation resulting from the execution of the SIM, makes the interpreter's prejudice clear, as it impacts the examining position. A critical theory approach can be used to refine this aspect of the SIM.
- Clarify and develop the reflection steps in the SIM. The role of reflection in qualitative research is important, because it allows for a means to show, and records the thinking involved in, an interpretation. More work is needed to further develop this aspect of the SIM into recognisable steps.

7.4.2 Further Research on the EAt

The EAt is the first of its kind, in that it bases an understanding of EA on an interpretive approach. The purpose, of making implicit meaning explicit, was achieved, but, in the larger scheme of EA research, is only scratching the proverbial surface. More work is needed to build on this explicit understanding of EA:

- The current EAt is built upon an interpretation of EAFs as they realise the EA. What is needed is a similar approach to explore the underlying meaning of an EAF, in the role of realising the EA. Perhaps the foundations made explicit by the EAt can serve as the first layer to a more detailed understanding of EA.
- With the underlying meaning of EA made explicit, and the questions as to what EA is, answered, to a degree, the next step is to explore how to do EA from the perspective of the EAt.
- The specific, well-known EA term did not appear in the EAt – such as, for example, *stakeholder*, view, viewpoint and governance. Further research is needed to understand on what layer of understanding these concepts belong.

- The impact of the architectonic elements of time, and especially the “has-been” concept, is new to EA thinking, more research is needed specifically to understand it value in EA work but more generally more research is needed to understand the role of the 'time' concept in EA work.
- The EAt can potentially be used as a tool to explain the EA conceptual foundations (section 6.4.1.3). Work needs to be done, in the development of such a tool, and tested for its efficacy in explaining what EA is.

7.5 PERSONAL REFLECTIONS

Attempting a purely conceptual research study is difficult for the beginner researcher. The success of such an attempt inevitably makes the researcher philosophical in the approach to research problem statements and especially research design. Issues of research paradigms should be very well understood before a sense of personal achievement and mastery of the subject is experienced. The lack of dedicated philosophy of science courses in IS education, makes the task of conceptual PhD research even more difficult. That said, the researcher's journey was productive in many respects what follows is an overview of lessons learned in the journey:

- Interpretive research is never complete, and the answers it produces is only an understanding that might (or will) change over time. This change in understanding even occurs during the research journey, resulting in changes of direction and research focus.
- The importance of literature reviews to any research endeavour is well known. The main problem of an appropriate literature review is how to select the material in such a way as to be representative of the study at hand. The lesson learned by the researcher is that even for a relatively young discipline such as EA, the number of publications was simply too much to process and include in the review. The impact of the suspected outcome, and especially the research design approach, already had an impact in the literature review phase.
- The appropriateness of the research strategy to the research problem is a lesson learned during the process of research, and not at the start of the research journey. Research paradigms include many philosophical aspects that makes the understanding of what is appropriate at times completely incomprehensible. The application of a DSR methodology to a conceptual research problem was harder to achieve than initially thought. In retrospect, a grounded theory or action research approach might have achieved faster results.

7.6 CONCLUSION

The research problem has been addressed, with a solution that has merit only in as far as the issue of making implicit understanding explicit. The EA claim, and six EA propositions, as the result of an interpretation method, are not meant as either a final or an absolute answer to the questions of what EA is. Rather, they stand to be engaged with, debated on, or even changed completely. The EAt serves as an explanation of an understanding of the foundations of EA. As an artefact, the researcher regards the EAt as containing the least set of concepts, such that taking away any of the concepts or relationships will impact negatively on the foundational understanding of EA. The EAt is, as well, not regarded as an absolute or final answer; it too is open to be engaged with.

The research question may be answered, and the problem partially solved but, more needs to be done. This thesis and its results are a part of this continual process of trying to understand EA for what it is, based on the intentions of its existence. Let the inquiry continue.

BIBLIOGRAPHY

ABDALLAH, S. & GALAL-EDEEN, G. H. 2006. Towards a framework for enterprise architecture frameworks comparison and selection. *The Fourth International Conference on Informatics and Systems (INFOS2006).*

ADENUGA, O. A. & KEKWALETSWE, R. M. 2013. Towards a Framework for a Unified Enterprise Architecture.

AERTS, D., APOSTEL, L., MOOR, B. D., HELLEMANS, S., MAEX, E., BELLE, H. V. & VEKEN, J. V. D. 2007. *World Views: From fragmentation to integration*.

ALGHAMDI, A. S. 2010. A Review of Commercial Related Architecture Frameworks and their Feasibility to C4I System. *European Journal of Scientific Research,* 40**,** 43-49.

ALLEGA, P. 2010. *EA Dying? No! Let's Get Ready to Rumble!* [Online]. accessed on: 7 December 2010.

ALTER, S. 2002. The work system method for understanding information systems and information system research. *Communications of the Association for Information Systems,* 9**,** 90-104.

ALTER, S. 2006. *The Work System Method: connecting people, processes, and IT for business results*, Work Systems Press.

ANDERSON, P. 1999. Complexity theory and organization science. *Organization Science,* 10**,** 216-232.

ANNELLS, M. 1996. Hermeneutic phenomenology: philosophical perspectives and current use in nursing research. *Journal of Advanced Nursing,* 23**,** 705-713.

ATKIN, A. 2005. *Charles Sanders Peirce: Architectonic Philosophy* [Online]. IEP. [Accessed 17 April 2014.

AYLESWORTH, G. E. 1991. Dialogue, text, narrative: confronting Gadamer and Ricoeur. *Gadamer and hermeneutics***,** 63-82.

BANERJEE, U. 2010. *Why is Enterprise Architecture Dying?* [Online]. accessed on: 7 December 2010.

BARRETT, F. J., POWLEY, E. H. & PEARCE, B. 2011. Hermeneutic Philosophy and Organizational Theory. *In:* TSOUKAS, H. & CHIA, R. (eds.) *Research in the Sociology of Organizations.* Emerald Group Publishing Limited.

BASKERVILLE, R. L., KAUL, M. & STOREY, V. C. 2011. UNPACKING THE DUALITY OF DESIGN SCIENCE. *Thirty Second International Conference on Information Systems.* Shanghai.

BÉRCI, M. E. & GRIFFITH, B. 2005. What Does it Mean to Question? *Interchange,* 36**,** 405-430.

BEREITER, C. 2002. *Education and Mind in the Knowledge Age*, L. Erlbaum Associates.

BERGER, P. L. & LUCKMANN, T. 1966. *The social construction of reality: a treatise in the sociology of knowledge*, Doubleday.

BERNARD, L. L. 1941. The Definition of Definition. *Social Forces,* 19**,** 500-510.

BERNARD, S. A. 2005. *An introduction to Enterprise Architecture, 2nd edition*, AuthorHouse.

BERNSTEIN, S. 1999. Goethe's architectonic bildung and buildings in classical Weimar. *MLN,* 114**,** 1014-1036.

BERRIOS, G. E. 1989. What is phenomenology? A review. *Journal of the Royal Society of Medicine* 82.

BLACKBURN, S. 2008. *Oxford Dictionary of Philosophy: 2nd edition revised*, Oxford University Press.

BOEDEKER, E. C. 2005. Phenomenology. *In:* DREYFUS, H. L. & WRATHALL, M. A. (eds.) *A Companion to Heidegger.* Blackwell Publishing.

BOELL, S. K. & CECEZ-KECMANOVIC, D. 2014. A Hermeneutic Approach for Conducting Literature Reviews and Literature Searches. *Communications of the Association for Information Systems,* 34**,** 10.

BOLAND, R. J. J. 1991. Information System Use as a Hermeneutic Process. *In:* NISSEN, H.-E., KLEIN, H. K. & HIRSCHHEIM, R. A. (eds.) *Information Systems Research: Contemporary Approaches and Emergent Traditions.* North-Holland, Amsterdam.

BONTEKOE, R. 1996. *Dimensions of the hermeneutic circle*, Humanities Press Intl.

BOUCHARAS, V., STEENBERGEN, M. V., JANSEN, S. & BRINKKEMPER, S. 2010. The Contribution of Enterprise Architecture to the Achievement of Organizational Goals: Establishing the Enterprise Architecture Benefits Framework. Utrecht, The Netherlands: Department of Information and Computing Sciences Utrecht University.

BUCKL, S., MATTHES, F., ROTH, S., SCHULZ, C. & SCHWEDA, C. M. 2010. A conceptual framework for enterprise architecture design. *Trends in Enterprise Architecture Research.* Springer.

BURTON, B. & ALLEGA, P. 2010. Hype Cycle for Enterprise Architecture, 2010. *GARTNER* [Online], G00201646.

BURTON, B. & ALLEGA, P. 2011. Hype Cycle for Enterprise Architecture, 2011. Gartner Inc.

BURTON, B. & ALLEGA, P. 2012. Hype Cycle for Enterprise Architecture, 2012. Gartner, Inc.

BURTON, B. & ALLEGA, P. 2013. Hype Cycle for Enterprise Architecture, 2013. Gartner Inc.

BUTLER, M. J. R., ALLEN, P. & WILKINSON, J. 2010. Complexity and organisations-The case of public sector change. *Annals of the New York Academy of Sciences*.

BUTLER, T. 1998. Towards a hermeneutic method for interpretive research in information systems. *Journal of Information Technology,* 13**,** 285-300.

CAMERON, B. H. & MCMILLAN, E. 2013. Analyzing the Current Trends in Enterprise Architecture Frameworks. *Journal of Enterprise Architecture,* 9**,** 60-71.

CAO, G. 2010. A four-dimensional view of IT business value. *Systems Research and Behavioral Science*.

CARVALHO, J. J. 2006. Overview of the Structure of a Scientific Worldview. *Zygon,* 41**,** 113-124.

CERBONE, D. R. 2008. *Heidegger: a guide for the perplexed,* Continuum INternational Publishing Group.

CHAN, Y. E. & REICH, B. H. 2007. IT alignment: an annotated bibliography. *Journal of Information Technology,* 22**,** 316-396.

CHORAFAS, D. N. 2001. *Enterprise architecture and new generation information systems*, CRC Press.

CLARK, T. 2002. *Martin Heidegger*, Routledge.

COBERN, W. W. 1988. "World View" Theory and Misconception Research. *Annual Meeting of the National Association for Research in Science Teaching.*

COLE, M. & AVISON, D. 2007. The potential of hermeneutics in information systems research. *European Journal of Information Systems,* 16**,** 820.

COOPER, D. E. 1996. *Heidegger,* The Claridge Press.

CORMACK, D. F. S. & BENTON, D. C. 2000. Asking the research question. *In:* CORMACK, D. F. S. (ed.) *The Research Process in Nursing, 4th edition.* Blackwell Science, Oxford.

CRESWELL, J. W. 2003. *Research design: qualitative, quantitative, and mixed method approaches*, SAGE.

CROTTY, M. 1998. *The foundations of social research: meaning and perspective in the research process*, SAGE.

CROWELL, S. 2006. Husserlian Phenomenology. *In:* HUBERT L. DREYFUS, M. A. W. (ed.) *A Companion to Phenomenology and Existentialism.* Blackwell Publishing Ltd.

CROWTHER, J. 1989. Oxford Advanced Learner's Dictionary of current english. 4 ed.: Oxford University Press.

DAFT, R. L. 2001. *Organization theory and design*, Thompson Learning.

DANKOVA, C. 2009. Main Aspects of Enterprise Architecture Concept. *Economic Alternatives***,** 102-114.

DAVENPORT, T. H. 2008. Improving knowledge worker performance. *In:* PANTALEO, D. & PAL, N. (eds.) *From strategy to execution: turning accelerated global change into opportunity.* Springer Berlin Heidelberg.

DAVEY, N. 2006. *Unquiet understanding: Gadamer's philosophical hermeneutics*, State University of New York Press.

DAVIS, G. B., LEE, A. S., NICKLES, K. R., CHATTERJEE, S., HARTUNG, R. & WU, Y. 1992. Diagnosis of an Information System Failure: A Framework and Interpretive Process. *Information & Management,* 23**,** 293.

DEL RÍO-CIDONCHA, M. G., IGLESIAS, J. E. & MARTÍNEZ-PALACIOS, J. 2007. A comparison of floorplan design strategies in architecture and engineering. *Automation in Construction,* 16**,** 559-568.

DEL ROSSO, C. & MACCARI, A. 2007. Assessing the architectonics of large, software-intensive systems using a knowledge-based approach. *The Working IEEE/IFIP Conference on SOftware Architecture (WICSA'07).* IEEE.

DEMETERIO, F. P. A. 2001. Introduction to hermeneutics. *Diwatao,* 1**,** 1-9.

DENT, E. B. 1999. Complexity science: a worldview shift. *Emergence,* 4**,** 5-19.

DENZIN, N. K. & LINCOLN, Y. S. (eds.) 2005. *The SAGE handbook of qualitative research*: SAGE.

