

## CHAPTER 2 - ENTERPRISE ARCHITECTURE



## 2.1 INTRODUCTION

Enterprises usually comprise multiple sub-organisations, divisions and sections working together towards achieving various sub-aims but usually common business goals. EA is used to understand, describe and manage the complexity of the business, its people and its information. The ongoing success of large organisations depends on various factors, including how well the business of the organisation is described, understood and able to manage change (Ballangee, 2010a:46). Business activities of organisations do not only refer to economic, revenue-generating activities but may in general refer to functional activities of organisations such as manufacturing, service or education (Vernadat, 1996:22). As soon as business activities of organisations are perceived as diffused and complex, these organisations are classified as enterprises. Martin (1995:6) states that “organisational knowledge resides in software of ever-growing complexity” and modern enterprises rely on its “knowledge infrastructure”. Complex enterprises need to align business services and IM according to set standards and require design principles to be successful and competitive. In a constantly dynamic and changing business environment enterprises need to be able to manage change fast and effectively. EA as a strategy is increasingly used not only to describe the integration of business and IM in complex enterprises but to support strategic vision, organisational governance and IT requirements (Ballangee, 2010a:46; Dietz & Hoogervorst, 2010:1; Mathee *et al.*, 2007:11; Zachman, 2010a:37).

In a competitive and changing world, enterprises focus on delivering better services and products faster and more cost effectively. Therefore, strategic and business issues are continuously addressed and IM is acknowledged as a basis for effective and efficient business operations. Although implementing EA is a long-term process, it provides enterprises with a detailed description of all their assets and operations to assist them in keeping their competitive business focus when they institute change.

The purpose of this chapter is to report on a literature review of EA in general. The focus of this chapter is, first, to describe EA as a basic strategy for enterprises used to obtain a blueprint of its business, technology and IM operations. Second, this chapter outlines different EA frameworks and distinguishes between differences in the application and use of EA frameworks.

In Section 2.2 the concept of EA, its origin and several definitions of EA are discussed. Section 2.3 is used to describe the current state of research on EA and in Section 2.4 EA’s relation to enterprise engineering (EE) is discussed. In Section 2.5 an overview of three enterprise architecture frameworks relevant to the research is given; namely, The Zachman Enterprise Architecture Framework, The Open Group Architecture Framework (TOGAF) and Generalised Enterprise Reference Architecture Methodology (GERAM). An example is given to illustrate how combinations of EA frameworks complement the processes of describing, engineering or re-engineering of enterprises. EA management in organisations is discussed in Section 2.6 followed by a summary of this chapter.

## 2.2 ENTERPRISE ARCHITECTURE DEFINED

Over the last twenty years, EA has emerged as an approach to describe an enterprise's business processes and the technology needed to support its business processes. A result of EA is that all information concerning an enterprise, its business and IT processes are gathered and described. EA ensures that enterprise information is manageable and secures information for future reference and use (Nadler & Tushman, 1997:68; Ross *et al.*, 2006:5, 192).

EA originated over two decades ago in 1987 when Zachman (1987:276) first described what he called a framework for information systems architecture. Information system technology, although expensive, was beginning to play a more and more important role in the success of large organisations. One of the problems, however, was to deal with understanding, describing and the alignment of information system technology and business requirements in an increasingly complex, changing and competitive environment (Zachman, 1999:454). Zachman (1999:469) stated that information systems architecture was relative and should be seen as a set of architectural representations. This author emphasised that architectures were "additive" and "complementary" and that the choice of architecture would depend on who needs architecture for what purpose in an organisation to determine the value of EA (Zachman, 1999:469).

An enterprise is a system of systems (Section 3.2.3) and generally a system is described as a group or combination of interrelated, interdependent, or interacting elements forming a collective entity (Collins Concise Dictionary, 2004). Senge *et al.* (1994:90) describe a system as a perceived whole whose elements "hang together" because they continually affect each other over time and operate toward a common purpose. Checkland (1999:14) distinguishes four different systems types: natural, physical, abstract designed and human activity. Enterprises are human activity systems comprising many other sub-systems. An IT database system is an example of an abstract-designed sub-system serving a purpose in an information system (IS) of an enterprise system. In information systems thinking, Checkland *et al.* (1998:41) describe the so-called 'hard' systems as functional systems, usually problem-solving- and decisional-support systems that can be 'engineered' to best reach set goals. 'Soft' systems are regarded as interpretive where humans in organisations interact and subjectively extract meaningful and useful information. EA was designed to describe an enterprise holistically in order to understand its complex nature. Management of change processes in such a complex environment could only be dealt with if people involved understood characteristics of systems and integration of all systems of the enterprise. In many instances, EA was and is still conceptualised and misunderstood as relevant only to an enterprise's IS and its IT.