DEPARTMENT OF DEFENSE 2010. Version Description Document for The DoD Architecture Framework (DoDAF) and DoDAF Meta Model (DM2) Version 2.02. Office of the Assistant Secretary of Defense (OASD) for Network Infrastructure and Integration (NII): United States of America Department of Defense.

DEWITT, R. 2004. *Worldviews: An Introduction to the History and Philosophy of Science*, Blackwell Publishers.

DILLON, J. T. 1984. The Classification of Research Questions. *Review of Educational Research,* 54**,** 327-361.

DOD CHIEF INFORMATION OFFICER. 2009. *Volume 1: Introduction, Overview, and Concepts Manager's Guide* [Online]. http://dodcio.defense.gov/dodaf20.aspx. Available: http://cio-nii.defense.gov/sites/dodaf20/index.html [Accessed 8 March 2010 2010].

DONNELLY, J. F. 1999. Schooling Heidegger: on being in teaching. *Teaching and Teacher Education,* 15**,** 933 - 949.

DOSTAL, R. J. (ed.) 2002. *The Cambridge companion to Gadamer*: Cambridge University Press.

DOTLICH, D. L., CAIRO, P. C. & RHINESMITH, S. H. 2009. *Leading in Times of Crisis: Navigating Through Complexity, Diversity and Uncertainty to Save Your Business*, John Wiley and Sons.

DREYFUS, H. L. 1991. *Being-in-the-world: a commentary on Heidegger's Being and time, division I*, MIT Press.

DRUCKER, P. F. 1992. The new society of organizations. *Harvard Business Review***,** 95-104.

DRUCKER, P. F. 1994. The theory of the business. *Harvard Business Review***,** 95-104.

DUFOUR, Y. & LAMOTHE, L. 2009. Revisiting a classic case study: Anita Roddick and the Body Shop International. *Journal of Strategy and Management,* 2**,** 97-109.

EIRAS, J. C. & SCOTT, T. 2010. *The Practical CIO: A Common Sense Guide for Successful IT Leadership*, John Wiley and Sons.

EISENBERG, M. B. 2008. Information Literacy: Essential Skills for the Information Age. *Journal of Library & Information Technology,* 28**,** 39-47.

ERNST, A. M. & MATTHES, F. 2009. A Pattern-based Approach to Enterprise Architecture Management. *4th Meeting of the Working Group Enterprise Architecture Management (AkEAM).* Munchen.

FAHMY, A. E. 2004. PRECEDENTS ARE" OBJECTIVE CONTENTS OF THOUGHT. *1st Conference on Sustainable and Urban Development (ArchCairo 2004).* Cairo.

FEHSKENS, L. 2008. Enterprise Architecture Definition Status Update.

FEHSKENS, L. 2009. A Definition of Enterprise Architecture: Status and Next Steps. *The Open Group Hong Kong 2009.* Hong Kong: The Open Group.

FERRATER MORA, J. 1955. Pierce's conception of architectonic and related views. *Philosophy and Phenomenological Research,* 15**,** 351-359.

FRANKE, U., HÖÖK, D., KÖNIG, J., LAGERSTRÖM, R., NÄRMAN, P., ULLBERG, J., GUSTAFSSON, P. & EKSTEDT, M. 2009. EAF2-A Framework for Categorizing Enterprise Architecture Frameworks. *10th ACIS International Conference on Software Engineering, Artificial Intelligences, Networking and Parallel/Distributed Computing.* IEEE.

GADAMER, H.-G. 1983. *Reason in the Age of Science* MIT Press.

GADAMER, H.-G. 2004. *Truth and Method*, Continuum.

GALAL-EDEEN, G. H. 2002. Reverse architecting: seeking the architectonic. *Reverse Engineering, 2002. Proceedings. Ninth Working Conference on.* IEEE.

GARRETT, J. E. 1978. Hans-Georg Gadamer on "fusion of horizons". *Man and World,* 11**,** 392-400.

GARTNER. 2011. *About Gartner* [Online]. [Accessed 16 June 2014 2014].

GARTNER INC. 2012. *Gartner Research* [Online]. http://www.gartner.com/technology/research.jsp. [Accessed 2 February 2012 2012].

GELVEN, M. 1989. *A commentary on Heidegger's Being and Time: revised edition*, Harper & Row.

GOETHALS, F. 2005. An overview of enterprise architecture framework deliverables. *Working Paper Series.* Leuven, Belgium: Catholic University of Leuven (KUL).

GOIKOETXEA, A. 2007. *Enterprise architecture and digital administration: planning, design and assesment,* Worl Scientific Publishing.

GOLAFSHANI, N. 2003. Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report,* 8**,** 597-607.

GOULD, B. 1999. Five organization types. *The Antidote,* 4**,** 21-25.

GREEFHORST, D., KONING, H. & VLIET, H. V. 2006. The many faces of architectural descriptions. *Information Systems Frontiers,* 8**,** 103-113.

GRONDIN, J. 2002. Gadamer's Basic Understanding of Understanding. *In:* DOSTAL, R. J. (ed.) *The Cambridge Companion to Gadamer.* Cambridge University Press.

GUBA, E. 1990. The alternative paradigm dialog. *In:* GUBA, E. (ed.) *The paradigm dialog.* SAGE.

HAGAN, P. J. 2004. Guide to the (Evolving) Enterprise Architecture Body of Knowledge. *EABOK.* McLean, Virginia: MITRE corporation.

HAMMERSLEY, M. 2003. Phenomenology. *Encyclopedia of Social Science Research Methods. 2003.* . SAGE Publications

HARMAN, G. 2007. *Heidegger explained: from phenomenon to thing*, Carus Publishing Company.

HAUGEN, L. K. 2006. The Case for Complexity: A Look at the Relationship between Individual and Structure from the Inside Out. *Human Resource Development International,* 9**,** 49-67.

HAYES, B. 2008. Cloud computing. *Communications of the ACM,* 51**,** 9-11.

HEIDEGGER, M. 1968. *What is called thinking?*, Harper & Row publishers.

HEIDEGGER, M. 1992. *History of the concept of time: prolegomena*.

HEIDEGGER, M. 2000. *Being and time*, Blackwell Pub.

HEIDEGGER, M. & STAMBAUGH, J. 1996. *Being and Time*, State University of New York Press.

HEKMAN, S. 1983. From epistemology to ontology: Gadamer's hermeneutics and Wittgensteinian social science. *Human Studies,* 6**,** 205-224.

HERDEN, S. & ZENNER, U. 2011. Klassifikation von Enterprise-Architecture-Frameworks: Eine Literaturanalyse. Institut für technische und betriebliche Informationssysteme: Fakultät für Informatik, Otto-von-Guericke-Universität Magdeburg.

HEVNER, A. & CHATTERJEE, S. 2010. *Design Science Research in Information Systems: Theory and Practice*, Springer.

HEVNER, A., MARCH, S. T. & PAK, J. 2004. Design Science in Information Systems Research. *MIS quarterly,* 28**,** 75-105.

HEYLIGHEN, F. 2000. *What is a world view?* [Online]. Brussels: Principia Cybernetica. Available: http://cleamc11.vub.ac.be/REFERPCP.html. 2009].

HOLMES, A. F. 1983. *Contours of a world view*, Eerdmans

HOOGERVORST, J. A. 2009. *Enterprise governance and enterprise engineering*, Springer.

IEEE 2011. ISO/IEC/IEEE 42010:2011, Systems and software engineering — Architecture description. http://www.iso-architecture.org/ieee-1471/index.html.

IFIP-IFAC TASK FORCE 1999. GERAM: Generalised Enterprise Reference Architecture and Methodology.

IIVARI, J. 2007. A Paradigmatic Analysis of Information Systems as a Design Science. *Scandinavian Journal of Information Systems*, 19**,** 39-64.

INWOOD, M. 1997. *Heidegger: a very short introduction*, Oxford University Press.

INWOOD, M. 1999. *A Heidegger Dictionary*, Blackwell Publishers.

ISO/IEC/IEEE 42010 USERS GROUP. 2013. *Survey of Architecture Frameworks* [Online]. http://www.iso-architecture.org/ieee-1471/afs/frameworks-table.html. [Accessed 27 June 2013].

JAMES, G. A., HANDLER, R. A., LAPKIN, A. & GALL, N. 2005. Gartner Enterprise Architecture Framework: Evolution 2005. Gartner Inc.

JASPER, D. 2004. *A short introduction to hermeneutics*, Westminster John Knox Press.

JEANROND, W. G. 1994. *Theological Hermeneutics: Development and Significance*, SCM.

JOHNSON, P., EKSTEDT, M., SILVA, E. & PLAZAOLA, L. 2004. Using enterprise architecture for cio decision-making: On the importance of theory. *Proceedings of the Second Annual Conference on Systems Engineering Research.*

JOHNSON, P. A. 2000. *On Gadamer*, Wadsworth/Thomson Learning.

JOSEY, A. 2009. TOGAF™ : A Comprehensive Overview. *IntegratedEA 09.*

KANG, D., LEE, J., CHOI, S. & KIM, K. 2009. An ontology-based Enterprise Architecture. *Expert Systems With Applications*.

KANT, I., GUYER, P. & WOOD, A. W. 1998. *Critique of pure reason*, Cambridge University Press.

KAPPELMAN, L. A., MCGINNIS, T., PETTITE, A. & SIDOROVA, A. 2008. Enterprise Architecture: Charting the Territory for Academic Research. *AMCIS 2008.*

KAPPELMAN, L. A. & ZACHMAN, J. A. 2013. The Enterprise and Its Architecture: Ontology & Challenges. *Journal of Computer Information Systems,* 53**,** 87-95.

KELLER, W. 2009. TOGAF 9: quick start guide for enterprise architects.

KING, M. 1964. *Heidegger's philosophy: a guide to his basic thought*, The Macmillan Company.

KINSELLA, E. A. 2006. Hermeneutics and Critical Hermeneutics: Exploring Possibilities Within the Art of Interpretation. *FORUM: QUALITATIVE SOCIAL RESEARCH,* 7.

KLEIN, H. K. & MYERS, M. D. 1999. A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS quarterly***,** 67-93.

KOHLI, R. & GROVER, V. 2008. Business value of IT: An essay on expanding research directions to keep up with the times. *Journal of the Association for Information Systems,* 9**,** 23-39.

KORHONEN, J. J. & POUTANEN, J. 2013. Tripartite Approach to Enterprise Architecture. *Journal of Enterprise Architecture,* 9.

KOTZÉ, P., TSOGANG, M. & VAN DER MERWE, A. 2012. A Framework for Creating Pattern Languages for Enterprise Architecture. *Trends in Enterprise Architecture Research and Practice-Driven Research on Enterprise Transformation.* Springer.

KOZINA, M. 2006. Evaluation of Aris and Zachman frameworks as enterprise architectures. *Journal of Information and Organizational Sciences,* 30**,** 115-136.

KRIKORIAN, Y. H. 1935. The Concept of Organization. *The Journal of Philosophy,* 32**,** 119-126.

KURZYNSKI, M. 2009. Peter Drucker: modern day Aristotle for the business community. *Journal of Management History,* 15**,** 357-374.

LANDRY, M. & BANVILLE, C. 1992. A Disciplined Methodological Pluralism for MIS Research. *Accounting, Management and Information Technologies,* 2**,** 77-97.

LANGENBERG, K. & WEGMANN, A. 2004. Enterprise Architecture: What Aspects is Current Research Targeting. Technical report, EPFL.

LANKHORST, M. M. 2004. Enterprise architecture modelling—the issue of integration. *Advanced Engineering Informatics,* 18**,** 205-216.

LANKHORST, M. M. 2005. *Enterprise Architecture at Work: Modelling, Communication, and Analysis,* Springer.

LANKHORST, M. M., PROPER, H. A. & JONKERS, H. 2009. The Architecture of the ArchiMate Language. *In:* HALPIN, T. A., KROGSTIE, J., NURCAN, S., PROPER, H. A., SCHMIDT, R., SOFFER, P. & R. UKOR (eds.) *Enteprise, Business-Process and Information Systems Modeling - 10th International Workshop, BPMDS 2009 and 14th International Conference, EMMSAD 2009, held at CAiSE.* Amsterdam, The Netherlands: Springer.

LAPALME, J. 2012. Three schools of thought on enterprise architecture. *IT Professional,* 14**,** 37-43.

LAPKIN, A. 2006. Gartner Defines the Term 'Enterprise Architecture'. Gartner Inc.

LAPKIN, A. 2009. Enterprise Architecture Research Index: EA Foundation. Gartner Inc.

LAPKIN, A., ALLEGA, P., BURKE, B., BURTON, B., BITTLER, R. S., HANDLER, R. A., JAMES, G. A., ROBERTSON, B., NEWMAN, D., WEISS, D., BUCHANAN, R. & GALL, N. 2008. Gartner Clarifies the Definition of the Term 'Enterprise Architecture'. *Gartner research.*

LAPKIN, A. & BURTON, B. 2008. Myth Busting: What Enterprise Architecture Is Not. Gartner Inc.

LARSEN, K. R., ALLEN, G., VANCE, A. & EARGLE, D. 2014. *Theories Used in IS Research Wiki* [Online]. http://istheory.byu.edu. [Accessed 10 June 2014.

LAUDAN, L. 1986. *Science and Values: The Aims of Science and Their Role in Scientific Debate,* University of California Press.

LAUDON, K. C. & LAUDON, J. P. 2006. *Management Information Systems: managing the digital firm,* Pearson Prentice Hall.

LAVERTY, S. M. 2003. Hermeneutic phenomenology and phenomenology: A comparison of historical and methodological considerations. *International Journal of Qualitative Methods,* 2**,** 1-29.

LEE, A. 1994. The hermeneutic circle as a source of emergent richness in the managerial use of electronic mail. *International Conference on Information Systems (ICIS).*

LEIST, S. & ZELLNER, G. 2006. Evaluation of current architecture frameworks. *SAC'06.* Dijon, France: ACM.

LEVY, Y. & ELLIS, T. J. 2006. A Systems Approach to Conduct an Effective Literature Review in Support of Information Systems Research. *Informing Science,* 9**,** 181-212.

LI, X. 2009. Preemptive Learning, Competency Traps, and Information Technology Adoption: A Real Options Analysis. *IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT,* 56.

LIIMATAINEN, K., HOFMANN, M. & HEIKKILÄ, J. 2007. Overview of Enterprise Architecture work in 15 countries: Finnish Enterprise Architecture Research Project. Finnish Ministry of Finance.

LILLEHAGEN, F. & KARLSEN, D. 2005. Enterprise Architectures–Survey of Practices and Initiatives. *Interoperability of Enterprise Software and Applications (INTEROP-ESA ´05).* Geneva, Switzerland.

LINKEDIN CORPORATION. 2014. *What is linkedin? (http://www.linkedin.com/static?key=what_is_linkedin)* [Online]. [Accessed 16 June 2014].

LINKLETTER, K. E. & MACIARIELLO, J. A. 2009. Genealogy of a social ecologist. *Journal of Management History,* 15**,** 334-356.

LISSACK, M. R. 1999. Complexity: the science, its vocabulary, and its relation to organizations. *Emergence,* 1**,** 110-126.

LUKAITIS, S. & CYBULSKI, J. 2005. A hermeneutic analysis of the Denver International Airport Baggage Handling System.

MACCARI, A. & GALAL, G. H. 2002. Introducing the software architectonic viewpoint. *Software Architecture.* Springer.

MACDONALD, C. 2005. *Varieties of Things: foundations of contemporary metaphysics*, Blackwell Publishing.

MAGOULAS, T., HADZIC, A., SAARIKKO, T. & PESSI, K. 2012. Alignment in Enterprise Architecture: A Comparative Analysis of Four Architectural Approaches. *Electronic Journal Information Systems Evaluation Volume,* 15.

MANCHESTER, P. 2003. Kant's Conception of Architectonic in its Historical Context. *Journal of the History of Philosophy,* 41**,** 187-207.

MANTZOUKAS, S. 2008. Facilitating research students in formulating qualitative research questions *Nurse Education Today,* 28**,** 371-377.

MARCH, S. T. & SMITH, G. F. 1995. Design and Natural Science Research on Information Technology. *Decision Support Systems* 15**,** 251 - 266.

MCCARTHY, R. V. 2006. Toward a unified enterprise architecture framework: an analytical evaluation. *Issues in Information Systems,* 7.

MCGRATH, R. G. & MACMILLAN, I. C. 2009. How to rethink your business during uncertainty. *MIT Sloan Management Review*.

MENTZ, J., KOTZÉ, P. & VAN DER MERWE, A. 2012. A comparison of practitioner and researcher definitions of enterprise architecture using an interpretation method. *Advances in Enterprise Information Systems II: Proceedings of the Fifth International Conference on Research and Practical Issues of Enterprise Information Systems (CONFENIS 2011), Aalborg, Denmark, October 16-18, 2011.* CRC Press.

METCALFE, M. 2003. Author(ity): The Literature Review as Expert Witnesses. *Forum: Qualitative Social Research,* 4.

MEYERS, M. D. 2014. *Association for Information Systems (AISWorld) Section on Qualitative Research in Information Systems* [Online]. www.qual.auckland.ac.nz. [Accessed 10 June 2014.

MINGERS, J. 2001. Combining IS Research Methods: Towards a Pluralist Methodology. *Information Systems Research,* 12**,** 240-259.

MINTZBERG, H. 1981. Organization design: fashion or fit? *Harvard Business Review***,** 103-116.

MINTZBERG, H. 1991. The effective organization: forces and forms. *Sloan Management Review,* 32**,** 54-67.

MORAN, D. 2002. *Introduction to Phenomenology*, Routledge.

MORRISTON, W. 1972. Heidegger on the world. *Man and World,* 5**,** 452-4678.

MORSE, J. M., BARRETT, M., MAYAN, M., OLSON, K. & SPIERS, J. 2002. Verification Strategies for Establishing Reliability and Validity in Qualitative Research. *International Journal of Qualitative Methods,* 1.

MOULES, N. J. 2002. Hermeneutic inquiry: paying heed to history and Hermes - an ancestral, substantive, and methodological tale. *International Journal of Qualitative Methods,* 1.

MOUTON, J. 2001. *How to succeed in your Master's and Doctoral studies*, Van Schaik Publishers.

MOUTON, J. & MARAIS, H. C. 1988. *Basic concepts in the methodology of the social sciences*, HSRC Press.

MYERS, M. D. 2008. *Qualitative Research in Business & Management*, SAGE Publications Ltd.

MYKHASHCHUK, M., BUCKL, S., DIERL, T. & SCHWEDA, C. M. 2011. Charting the landscape of enterprise architecture management. *10th International Conference on Wirtschaftsinformatik.* Zurich, Switzerland.

NAMKYU, L., LEE, T.-G. & PARK, S.-G. 2009. A comparative analysis of enterprise architecture frameworks based on EA quality attributes. *Software Engineering, Artificial Intelligences,* *Networking and Parallel/Distributed Computing, 2009. SNPD'09. 10th ACIS International Conference on.* IEEE.

NEEDHAM, W. 2010. Government-Wide Enterprise Architecture (GWEA) Framework Implementation Guide. South Africa: Government Information Technology Officer’s Council (GITOC) of South Africa.

NIEHAVES, B. 2007. On epistemological pluralism in design science. *Scandinavian Journal of Information Systems,* 19**,** 93.

NIELSEN, K. 2007. Aspects of a Practical Understanding: Heidegger at the workplace. *Scandinavian Journal of Educational Research,* 51**,** 455 - 470.

O'BRIEN, J. 2004. *Management Information Systems: managing information technology in the business enterprise*, McGraw-Hill.

OATES, B. J. 2006. *Researching Information Systems And Computing*, Sage.

ODONGO, A. O., KANG, S. & KO, I.-Y. 2010. A Scheme for Systematically Selecting an Enterprise Architecture Framework. *Computer and Information Science (ICIS), 2010 IEEE/ACIS 9th International Conference on.* IEEE.

OHREN, O. P. 2005. An Ontological Approach to Characterising Enterprise Architecture Frameworks. *In:* BERNUS, P. & FOX, M. (eds.) *Knowledge sharing in the integrated enterprise: interoperability strategies for the enterprise architect.* Springer Boston.

OXFORD DICTIONARIES *"architectonic". Oxford Dictionaries*, Oxford University Press.

PAL, S. K. 2008. 21st century information technology revolution. *Ubiquity*.

PALMER, R. E. 1969. *Hermeneutics: Interpretation Theory in Schleiermacher, Dilthey, Heidegger and Gadamer*, Northwestern University Press.

PASZKOWSKI, S. & MORTENSEN, R. K. 2008. Enterprise Architecture Survey Results. Copenhagen Business School.

PATTEN, K. P., FJERMESTAD, J. & WHITWORTH, B. 2009. How CIOs Use Flexibility to Manage Uncertainty in Dynamic Business Environments. *5th Americas Conference on Information Systems (AMCIS 2009).* San Francisco, California: Curran Associates, Inc.

POPPER, K. 1978. Three worlds. *The Tanner lectures on human values,* 1**,** 141-167.

PRASAD, A. 2002. The contest over meaning: hermeneutics as an interpretive methodology for understanding texts. *Organizational Research Methods,* 5**,** 12.

RICHMOND, G. 2007. Trikonic Inter-Enterprise Architectonic. *Conceptual Structures: Knowledge Archtectures for Smart Applications.* Springer-Verlag.

RIEMER, K. & JOHNSTON, R. B. 2011. Artifact or Equipment? Rethinking the Core of IS using Heidegger’s ways of being. *International Conference on Information Systems (ICIS 2011).* Shanghai: AIS Electronic Library (AISeL).

RIEMER, K. & JOHNSTON, R. B. 2013. Rethinking the place of the artefact in IS using Heidegger's analysis of equipment. *European Journal of Information Systems*.

RITCHIE, J. & LEWIS, J. 2003. *Qualitative research practice: A guide for social science students and researchers,* Sage.

ROBBINS, S. P. 1987. *Organization Theory: Structure, Design and Applications 2nd edition,* Prentice-Hall International.

ROLFE, G. 2006. Validity, trustworthiness and rigour: quality and the idea of qualitative research. *Journal of Advanced Nursing,* 53**,** 304-310.

ROSS, J. W., WEILL, P. & ROBERTSON, D. 2006. *Enterprise architecture as strategy: Creating a foundation for business execution*, Harvard Business School Pr.

ROSS, R. G. 2011. Zachman Framework 3.0 Announced Tues, Aug. 23 … Quick Notes. *Ron Ross on business rules* [Online]. 2014].

SANDAGE, S. J., COOK, K. V., HILL, P. C., STRAWN, B. D. & REIMER, K. S. 2008. Hermeneutics and Psychology: A Review and Dialectical Model *Review of General Psychology,* 12**,** 344 - 364.

SCHEKKERMAN, J. 2005. How are organizations progressing? *In:* SCHEKKERMAN, J. (ed.) *Trends in Enterprise Architecture.* IFEAD.

SCHEKKERMAN, J. 2006. *How to Survive in the Jungle of Enterprise Architecture Frameworks: Creating Or Choosing an Enterprise Architecture Framework*, Trafford Publishing.

SCHÖENHERR, M. 2009. Towards a Common Terminology in the Discipline of Enterprise Architecture. *In:* FEUERLICHT, G. & LAMERSDORF, W. (eds.) *Service-Oriented Computing – ICSOC 2008 Workshops.* Springer Berlin / Heidelberg.

SCHÖNHERR, M. 2008. Towards a common terminology in the discipline of enterprise architecture. *In:* FEUERLICHT, G. & LAMERSDORF, W. (eds.) *Service-Oriented Computing – ICSOC 2008 Workshops.* Sydney, Australia: Springer.

SCOTT, J. & MARSHALL, G. 2009. ontology. *A Dictionary of Sociology.* Oxford University Press.

SEIGFRIED, H. 1976. Descriptive phenomenology and constructivism. *Philosophy and Phenomenological Research,* 37**,** 248-261.

SESSIONS, R. 2007. A Comparison of the Top Four Enterprise-Architecture Methodologies. MSDN Architecture Center. Microsoft Corporation.

SHAH, H. & KOURDI, M. E. 2007. Frameworks for enterprise architecture. *IT Professional,* 9**,** 36-41.

SIMON, D., FISCHBACH, K. & SCHODER, D. 2013a. Enterprise architecture management and its role in corporate strategic management. *Information Systems and E-Business Management***,** 1-38.

SIMON, D., FISCHBACH, K. & SCHODER, D. 2013b. An exploration of enterprise architecture research. *Communications of the Association for Information Systems,* 32**,** 1.

SIMON, H. A. 1996. *The sciences of the artificial 3rd edition,* MIT Press.

SIRE, J. W. 2004. *Naming the Elephant*, InterVarsity Press.

SMITH, K. 2010a. The 160 Character Challenge. http://www.pragmaticea.com/160challenge.asp.

SMITH, K. 2010b. 160 Character Challenge: What is the Purpose of EA? - Analysis. Pragmatic EA ltd.

SMITH, K. 2010c. 160 Character Challenge: What is the Purpose of EA? - Source. Pragmatic EA ltd.

SOWA, J. F. & ZACHMAN, J. 1992. Extending and Formalizing the Framework for Information Systems Architecure. *IBM Systems Journal,* 31**,** 590-616.

STIGE, B., MALTERUD, K. & MIDTGARDEN, T. 2009. Toward an Agenda for Evaluation of Qualitative Research. *Qualitative Health Research,* 19**,** 1504–1516.

TALLON, P. P. 2007. Inside the Adaptive Enterprise: An Information Technology Capabilities Perspective on Business Process Agility Center for Research on Information Technology and Organizations University of California (CRITO).