Zachman (2008a; 2011) defines EA as "the total set of descriptive representations, artifacts or models relevant for describing the knowledge infrastructure of an enterprise". This author advocates EA as basis for an engineering process with the purpose of dealing with complexity and change in enterprises because architecture describes how any large, complex entity is constructed and how it works. Zachman (2010a:37) emphasises: "For any complex object, if you can describe it, you can build it".

A description (architecture) or model is needed whenever it becomes necessary to change a complex enterprise in any way – the same as with possible changes to buildings, machines and other complex objects. In a panel discussion by Zachman, Wolff, Ross and Kappelman (Zachman *et al.*, 2011) each presented a

view of what EA is. Wolff sees functionality of an enterprise as the most important aspect of a successful enterprise and all other aspects as supportive or directional entities. For Ross, EA starts with projects to develop organisational capabilities. Kappelman (Zachman *et al.*, 2011) describes EA as:

*really being about communications ... just like when you're building a building, the architecture is how you communicate to all the different specialists and subcontractors and what they're supposed to do. And in creating that architecture, you do the governance of deciding what you need to do. So governance is really about the decision-making, the architecture is about the language of communication, the representation ... Alignment is a goal, so from strategy you decide whether you want alignment or whatever other goals there are ... I see governance as an enterprise-wide set of decision processes and architecture being the language with which that is communicated.*

Ross *et al.* (2006:47) define EA as “the organizing logic for business processes and IT infrastructure reflecting the integration and standardization requirements of the company’s operating model”. Lankhorst *et al.* (2009:3) defines EA as a coherent whole of principles, methods, and models that are used in the design and realisation of an enterprise’s organisational structure, business processes, IS, and infrastructure. Chen *et al.* (2008:648) states that EA should define the components of a system and support reasoning about the structure, properties and behaviour of the system.

Another perspective on EA is the recurring methodology of describing the ‘as-is’ and ‘to-be’ states of an enterprise and all developments, interventions and processes to take you from the one state to the other (Chen *et al.*, 2008:648; Harmon, 2005:3; TOGAF, 2009:7).

In his book on manufacturing enterprise modelling, Vernadat (1996:74) emphasises that complexity management is essential and that it requires knowledge of the current state (‘as-is’) the enterprise is in and where it wants to be (‘to-be’). With enterprises this is an ongoing, dynamic process of modelling what the enterprise is doing, how it is done, when it done and who is responsible for doing it.

TOGAF (2009:29) defines an organisation as a “self-contained unit of resources” and an enterprise as a high-level description of the missions and functions of an organisation and states that an enterprise can “span multiple organisations”. TOGAF (2008; 2009:744) describes EA as a description of an organisation’s properties (including structure) and processes that are essential for its ability to achieve its mission. EA enhances an organisation’s ability to effectively act with its assets and react to challenges. The TOGAF way of referring to ‘enterprise’ and ‘organisation’ is not always consistent (Dietz & Hoogervorst, 2010:1) and it is therefore necessary to explain the difference and the perceived understanding of the terms for the purpose of the research. Collins Concise Dictionary (2004:481) describes an enterprise as “a company or firm, project or undertaking requiring boldness or effort, participation in such projects, readiness to embark on new ventures, initiative in business”. Vernadat (1996) describes an enterprise as “a large collection of concurrent business processes executed by a set of functional entities (or resources) that contribute to business objectives”.

In the context of the research performed, the term *enterprise* is used as the all-inclusive term for all possible divisions and branches of an undertaking, local and global, and may consist of organisations, components of organisations such as offices, divisions, sections, departments or even areas within organisations. The

bonding factor is that all of these components work towards a common goal. According to international standards ISO/IEC 42010, IEEE 1471-2000 (ISO/IEC, 2007:24) and ISO 15704 (2000), an enterprise is one or more organisations working together with a mission, shared goals and objectives to deliver services or products.