TANG, A., HAN, J. & CHEN, P. 2004. A comparative analysis of architecture frameworks. *11th Asia-Pacific Software Engineering Conference (APSEC'04).* IEEE
THE AMERICAN HERITAGE DICTIONARY 2009. *The American Heritage® Dictionary of the English Language, Fourth Edition*
Houghton Mifflin Company.

THE NEW OXFORD DICTIONARY OF ENGLISH 1998. The New Oxford Dictionary of English. *In:* PEARSALL, J. (ed.) *The New Oxford Dictionary of English.* Oxford University Press.

THE OPEN GROUP. 2008a. *18th Enterprise Architecture Practitioners Conference Glasgow: Proceedings* [Online]. Available: http://archive.opengroup.org/public/member/proceedings/q208/20AF.htm [Accessed 3 October 2011 2011].

THE OPEN GROUP. 2008b. *The Open Group Conference Chicago: Proceedings* [Online]. Available: http://archive.opengroup.org/public/member/proceedings/q308/22AF.htm [Accessed 3 October 2011 2011].

THE OPEN GROUP. 2009a. *The Open Group Hong Kong 2009: Proceedings* [Online]. Available: http://www.opengroup.org/public/member/proceedings/q409/21AF.htm [Accessed 3 October 2011 2011].

THE OPEN GROUP 2009b. *TOGAF Version 9*, Van Haren Publishing.

THE OPEN GROUP. 2010. *The Open Group Boston 2010: Proceedings* [Online]. Available: http://www.opengroup.org/public/member/proceedings/q310/22AF.htm [Accessed 3 October 2011 2011].

THE OPEN GROUP. 2011a. *About Us* [Online]. The Open Group. [Accessed 16 June 2014].

THE OPEN GROUP. 2011b. *ArchiMate 2.1 Specification,* [Online]. http://theopengroup.org/archimate/. [Accessed 31 July 2014].

THE OPEN GROUP. 2011c. *TOGAF Version 9.1* [Online]. http://pubs.opengroup.org/architecture/togaf9-doc/arch/. [Accessed 31 July 2014].

THE OPEN GROUP 2011d. *TOGAF Version 9.1*, Van Haren Publishing.

THE OPEN GROUP. 2013. *Architecture Forum* [Online]. The Open Group. [Accessed 18 February 2014].

THEUERKORN, F. 2004. *Lightweight Enterprise Architectures*, CRC Press.

THIETART, R. A. & FORGUES, B. 1995. Chaos theory and organization. *Organization Science,* 6**,** 19-31.

TIMASHEFF, N. S. 1947. Definitions in the Social Sciences. *The American Journal of Sociology,* 53**,** 201-209.

TORRACO, R. J. 2005. Writing Integrative Literature Reviews: Guidelines and Examples. *Human Resource Development Review,* 4**,** 356 - 367.

TSOUKAS, H. 1998. Introduction: Chaos, complexity and organization theory. *Organization,* 5**,** 291-313.

URBACZEWSKI, L. & MRDALJ, S. 2006. A comparison of enterprise architecture frameworks. *Issues in Information Systems,* 7**,** 18-23.

VAISHNAVI, V. & KUECHLER, B. 2013. *Design Science Research in Information Systems* [Online]. 2014].

VAN BUREN, J. (ed.) 2005. *The Earliest Heidegger: A New Field of Research*: Blackwell Publishing Ltd.

VASCONCELOS, F. C. & RAMIREZ, R. 2009. Complexity in business environments. *Journal of Business Research,* In Press, Corrected Proof.

VIDAL, C. 2008. Wat is een wereldbeeld? (What is a worldview?). *In:* VAN BELLE, H. & VAN DER VEKEN, J. (eds.) *Nieuwheid denken. De wetenschappen en het creatieve aspect van de werkelijkheid.*

VIDAL, C. 2009. Metaphilosophical Criteria for Worldview Comparison (DRAFT). *unpublished.* Center Leo Apostel.

WAGTER, R., VAN DEN BERG, M., LUIJPERS, J. & VAN STEENBERGEN, M. 2005. *Dynamic enterprise architecture: how to make it work*, Wiley.

WALSH, K. 1996. Philosophical hermeneutics and the project of Hans Georg Gadamer: implications for nursing research. *Nursing Inquiry,* 3**,** 231 - 237.

WALSHAM, G. 2006. Doing interpretive research. *European Journal of Information Systems,* 15**,** 320.

WANG, S. F., LIN, C. M. & FENG, J. K. 2008. A Hermeneutic Approach to the Notion of Information in IS. *Lecture Notes in Computer Science,* 5178**,** 340-345.

WEBB, P. & POLLARD, C. 2006. Demystifying a Hermeneutic Approach to IS Research. *Australasian Journal of Information Systems*, 13**,** 31.

WEBSTER, J. & WATSON, R. T. 2002. Analyzing the past to prepare for the future: writing a literature review. *MISQ Quarterly*, 26**,** xiii - xxiii.

WHITTLE, R. & MYRICK, C. B. 2005. *Enterprise business architecture: the formal link between strategy and results*, CRC Press.

WILSON, C. & SHORT, J. 2010. Magic Quadrant for Enterprise Architecture Tools. Gartner Research.

WINTER, K., BUCKL, S., MATTHES, F. & SCHWEDA, C. M. 2010. Investigating the State-of-the-Art in Enterprise Architecture Management Methods in literature and Practice. *MCIS*, 90.

WINTER, R. & FISCHER, R. 2006. Essential layers, artifacts and dependencies of enterprise architecture. *10th IEEE International Enterprise Distributed Object Computing Conference Workshops EDOCW'06.* IEEE.

WIßOTZKI, M. & SONNENBERGER, A. 2012. Enterprise Architecture Management-State of Research Analysis & a Comparison of Selected Approaches. *actice of***,** 37.

WRATHALL, M. A. & DREYFUS, H. L. 2006. A Brief Introduction to Phenomenology and Existentialism. *In:* DREYFUS, H. L. & WRATHALL, M. A. (eds.) *A Companion to Phenomenology and Existentialism.* Blackwell Publishing Ltd.

WYSSUSEK, B., SCHWARTZ, M. & GET, E. 2003. Towards a Sociopragmatic-Constructivist Understanding of Information Systems. *GET TITLE.* Idea Group Inc.

ZACHMAN, J. A. 1987. A framework for information systems architecture. *IBM Systems Journal*.

ZACHMAN, J. A. 1996. The framework for enterprise architecture: background, description and utility. *Zachman International*.

ZACHMAN, J. A. 1997a. Concepts of the framework for enterprise architecture. *Zachman International, Inc., La Cañada, Ca*.

ZACHMAN, J. A. 1997b. Enterprise architecture: The issue of the century. *Database Programming and Design*, 10**,** 44-53.

ZACHMAN, J. A. 2000. Architecture Artifacts vs Application Development Artifacts.

ZACHMAN, J. A. 2002. The Zachman Framework for Enterprise Architecture: Primer for Enterprise Engineering and Manufacturing. Zachman Framework Associates Metadata Systems Software Inc.

ZACHMAN, J. A. 2008. The Zachman Framework: the official concise definition. http://www.zachman.com/about-the-zachman-framework [Online].

ZACHMAN, J. A. 2009a. Yes, "Enterprise Architecture Is Relative" BUT It Is Not Arbitrary. http://www.scc.cc/voice/ArtArchitecture%20Is%20Architecture.pdf [Online].

ZACHMAN, J. A. 2012. *The Zachman Certified™ - Enterprise Architect Program* [Online]. http://www.zachman.com/zachman-certified: Zachman International, Inc. [Accessed 29 July 2014].

ZACHMAN, J. P. 2009b. The Zachman Framework evolution. *http://www.zachman.com/ea-articles-reference/54-the-zachman-framework-evolution* [Online].

ZARVIC, N. & WIERINGA, R. An integrated enterprise architecture framework for business-IT alignment. 2006. Citeseer, 262–270.

APPENDIX A: ENTERPRISE ARCHITECTURE FRAMEWORK SELECTION

Summary of comparison articles

Article title	Date	Frameworks	Zachman	TOGAF	DODAF	FEAF	Kruchten 4+1 view	C4ISR	RM-ODP	TEAF	E2AF	MDA	IAF	GERAM	GARTNE	ArchiMat
A comparative analysis of architecture frameworks (Tang et al., 2004)	2004	Zachman, 4 + 1 view, FEAF, RM-ODP, TOGAF, DODAF	X	X	X		X		X							
An Ontological Approach to Characterizing Enterprise Architecture Frameworks (Ohren, 2005)	2005	FEAF, DODAF, TEAF, Zachman, TOGAF, GERAM	X	X	X	X				X				X		
An overview of enterprise architecture framework deliverables (Goethals, 2005)	2005	TOGAF, Zachman, Kruchten's 4+1, RM-ODP, MDA, FEAF, TEAF, C4ISR	X	X		X	X	X	X	X						
Towards a framework for enterprise architecture frameworks comparison and selection (Abdallah & Galal-Edeen, 2006)	2006	Zachman, TOGAF, C4ISR	X	X				X								
The many faces of architectural descriptions (Greefhorst et al., 2006)	2006	Zachman, 4+1	X				X									
Evaluation of current architecture frameworks (Leist & Zellner, 2006)	2006	ARIS, C4ISR, DODAF, FEAF, MDA, TEAF, TOGAF		X	X	X		X				X				
Toward a unified enterprise architecture framework: an analytical evaluation (McCarthy, 2006)	2006	Zachman, DODAF, FEAF, TOGAF, E2AF	X	X	X	X					X					
A comparison of enterprise architecture frameworks (Urbaczewski & Mrdalj, 2006)	2006	Zachman, DODAF, TOGAF, FEAF, TEAF	X	X	X	X				X						
An integrated enterprise architecture framework for business-IT alignment (Zarvic & Wieringa, 2006)	2006	Zachman, 4+1 Domain, TOGAF, RM-ODP	X	X			X		X							
A Comparison of the Top Four Enterprise-Architecture Methodologies (Sessions, 2007)	2007	Zachman, TOGAF, FEAF, Gartner	X	X		X									X	

Article title	**Date**	**Frameworks**	**Zachman**	**TOGAF**	**DODAF**	**FEAF**	**Kruchten 4+1 view**	**C4ISR**	**RM-ODP**	**TEAF**	**E2AF**	**MDA**	**IAF**	**GERAM**	**GARTNE**	**ArchiMat**
EAF2-A Framework for Categorizing Enterprise Architecture Frameworks (Franke et al., 2009)	2009	TOGAF, DODAF, IAF, MODAF, E2AF, FEA, Zachman, ArchiMate	X	X	X						X		X			X
A Review of Commercial Related Architecture Frameworks and their Feasibility to C4I System (Alghamdi, 2010)	2010	Zachman, TOGAF, IAF, MDA, OBASHI, SABSA, SAP EAF, NIST EA and FDIC EAF.	X	X								X	X			
Scheme for Systematically Selecting an Enterprise Architecture Framework (Odongo et al., 2010)	2010	Zachman, DoDAF, TOGAF, FEAF and TEAF	X	X	X	X				X						
Klassifikation von Enterprise-Architecture-Frameworks: Eine Literaturanalyse (Herden & Zenner, 2011)	2011	Zachman, DoDAF, FEA and TOGAF	X	X	X											
Alignment in Enterprise Architecture: A Comparative Analysis of Four Architectural Approaches (Magoulas et al., 2012)	2012	Zachman, TOGAF, E2AF and GERAM	X	X							X			X		
Towards a Framework for a Unified Enterprise Architecture (Adenuga & Kekwaletswe, 2013)	2013	TOGAF, DoDAF, FEAF and CIMOSA.		X	X	X										
Analyzing the Current Trends in Enterprise Architecture Frameworks: 2012-2013 (Cameron & McMillan, 2013)	2013	Zachman, TOGAF, FEAF and DoDAF	X	X	X	X										
Totals:			15	16	10	9	4	3	3	4	3	2	2	2	1	1

Selection criteria for shortlist of enterprise architecture frameworks

Framework	**Criteria**					**Selected (y/n)**
	Referenced (literature and surveys) (count)	**Have traceable history (y/n)**	**Is updated/active (y/n)**	**Descriptions accessible (y/n)**	**Currently in use (y/n)**	
Zachman	15	Y	Y	Y, on web and print	Y	Y
TOGAF	15	Y	Y, version 9.1 released 2011	Y, on web and print	Y	Y
DoDAF	10	Y	Y, version 2 released 2009	Y, on website	Y	Y
FEAF	9	Y	N, Subsumed under FEA	Y, for FEA on website	Y	N
Kruchten 4+1	4	n/a, software architecture	n/a	Y	n/a	N
E2AF	3	Y	Y, version 1.5 released 2006	Y	Not clear	N
RM-ODP	3	Y, used initially in network domain	N	Y	n/a	N
TEAF	2	Y, limited	Y, consolidated in TEA	Y	Y	N
MDA	2	n/a	n/a	n/a	n/a	N
GERAM	1	Y	N	Y	n/a	N
GARTNER	1	Limited	n/a	N, commercial	Y	N
ArchiMate	1	Y	n/a recently standardized by open group	Y	Y	N

APPENDIX B: ENTERPRISE ARCHITECTONIC DEMONSTRATION

This letter serves a mechanism to acquire your consent for participating in the research to be conducted by Jan C Mentz (jcmentz@gmail.com). The research contributes to the completion of a PHD: Information Systems degree at the University of South Africa (UNISA), under the supervision of Professors Paula Kotzé (Paula.Kotze@meraka.org.za) and Alta van der Merwe (Alta.vdm@up.ac.za). The purpose of this research is to: establish whether the use of an enterprise architectonic will aid in the fundamental understanding of enterprise architecture as a concept.