The following definition of EA (EARF, 2009) is accepted and used for the purpose of this study:

*Enterprise architecture is the continuous practice of describing the essential elements of a socio-technical organisation, their relationships to each other and to the environment, in order to understand complexity and manage change.*

Siderova *et al.* (2010:71) explain the essential elements and state that all the different views of EA confirm its dynamic complexity “spanning the boundaries between the technical and social, present and future, and logical and physical dimensions of organisations”. Enterprises are dynamic social entities run and maintained by humans. EA is a strategy according to which all “technical and social, present and future, and logical and physical dimensions” are described. The first step for any enterprise would thus be to ensure that people and stakeholders involved in this strategy accept EA to align ideas, activities and processes.

### **2.3 CURRENT STATE OF RESEARCH ON ENTERPRISE ARCHITECTURE**

Although the practice of EA has been ongoing for more than two centuries, there is as yet limited agreement about EA as a concept and discipline (Chen *et al.*, 2008:647; Dankova, 2009:102; Lapalme, 2012; Schöenherr, 2009:400). Possible reasons for the state of affairs listed in the literature are:

- The development of context specific architectures, methodologies and reports being based on results of best practices worldwide without defining important, basic, grounded, underlying and theoretical concepts (DoDAF, 2009; FEA, 1999; GERAM, 1999; TOGAF, 2009:744).
- No mutual agreement on and acceptance of concepts used by different architectures and methodologies (Lapalme, 2012; Zachman, 2008c; Zachman, 2011a).
- Agile and global nature of organisational change in recent years (Martin, 1995; Zachman, 2010d).
- Perceived IT connotation to EA (Kappelman, 2010).
- Practices of continuous balance of business goals of organisations with new technology support in a global context without time to contribute to a global body of knowledge on EA (Ross *et al.*, 2006:47).

In a recent study Simon *et al.* (2013:3) reviewed EA research and literature (608 core documents) to establish the main research trends and topics in EA over the past years. Since 2003 there has been a significant increase in the number of research and practitioner publications on EA-related topics. According to Simon *et al.* (2013:2), EA is still progressing on its way to an understood and valuable methodology for enterprises. Research streams and themes of the past almost ten years are highlighted:

- EA frameworks including foundational EA structures, content, activities and deliverables;
- EA operations, functions, modelling and EA management of such operations, functions and meta-modelling; and
- EA’s conception and contribution to effective management of enterprise business and information goals.

In spite of the abovementioned research, there is still an imposed risk of EA failure. Simon *et al.* (2013:14, 19) propose that more research is needed in areas of concern in the EA field:

- EA planning and factors affecting EA planning;
- integration of EA design and management with other management functions in organisations; and
- a complex model and applications designed for EA management.

Simon *et al.* (2013:19) propose more specific ways of future research and future research in what they call “a very lively research field”:

- EA terminology to ensure better integration of different methodologies and practices;
- participation and cooperation of academics, practitioners, others and relevant groups in EA research projects and conferences;
- standards management to assist in EA governance;
- a comprehensive approach to business architecture governance and management;
- the requirement for research not only to focus on documentation but to include analysis, planning, practices and activities; and
- the over-all governance life-cycle.

According to Zachman (2012a), the information age paradigm is not about building and running systems (an expense-based concept) but about engineering and manufacturing enterprises (an asset-based concept). Enterprise architecture is a different paradigm, a new paradigm, which has to do with engineering enterprises to be ‘lean and mean’, integrated, flexible, interoperable, aligned, dynamically reconfigured, ‘mass-customized’, etc. These are engineering-derived characteristics ... not implementation-derived characteristics. Building and running systems does not produce these characteristics for the enterprise as evidenced by the preponderance of legacies that exist in enterprises today.

In a fast-changing, information-driven world agile adaptation is required to help keep organisations successful and in control of their business goals. One of the important aims of EA is to assist organisations with understanding and managing their business and information relationship in a global and uncertain environment (Mathee *et al.*, 2007:15). The organisational benefits and value of EA are highlighted by Radeke (2011:497) when this author states that the dynamic enterprise of today needs to adapt to new ways of strategy planning and implementation:

- flexible organisational infrastructures;
- effective alignment of strategic planning and decisions with organisational infrastructure; and
- continuous coordination of strategic business plans with IT infrastructure.

Revisiting the continuous ‘as-is’ to ‘to-be’ transformation of organisations, more benefits of EA are:

- understanding of organisational-IM relation;
- assistance with planning, designing, implementation and governance of future strategic goals;
- alignment of business goals and processes with IM and IT procedures;
- organisational and strategic governance;
- obtaining a holistic organisational view of business, IM and IT integration;

- retaining and reusing of information; and
- effective handling of complexity and change.

## **2.4 EA AND ITS RELATION TO ENTERPRISE ENGINEERING**

The following sections discuss enterprise engineering as an unfolding discipline and enterprise ontology as a formal, shared, conceptual structure. According to Hoogervorst (2009:8), enterprise ontology and EA are the pillars of enterprise engineering. EA as ontology should be the basic starting point or plan when enterprises are described, engineered or re-engineered.

### **2.4.1 Enterprise Ontology**

Ontology is a set of entities presupposed by a theory (Collins Concise Dictionary, 2004). According to Gruber (1995:907), ontology is a formal and explicit specification of a shared conceptualisation. Vernadat (1996:25) defines ontology as “a formalization of some knowledge in terms of abstract concepts (entities made of a list of properties) and axioms (predicates on the properties)”.

The Zachman Framework for Enterprise Architecture (Zachman, 2010d) is an ontology or structure according to which an enterprise can be explicitly defined and described. The Zachman Framework for Enterprise Architecture, however, is more than ontology; it is the basis for architecture. Enterprises today are dynamic entities that have to stay updated and abreast with change in business knowledge, business operations and, advancement in IM and IT. Just as architecture describes the total planning, description and construction of buildings, EA describes the total planning, description and construction of an enterprise’s business, operations, information-management and IT.

### **2.4.2 Enterprise Engineering**

“Engineering” is a noun whose meaning describes techniques and applied methods to produce an artefact or working system.

Systems engineering (SE) is a discipline where engineering techniques are applied to create working systems. Checkland (1999) explains that the outcome of the types of systems that are created using SE, are known entities and that it is merely a choice between different processes to establish an end product or ‘hard system’. Thus, when SE is referred to, a more technical process, which goes through building phases to create a product or a system, is presumed. Examples of such systems are aeroplanes, train systems and software systems.

Enterprise engineering (EE) originated as a perceived sub-discipline of SE where an enterprise is ‘the system’ and EE is described as the body of knowledge, principles, disciplines and practices related to enterprise establishment, development, operation, restructuring or maintenance. What necessitated EE and distinguishes EE as different from SE is the continuous human involvement, the context of enterprises and the ever-changing socio-technical environment in which enterprises operate (Checkland, 1999; Dietz, 2010a; Hoogervorst, 2009:428). Systems where human involvement, work roles and decision making continuously

play a role and the outcomes are not fixed entities but changing targets are often referred to as “soft systems”.

Vernadat (1996:30) defines enterprise engineering as “the art of understanding, defining, specifying, analysing, and implementing business processes for the entire enterprise life cycle, so that the enterprise can achieve its objectives, be cost-effective, and be more competitive in its market environment”.

According to Martin (1995:58), “enterprise engineering is an integrated set of disciplines for building or changing an enterprise, its processes, and systems. It integrates the most powerful change methods and makes them succeed. The goal is a human-technology partnership of maximum efficiency in which learning takes place at every level”.

Hoogervorst (2009:265) describes the basics of EE as a ‘developing discipline’. He distinguishes between data systems engineering (form) and information systems engineering (content), and states that in a socio-technical environment such as an enterprise, the third underlying component of EE is “intentional cooperation and collaboration”. Not only is knowledge of theory and methodology necessary to analyse, design and implement an enterprise as a system but enterprise culture and governance play an important role in the successful engineering process of an enterprise.

An example of a framework used in EE is CIMOSA (European Open Systems Architecture for Computer-integrated Manufacturing) architectural framework for enterprise modelling and enterprise integration (Vernadat, 1996:47). This framework is used to describe integration of a typical system’s and product’s life-cycle in the manufacturing industry (requirements, design, implementation, release, operation and maintenance).

Most of the research and literature on EE relies on descriptions of best practices and implementation. Dietz (2010a:71) expresses the need for recognising EE as a discipline, concerned with the design and engineering of the business operations as well as the internal organisation of an enterprise. Engineering methods to establish change or improve business or organisational elements of an enterprise include operations and tools for requirements definition, planning, designing, analysis, implementation and maintenance (Dietz, 2010a; Hagan, 2004; Kosanke *et al.*, 1999:85). In an example described by Vernadat (1996:48), manufacturers use CIMOSA to manage their functional activities (how they do it) as well as their business processes (what they do).