The demonstration will require approximately 60 minutes of your time. The demonstration is divided into three parts as follows:

- Part 1 - answer six questions about your understanding of enterprise architecture
- Part 2 – listen to a 40 minute presentation about the enterprise architectonic
- Part 3 – answer five questions about your understanding of enterprise architecture

You will be required to complete parts 1 and 3 without interference whilst part 2 is a presentation with the opportunity to discuss the contents of the presentation.

The input you provide will be treated with confidentiality in accordance with the UNISA ethics policy and will only be used towards the completion of the aforementioned qualification. All data will be used anonymously in summary form without reference to any individual. The purpose of the demonstration is to determine whether the artefact (enterprise architectonic) is useful as a tool to explain the fundamental concepts of enterprise architecture.

Please note that the Intellectual Property associated with this research inclusive of this demonstration instrument as well as the enterprise architectonic resides with the UNISA as described in the relevant Intellectual Property policy. This policy can be made available to you if so requested.

Participation in this research study is voluntary, and you have the right to, at any time, withdraw or refuse to participate. There are no risks or discomforts associated with your participation. All answers from you and other participants will be analysed collectively. Individual answers will therefore not be linked to any specific participant.

I have read and understood all the above and I willingly choose to participate in this study.

Date: **Signature:**

UNISA | college of science, engineering and technology

Mr Jan Carel Mentz (38358778)
College of Science, Engineering and Technology
UNISA
Johannesburg

2014-05-15

Permission to conduct research project

Ref: 127/JCM/2014

The request for ethical approval for your PhD (Information Systems) research project entitled "Towards using Enterprise Architectonics to promote a Fundamental Understanding of Enterprise Architecture" refers.

The College of Science, Engineering and Technology's (CSET) Research and Ethics Committee (CREC) has considered the relevant parts of the studies relating to the abovementioned research project and research methodology and is pleased to inform you that ethical clearance is granted for your study as set out in your proposal and application for ethical clearance.

Therefore, involved parties may also consider ethics approval as granted. However, the permission granted must not be misconstrued as constituting an instruction from the CSET Executive or the CSET CREC that sampled interviewees (if applicable) are compelled to take part in the research project. All interviewees retain their individual right to decide whether to participate or not.

We trust that the research will be undertaken in a manner that is respectful of the rights and integrity of those who volunteer to participate, as stipulated in the UNISA Research Ethics policy. The policy can be found at the following URL:
http://cm.unisa.ac.za/contents/departments/res_policies/docs/ResearchEthicsPolicy_apprvCounc_21Sept07.pdf

Please note that if you subsequently do a follow-up study that requires the use of a different research instrument, you will have to submit an addendum to this application, explaining the purpose of the follow-up study and attach the new instrument along with a comprehensive information document and consent form.

Yours sincerely

Chair: College of Science, Engineering and Technology Ethics Sub-Committee

University of South Africa
College of Science, Engineering and Technology
The Science Campus
C/o Christiaan de Wet Road and Pioneer Avenue,
Florida Park, Roodepoort
Private Bag X6, Florida, 1710
www.unisa.ac.za/cset

UNISA | college of science, engineering and technology

APPENDIX C: PART 1 - PRE-TEST OF YOUR UNDERSTANDING OF FUNDAMENTAL ENTERPRISE ARCHITECTURE CONCEPTS

This test's purpose is to determine your current understanding or opinion of enterprise architecture. This will serve as a base line for your position before you are shown the enterprise architectonic itself. Answer the questions below and give the completed form to the presenter before moving on to the next step. Please note it is very important that you complete this step before you watch the presentation.

Answer the following questions please (note that there are no right or wrong answers to these questions, the aim is to get your opinion):

Question 1:

How long have you been involved in the EA discipline? (Options: not involved, 1-5 years, 5 – 10 years, more than 10 years)

Question 2:

How would you describe your current role in the EA discipline? (Options: researcher, practitioner, no specific role)

Question 3:

What is your understanding of what EA is in terms of a short description or a definition? (Write down your definition/ description)

Question 4:

What is your understanding of what an EAF is in terms of a short description or definition? (Write down your definition/ description)

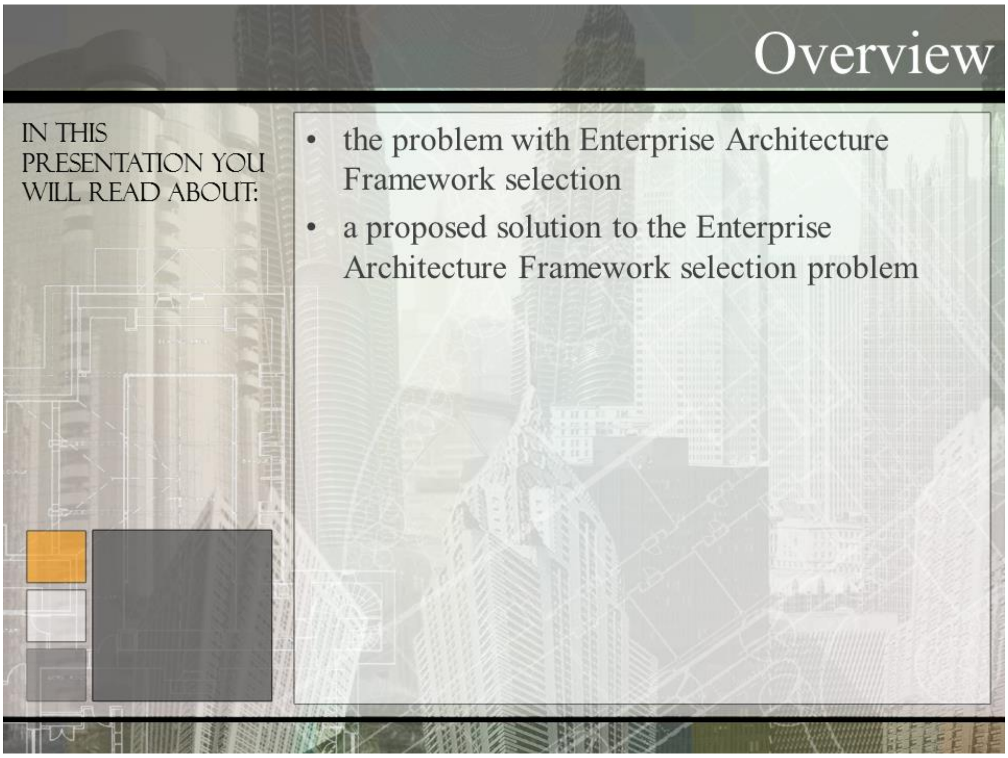
Question 5:

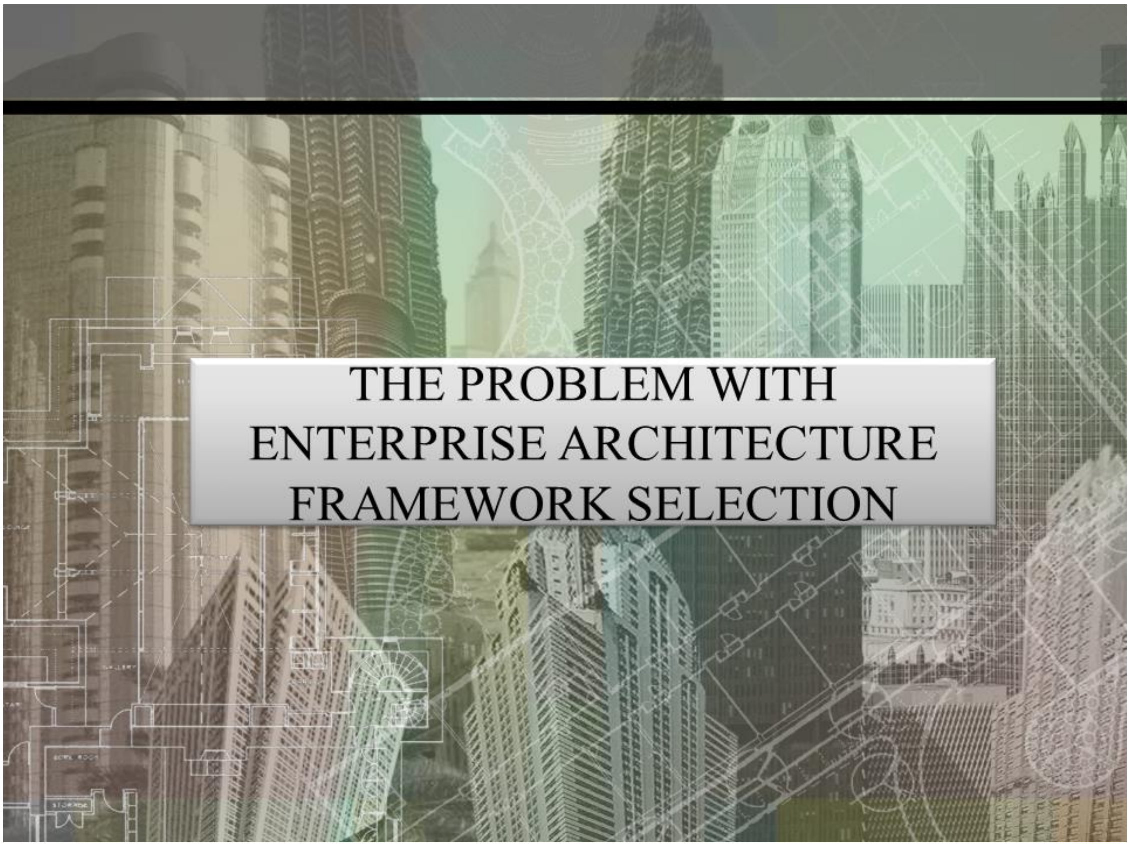
List according to your opinion/experience the fundamental concepts of EA. (write down your list of terms, try to list no more than 10 fundamental concepts)

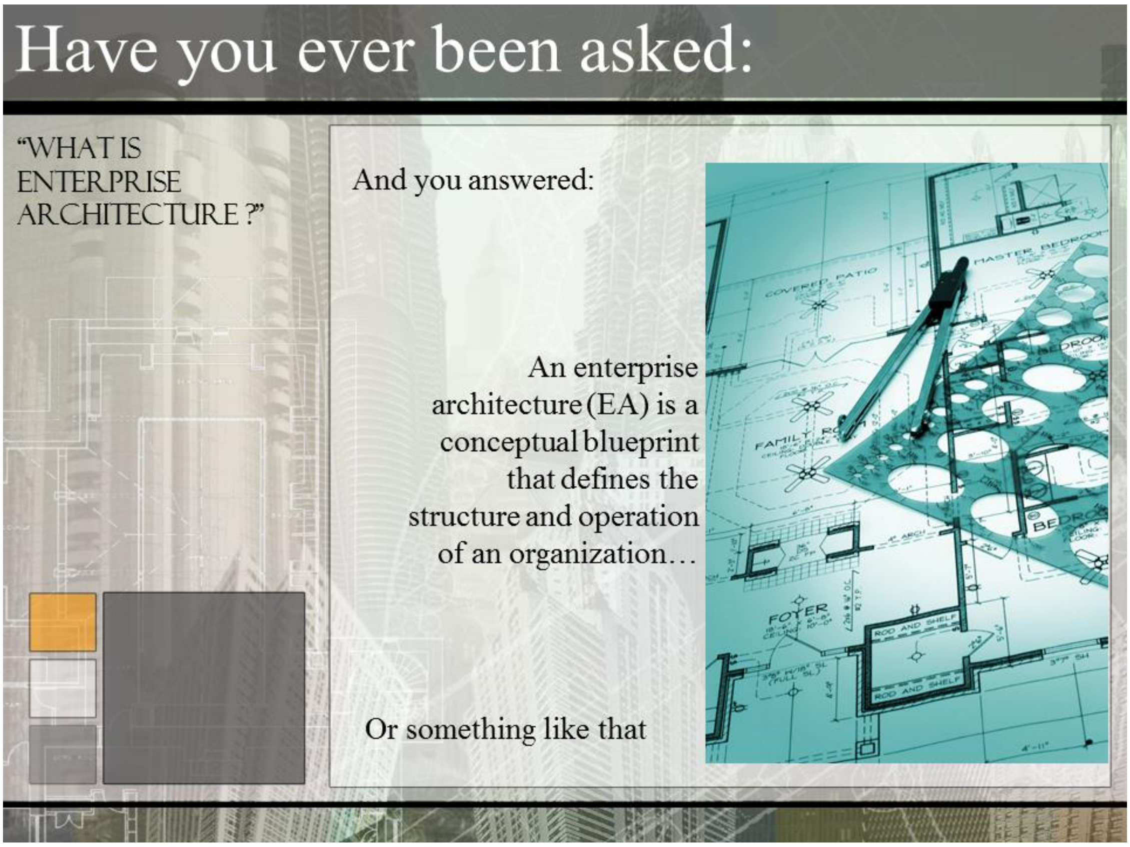
Question 6:

Describe either by way of diagram or in words how the fundamental concepts of EA relate to each other. (Write your description or draw your)

APPENDIX D: PART 2 - ENTERPRISE ARCHITECTONIC DEMONSTRATION

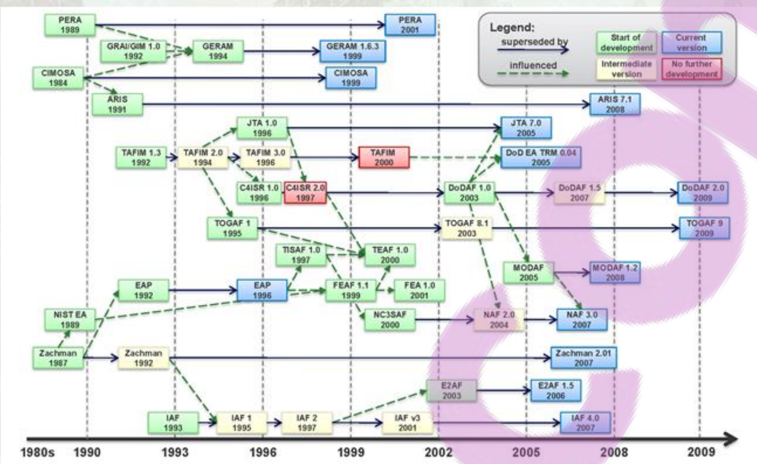



THE PROBLEM WITH
ENTERPRISE ARCHITECTURE
FRAMEWORK SELECTION


Have you ever been asked:
"WHAT IS ENTERPRISE ARCHITECTURE ?"
And you answered:
An enterprise architecture (EA) is a conceptual blueprint that defines the structure and operation of an organization…
Or something like that

Have you been confronted with this situation?

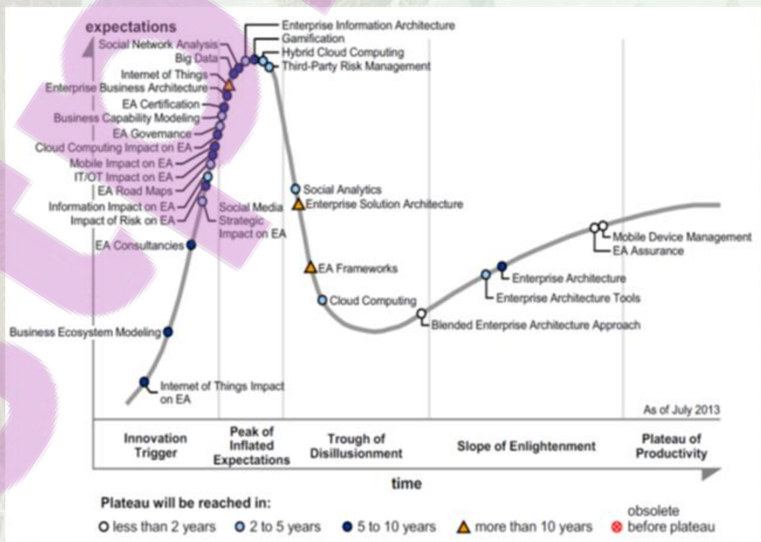
CHOOSING BETWEEN AVAILABLE ENTERPRISE ARCHITECTURE FRAMEWORKS FOR THE MOST SUITABLE FRAMEWORK FOR YOUR PROJECT…



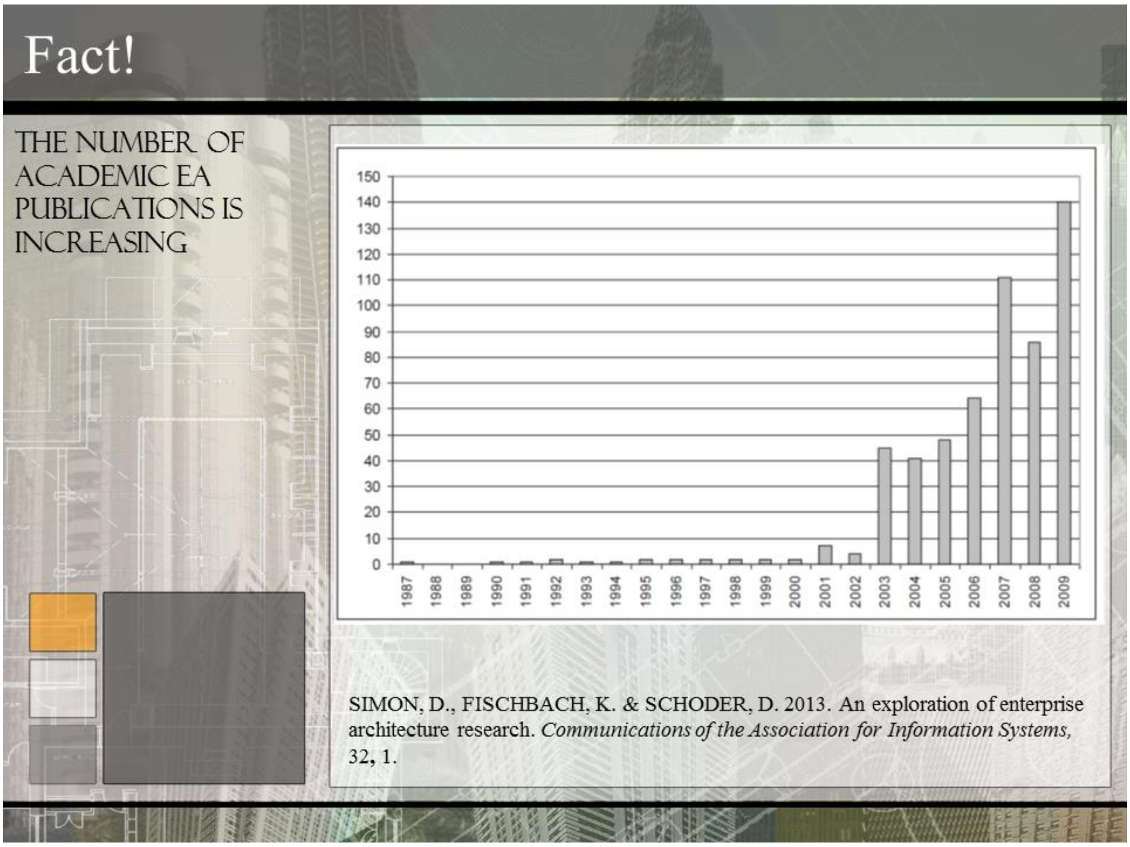
ERNST, A. M. & MATTHES, F. 2009. A Pattern-based Approach to Enterprise Architecture Management. *4th Meeting of the Working Group Enterprise Architecture Management (AkEAM)*. Munchen.

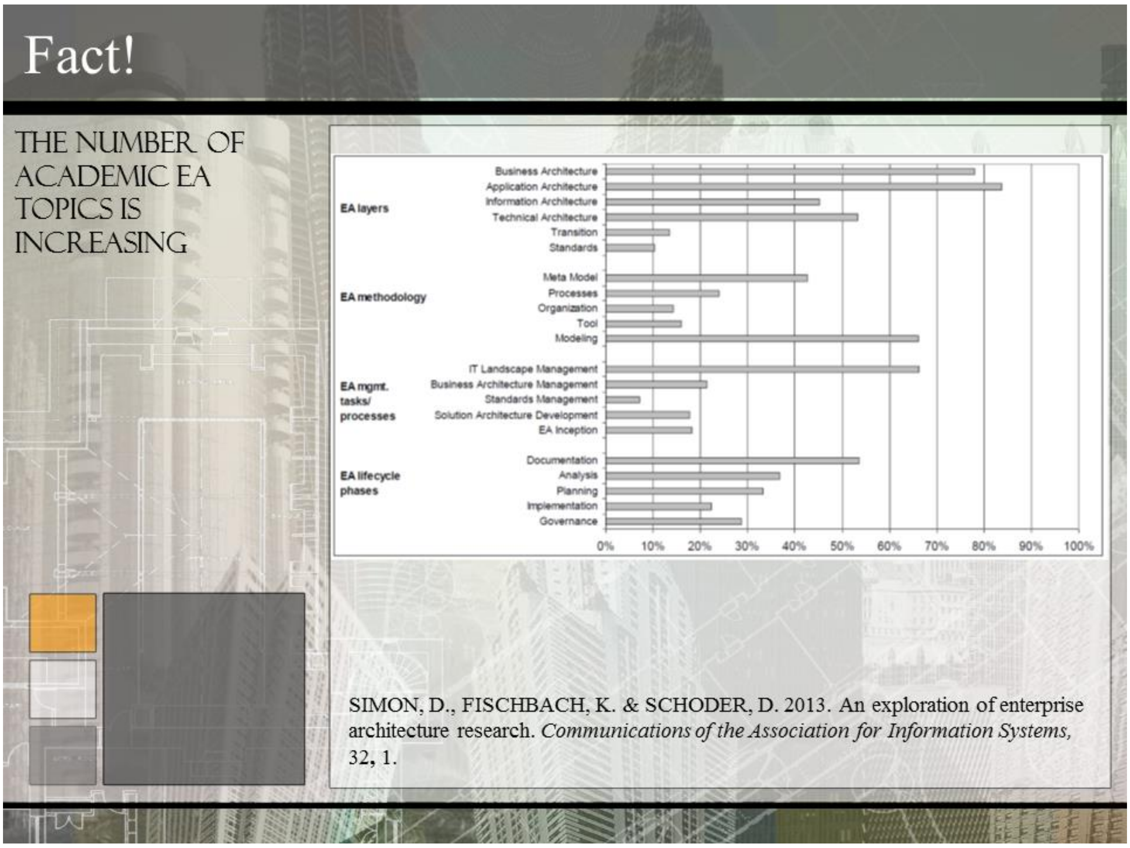
Fact!

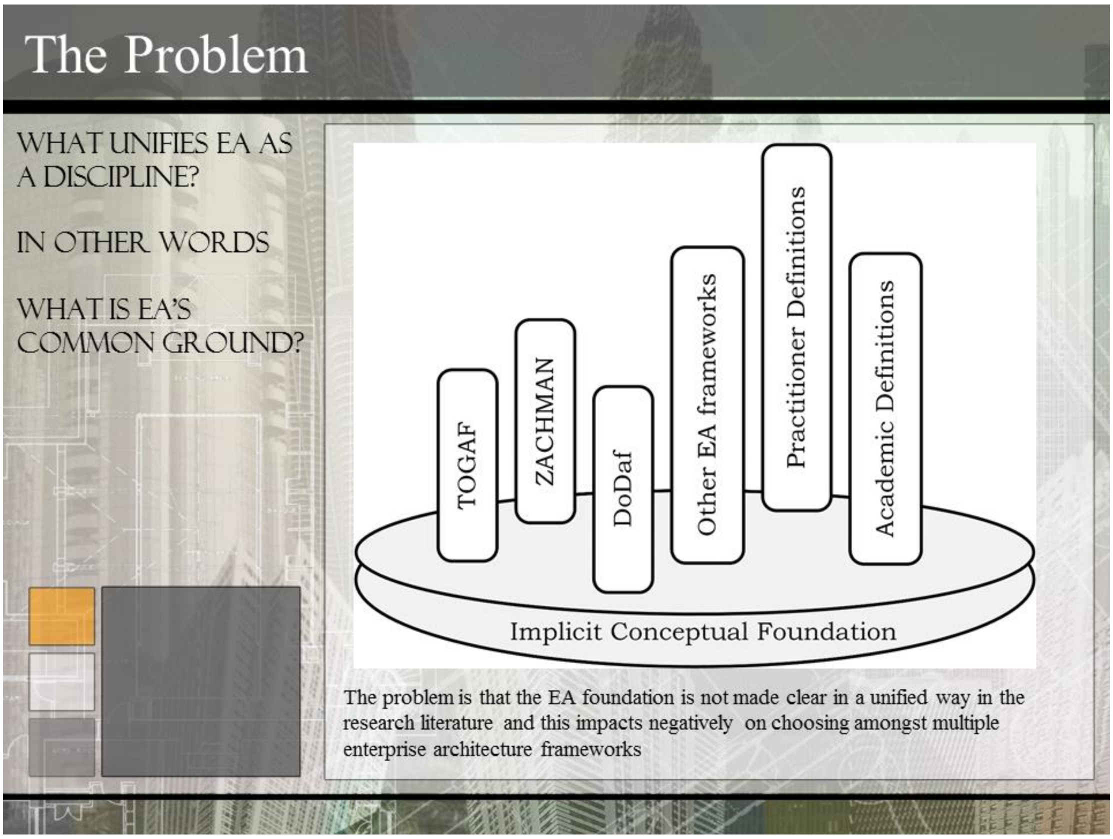
INDUSTRY ACCEPTANCE OF EA IS GROWING



BURTON, B. & ALLEGA, P. 2013. Hype Cycle for Enterprise Architecture, 2013. Gartner Inc.