Martin (1995:27) describes vital themes of enterprise reengineering and lists the following:

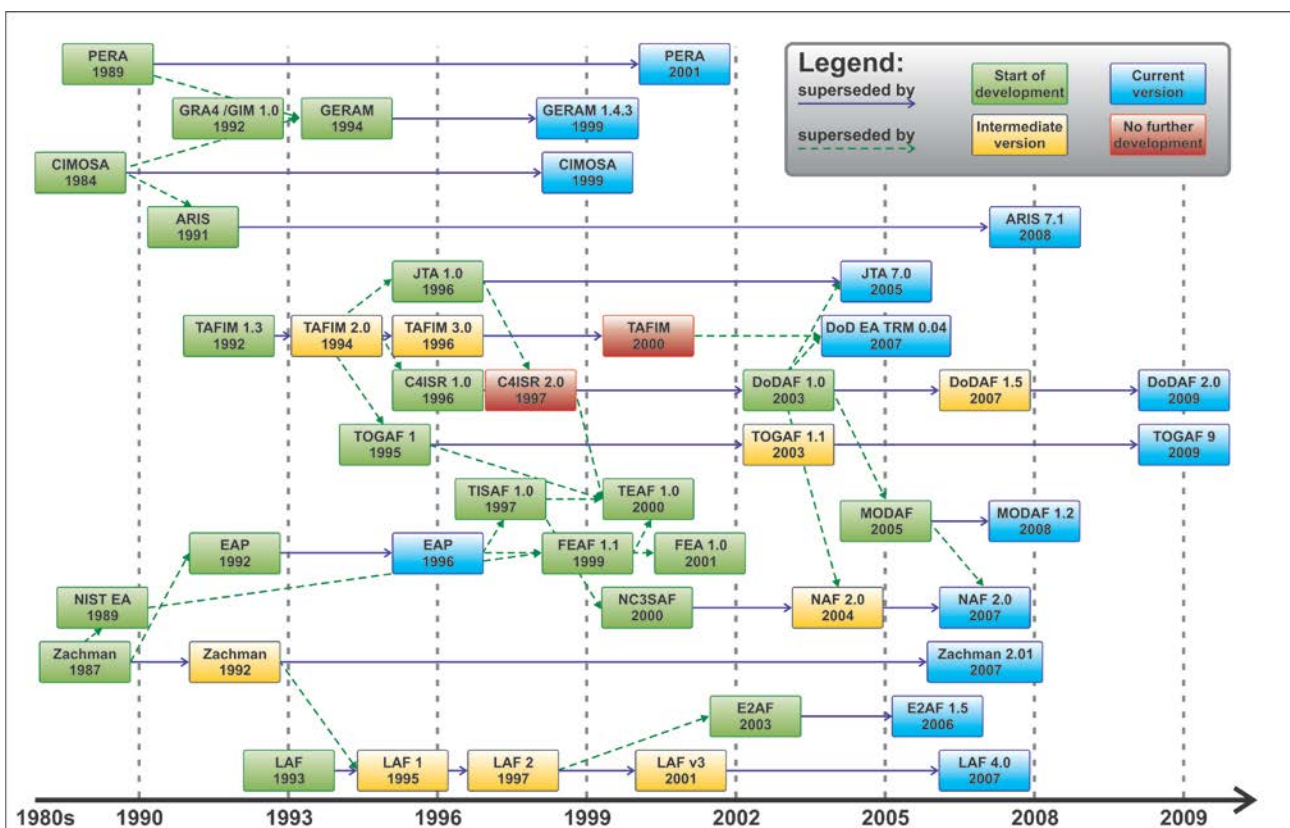
- interconnectedness, complexity and dealing with too much information contributing to uncertainty;
- organisations having to correlate human energy, skills, knowledge, technology, business goals and capital;
- the human elements of cybernetic and global organisations of today being able to learn, communicate, operate and participate in such environments;
- human factors, socio-technical issues and organisational culture driving the success or failure of organisations;
- management of change is not negotiable; and

- all members of the modern enterprise are organisational life-long learners.

According to Martin (1995:29), change methods of EE enable organisations to accommodate humans, their needs and encourage life-long learning.

## 2.5 ENTERPRISE ARCHITECTURE FRAMEWORKS

In this section a definition of EA frameworks is given, the role and purpose of EA frameworks are discussed and three popular EA frameworks are explained in more detail. Enterprise architecture frameworks are generalised organising structures used for managing the information needed for EA (Hagan, 2004). Since the introduction of the EA framework by Zachman in 1987, many EA frameworks had been developed and used worldwide (Figure 2.1).