Fact!
THE NUMBER OF ACADEMIC EA PUBLICATIONS IS INCREASING
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
SIMON, D., FISCHBACH, K. & SCHODER, D. 2013. An exploration of enterprise architecture research. *Communications of the Association for Information Systems,* 32, 1.


Fact!
THE NUMBER OF ACADEMIC EA TOPICS IS INCREASING
EA layers
Business Architecture
Application Architecture
Information Architecture
Technical Architecture
Transition
Standards
EA methodology
Meta Model
Processes
Organization
Tool
Modeling
EA mgmt. tasks/ processes
IT Landscape Management
Business Architecture Management
Standards Management
Solution Architecture Development
EA Inception
EA lifecycle phases
Documentation
Analysis
Planning
Implementation
Governance
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
SIMON, D., FISCHBACH, K. & SCHODER, D. 2013. An exploration of enterprise architecture research. *Communications of the Association for Information Systems,* 32, 1.


The Problem
WHAT UNIFIES EA AS A DISCIPLINE?
IN OTHER WORDS
WHAT IS EA'S COMMON GROUND?
TOGAF
ZACHMAN
DoDaf
Other EA frameworks
Practitioner Definitions
Academic Definitions
Implicit Conceptual Foundation
The problem is that the EA foundation is not made clear in a unified way in the research literature and this impacts negatively on choosing amongst multiple enterprise architecture frameworks


A PROPOSED SOLUTION

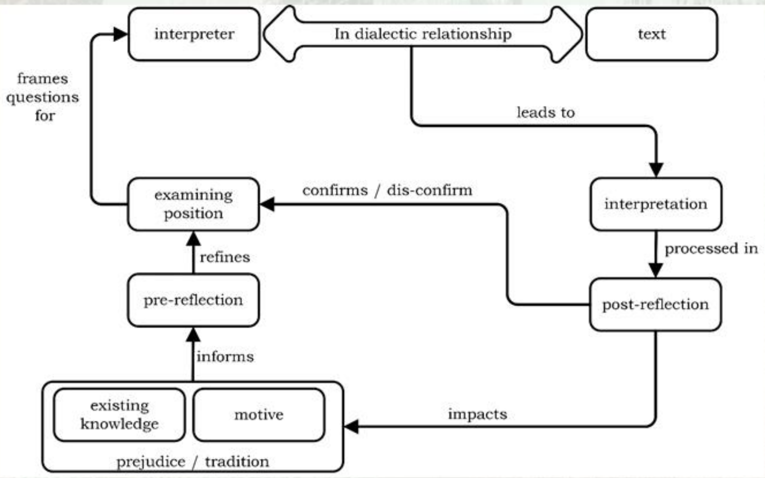
THE PROCESS

THE SOLUTION CONSIST OF A NUMBER OF STEPS:

1. Analyze Enterprise Architecture Frameworks to find the shared EA meaning
2. Identify fundamental EA concepts
3. Establish the relationships between fundamental concepts
4. Organize concepts and relationships in an architectonic
5. Explain the value of the architectonic

STEP 1 – FIND SHARED MEANING

DESIGN A STRUCTURED INTERPRETATION METHOD (SIM) AND ANALYZE PROMINENT ENTERPRISE ARCHITECTURE FRAMEWORKS (ZACHMAN, TOGAF AND DODAF)



STEP 1 - RESULT

AN EA UNDERSTANDING:

EA CLAIM + 6 PROPOSITIONS

(BASED ON ANALYSIS OF TOGAF, DODAF AND ZACHMAN)

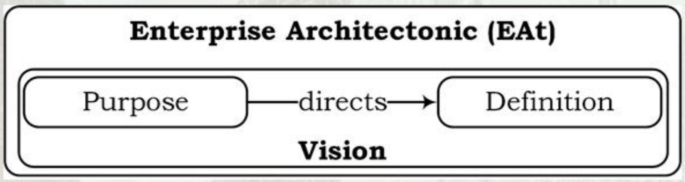
EA Claim	
Enterprise architecture is similar in intent to the enterprise as a worldview is to the world.	
EA Proposition	
1	**The underlying knowledge of EA is in a pre-suppositional state**
2	**EA is a description of the structure of the systems of an enterprise**
3	**EA represents the enterprise in time-oriented architectures such as an as-is, to-be and has-been architecture**
4	**EA translates the values/strategy of the enterprise into operational systems appropriate to the information society**
5	**EA provides a means to manage decisions about the IT/IS management and implementation in the enterprise**
6	**EA captures a representation of the enterprise in the form of a model or set of models**

STEP 2 - IDENTIFY FUNDAMENTAL EA CONCEPTS

Concepts	Description
Purpose	The purpose element recognises that humans operate with a purpose in mind. In the context of the EAt, the purpose of EA is summarised as *solving the problem of complexity that arises from technology use in the enterprise.*
Definition	This element describes EA as what it is in terms of its purpose. In order to fulfil the EA purpose, EA is defined as being *a representation of the enterprise.*
Model	The model element is described as the embodiment of the representation of the enterprise, based upon the purpose and definition of EA. To enable the creation of the model, it must be expressed in a *language*, created by means of a *method,* and stored in a *repository*.
Language	Language enables the representation of the enterprise in the form of a model. The EAt does not prescribe what language to use in creating a model, and is therefore language agnostic. ArchiMate (Lankhorst et al., 2009) is an example of a modelling language developed for creating EA models.
Method	The method element provides the means to create the model. The EAt is not specific about how to create the model. The EAF, as the entity that realises the EA, also contains methods to create models. TOGAF's ADM (The Open Group, 2011c) is an example of a method used to create architectures and models.
Repository	The model as a representation is closely linked with time. In order to make the storage and recall of the model possible, it needs to be stored. The ability to store and recall the model is achieved by the *repository* element. The EAt is not specific about what the repository should be, but in the information age it would probably be a type of data storage system.
Architect	The human element as the actor that is responsible for creating the EA by making use of EA theory.
Enterprise	This element captures the idea that the enterprise represents a world that exists as a for-the-sake of dasein.
EA Theory	This element captures the formal knowledge directly related to EA, and serves as the reference from which to do EA. The EAF references the EA theory as reference frameworks or meta models (section 2.4).
Time	This element captures the kairological moment of the model as it exists in time. In the chronological sense, the architecture develops sequentially as the to-be is incorporated into the as-is, and the as-is is incorporated into the has-been architecture. In the kairological sense, any decision about which to-be architecture to choose is dependent on the role of the past (has-been) and the present (as-is architecture).

STEP 3 - ESTABLISH RELATIONSHIPS

THE VISION OF EA IS TO SOLVE PROBLEMS THAT RESULT FROM THE COMPLEXITY THAT IS GENERATED BY THE INTRODUCTION OF IT/IS INTO THE ENTERPRISE

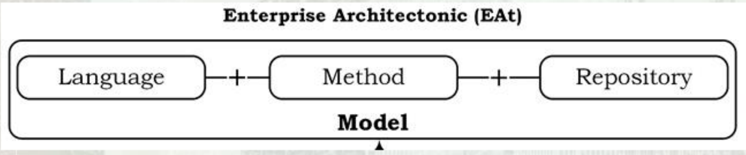


Concept	Description
Vision	The ability to think about or plan the future with imagination and wisdom
Purpose	To provide a solution to the solve or address the problems that results from complexity due to the role of IT/IS in the enterprise
Definition	EA describes the enterprise in such a way that it is a representation of the enterprise

Relationship	Description
Directs	The purpose directs the definition

STEP 3 - ESTABLISH RELATIONSHIPS

A MODEL EMBODIES THE REPRESENTATION OF THE ENTERPRISE

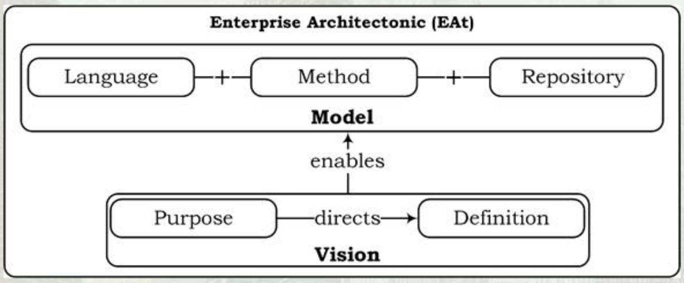


Concept	Description
Model	a combination of language, method and repository
Language	The symbols used to create the representation of the enterprise
Method	The systematic steps to apply the language element to create a symbolic representation of the enterprise
Repository	A storage mechanism for the Model so that it can be recalled for use

Relationship	Description
+	A combination of

STEP 3 - ESTABLISH RELATIONSHIPS

THE VISION ENABLES THE MODEL

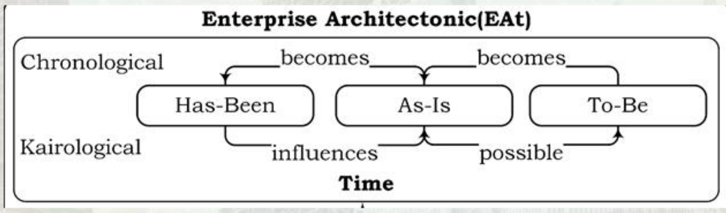


Concept	Description
Model	The embodiment of the enterprise as a combination of language, method and repository
Vision	The ability to think about or plan the future with imagination and wisdom

Relationship	Description
Enables	Makes something possible

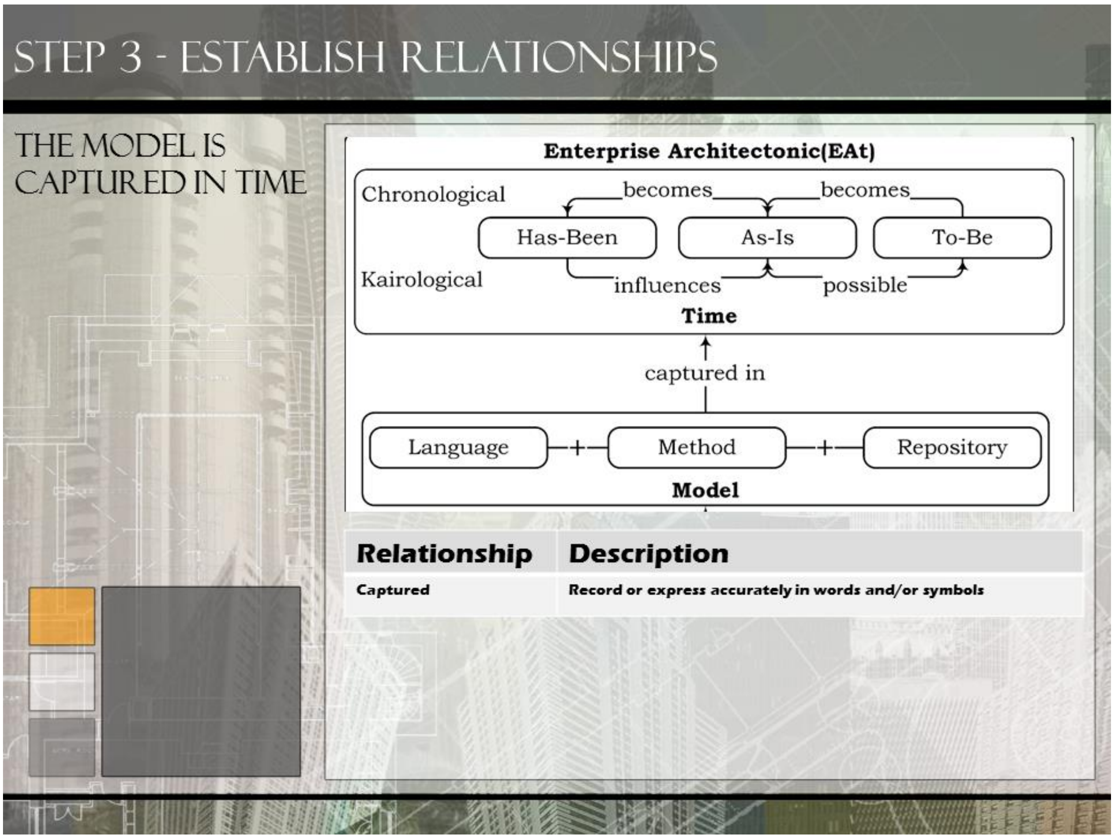
STEP 3 - ESTABLISH RELATIONSHIPS

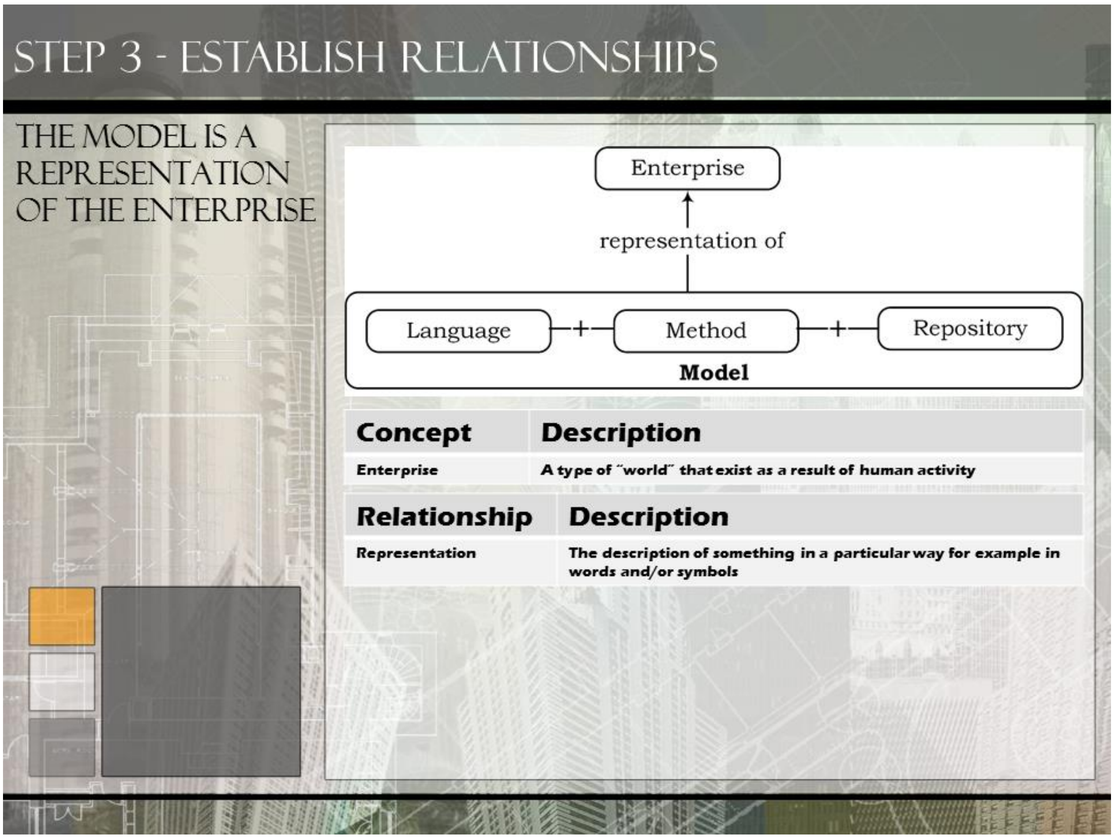
MULTIPLE TYPES OF MODELS EXISTS IN TIME



Concept	Description
Time	The context of a model's existence (a model exist in time)
Has-Been	A specific instance of the Model that relates to the past
As-Is	A specific instance of the Model that relates to the present
To-Be	A specific instance of the Model that relates to the future
Chronological Time	Time understood as a sequential flow from minute to minute
Kairological Time	Time understood as moment

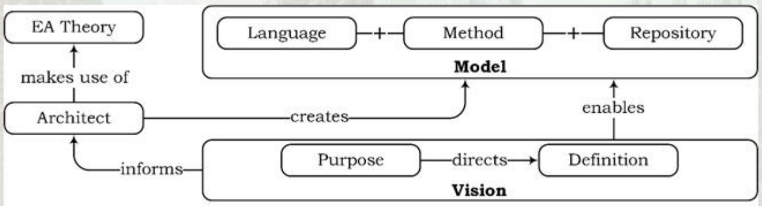
Relationship	Description
Becomes	Something turns into something else for example the To-Be becomes an As-IS which in turn becomes a Has-Been
influences	Something that has an effect on something else for example the Has-Been influences the As-Is
Possible	Something that may be done for example a To-Be can become an As-Is


STEP 3 - ESTABLISH RELATIONSHIPS
THE MODEL IS CAPTURED IN TIME
Enterprise Architectonic(EAt)
Chronological
becomes
becomes
Has-Been
As-Is
To-Be
Kairological
influences
possible
Time
captured in
Language
Method
Repository
Model
Relationship
Description
Captured
Record or express accurately in words and/or symbols


STEP 3 - ESTABLISH RELATIONSHIPS
THE MODEL IS A REPRESENTATION OF THE ENTERPRISE
Enterprise
representation of
Language
Method
Repository
Model
Concept
Description
Enterprise
A type of "world" that exist as a result of human activity
Relationship
Description
Representation
The description of something in a particular way for example in words and/or symbols

STEP 3 - ESTABLISH RELATIONSHIPS

THE ARCHITECT, INFORMED BY THE VISION, CREATES THE MODEL BY USING EA THEORY

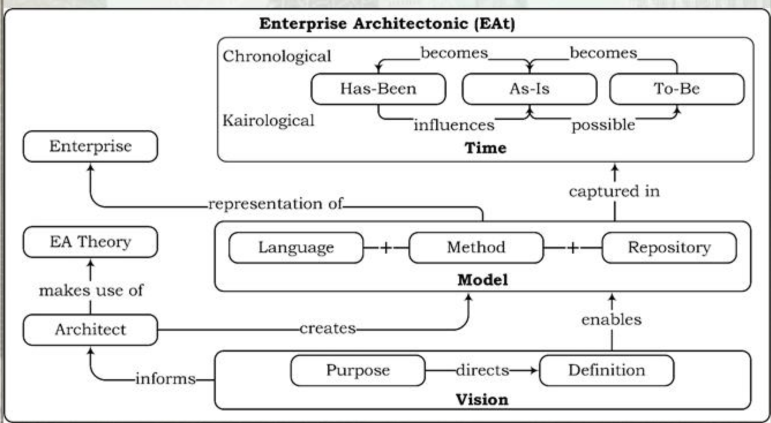


Concept	Description
Architect	**The human agent that is responsible for the "doing" of EA**
EA Theory	**The formal knowledge directly related to EA that serves as the reference for the Architect**

Relationship	Description
Informs	**Give an essential or formative principle something**
Makes use of	**Utilising something to accomplish a purpose**
Creates	**Bringing something into existence**

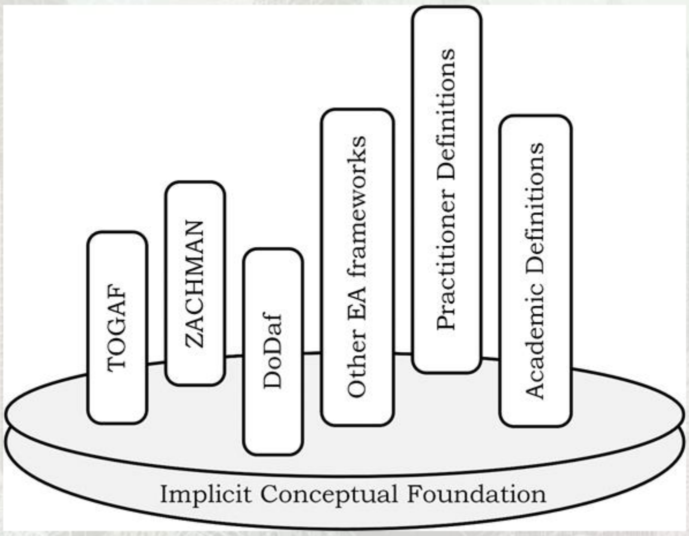
STEP 4 – AN ENTERPRISE ARCHITECTONIC

THE ENTERPRISE ARCHITECTONIC IS A CONCEPTUAL STRUCTURE DESIGNED TO EXPLAIN THE FUNDAMENTAL EA CONCEPTS AND THEIR RELATIONSHIPS



Step 5 – value of enterprise architectonic

THE ARCHITECTONIC IDENTIFIES THE FOUNDATIONAL EA CONCEPTS AND THEIR RELATIONSHIPS



The enterprise architectonic makes the EA foundation (common ground) clear in a unified way. This clarity serves as a starting point to making decision about choosing amongst multiple enterprise architecture frameworks.

Step 5 – value of enterprise architectonic

THE VISION OF EA AS A CONCEPT

The vision of EA is to solve problems that result from the complexity that is generated by the introduction of IT/IS into the enterprise. Keeping in mind that:

- The purpose of EA is to provide a solution to address the problems that results from complexity due to the role of IT/IS in the enterprise
- EA is defined as a description of the enterprise in such a way that it is a representation of the enterprise
- The purpose directs the definition so that it forms the vision of EA

So if the EAF under review does not capture the vision of EA then it likely would not be able to create a successful EA in the long term.

Step 5 – value of enterprise architectonic

THE EA MODEL

The model is a representation of the enterprise by making use of a language, a method and a repository. The model exist in time and is therefore a record of the past, present and future. Keeping in mind that:

- Language is the symbols used to create the representation of the enterprise
- Method is the systematic steps followed to use language to create a symbolic representation of the enterprise
- Repository is a storage mechanism for the Model so that it can be recalled for use

Most EAF's include this understanding of EA but the above meaning has implications for EAF tool support.

So, if the EAF under review does not have strong EA tool support in terms of (at least) modelling language, method and repository, then it would be limited in effectively representing the enterprise.

Step 5 – value of enterprise architectonic

THE ENTERPRISE ARCHITECT

The architect is the human agent responsible for "doing" EA whilst being informed by the vision of EA. This EA "doing" consists mainly of the task to create the model by using EA theory. Keep the following in mind:

- EA theory is the formal knowledge directly related to EA that serves as the reference for the Architect
- Informed means to give an essential or formative principle something
- Creates means to bring something into existence

So, if the EAF under review does not contain or refer to EA theory or clarify the role and tasks of the architect then it would be limited in clarifying the task of the architect.


THE END
THANK YOU FOR YOUR INTEREST

APPENDIX E: PART 3 - POST-TEST OF YOUR UNDERSTANDING OF FUNDAMENTAL ENTERPRISE ARCHITECTURE CONCEPTS

This test's purpose is to determine your understanding or opinion of enterprise architecture after seeing the enterprise architectonic presentation. Answer the questions below and give the completed paper to the presenter.

Based on the presentation that you've just seen answer the following questions please (note that there are no right or wrong answers to these questions, the aim is to get your opinion):

Question 1:

What is your understanding of Enterprise Architecture (definition or description) after viewing the presentation, has your understanding/opinion changed in any way?

Question 2:

What is your understanding of Enterprise Architecture Framework (definition or description) after viewing the presentation, has your understanding/opinion changed in any way?

Question 3:

After viewing the presentation has your list fundamental Enterprise Concepts changed in any way?

Question 4:

After viewing the presentation has your diagram or wording of the relationship between the enterprise fundamental concepts changed in any way?

Question 5:

Would you change the enterprise architectonic in any way (add/delete/change)?

Question 6:

Write down any additional comments about your impression of the enterprise architectonic in the space provided.

APPENDIX F: LANDRY AND BANVILLE'S EXPLORATION OF METHODOLOGICAL PLURALISM IN MIS RESEARCH

Aspect	**Evaluative questions**
Theories-	Are the theoretical foundations of the project adequately expressed? What are the explanatory or predictive virtues of the theory?
Methods-	Is the method clearly elaborated and viable? Does the method relate to orthodox methods? Is the method empirically sound? Is the economical (how is data to be collected? analysed?)? Is the research design feasible? Which scientific aims does it promote?
Aims	What are the explicit or implicit aims of the research project? Are there tensions between the implicit and explicit values? Who are the stakeholders to be considered for this research (managers? practitioners? academics?) What would progress mean relative to these aims (what would be progressive? regressive?)?
Theories constrain methods	What general constraints does the theory put on methods? Is the method adapted to the nature of the theory?
Theories must harmonize with aims and aims must harmonize with theories	Relative to the stated aims, how can progress be defined? Does the theory support the stated aims, and are the stated aims congruent with the theory? Is the theory congruent with aims? Are theory and goals of the same nature?
Methods must exhibit realize-ability of aims	Is the method well adapted to the aim(s)? Can the method assess the viability of the aim(s)? Would another method be more appropriate to the aims?
Methods justify theories	Is the theory "in line" with the method? Can the theory be verified through this method? How do the measures proposed in the method operationalize aspects of the theory(ies)? Is this set of measures exhaustive? Is it sufficient? Can this method be complemented?
Aims justify methods	Is the method needed? Is the method a way of attaining the goals? Is it rational in the sense that it incorporates whatever procedures most likely to facilitate or guarantee the achievement of one's end?