**Figure 2.1: Evolution of EA frameworks (Matthes, 2009)**

Two of the best known earlier EA frameworks were TAFIM (Technical Architecture Framework for Information Management) and EAP (Enterprise Architecture Planning) (Schekkerman, 2004c:173, 101). According to Schekkerman (2004c), TAFIM together with DoD TRM (Department of Defense Technical Reference Model) influenced the development of C4ISR (Command, Control, Communication, Computers, Intelligence, Surveillance, Reconnaissance) and DoDAF (Department of Defence Architecture Framework) (Schekkerman, 2004c:157). TAFIM was also the forerunner of TOGAF (Schekkerman, 2004c:119). Zachman's framework for information systems architecture (1999:454) inspired the development of EAP,

TEAF (Treasury Enterprise Architecture Framework), FEAF (Federal Enterprise Architecture Framework) and E2AF (Schekkerman, 2004c:89).

Sessions (2007) compares the four best known EA methodologies namely The Zachman Framework for Enterprise Architecture, TOGAF, FEA (Federal Enterprise Architecture) and Gartner. Sessions (2007) describes The Zachman Framework for Enterprise Architecture as taxonomy, TOGAF as a process, FEA (1999) as a complete methodology and Gartner (Lapkin, 2005:1) as a practice. Burton and Allega (2010) identifies four basic EA approaches and predicts that 95 percent of organisations will in the near future use a combination of traditional, federated, managed-diversity and middle-out EA approaches. Traditional approaches suit organisations where it is possible to centralise decision-making and where business directives control the way in which projects are run. Federated EA approaches are suitable for decentralised organisations where core business elements are defined centrally to ensure coordination but where business units have control over EA initiatives. In a managed-diversity EA approach, project owners have the option to choose the best-fit standards for various solutions to promote business growth and innovation. The middle-out EA approach focuses on providing standards and promoting interoperability between those business units and organisational elements mostly affected by agility and change (Burton & Allega, 2010).

Minoli (2008:55) shows that in a survey completed in 2008, the following EA frameworks were the most commonly used: The Zachman Framework for Enterprise Architecture (25%); Organisation's own (22%); TOGAF (11%), DoDAF (United States Department of Defense) (11%); E2AF (9%); IAF (3%); TAFIM (2%); FEAF (9%); Other (9%).

The Zachman Framework for Enterprise Architecture, TOGAF and the Generalized Enterprise Reference Architecture and Methodology (GERAM) are three of the popular EA frameworks used worldwide and also in the South African EA context (Matthee *et al.*, 2007:19; Saha, 2004:24; Schekkerman, 2004b; Simon *et al.*, 2013:12). The Zachman Framework for Enterprise Architecture is described as ontology and is used in my research to assist as a guideline in establishing work roles related to my research. Human factors described in The Zachman Framework for Enterprise Architecture are investigated. TOGAF presents a process for EA and is used as a reference framework to investigate how human factors are addressed in one specific and widely used EA framework. GERAM is an EA methodology that provides basic requirements for EA and enterprise engineering (EE) (Mo, 2007:351). GERAM is an overall definition of a generalised architecture that originated from CIMOSA, GRAI/GIM and PERA. GERAM can be used to organise and integrate enterprise knowledge (Kim *et al.*, 2007:66; Matthes, 2009; Mo, 2007:352; Saha, 2007:2; Schekkerman, 2004c). GERAM is used in my research in the context of a general reference architecture to investigate its stance towards human factors relevant to EA. These three frameworks are therefore discussed in detail in the following sections.

### **2.5.1 The Zachman Framework for Enterprise Architecture**

The first original Zachman Framework was defined by Zachman in 1984 and was known as Information Systems Architecture – A Framework (Zachman, 2011). Zachman (1987:291) explained that an architecture exists for everyone involved in information systems depending on what they are doing. Information system architecture was a set of complementary but different architectures.

In a description of his first framework, Zachman (1987:276) predicted that rapid business and technology development and the information exchange explosion would require some formal structuring (architecture) of technology, IS and business processes of enterprises to prevent organisations from becoming disintegrated, chaotic entities in the future.

The Zachman Framework for Enterprise Architecture is both a taxonomy and classification structure. It is an ontological description or set of entities based on a grounded theory (Zachman, 2011a). Zachman (2009) describes his framework as a designed logical structure or normalised schema that represents a set of descriptive entities (models) to help engineer an enterprise. The Zachman Framework for Enterprise Architecture as ontology is implementation independent and a way of globally describing an enterprise in its totality. Zachman (2010d) claims that a process based on ontology will be predictable and repeatable.

Domains of knowledge that need to be modelled and managed by enterprises are listed by Zachman (2006) as:

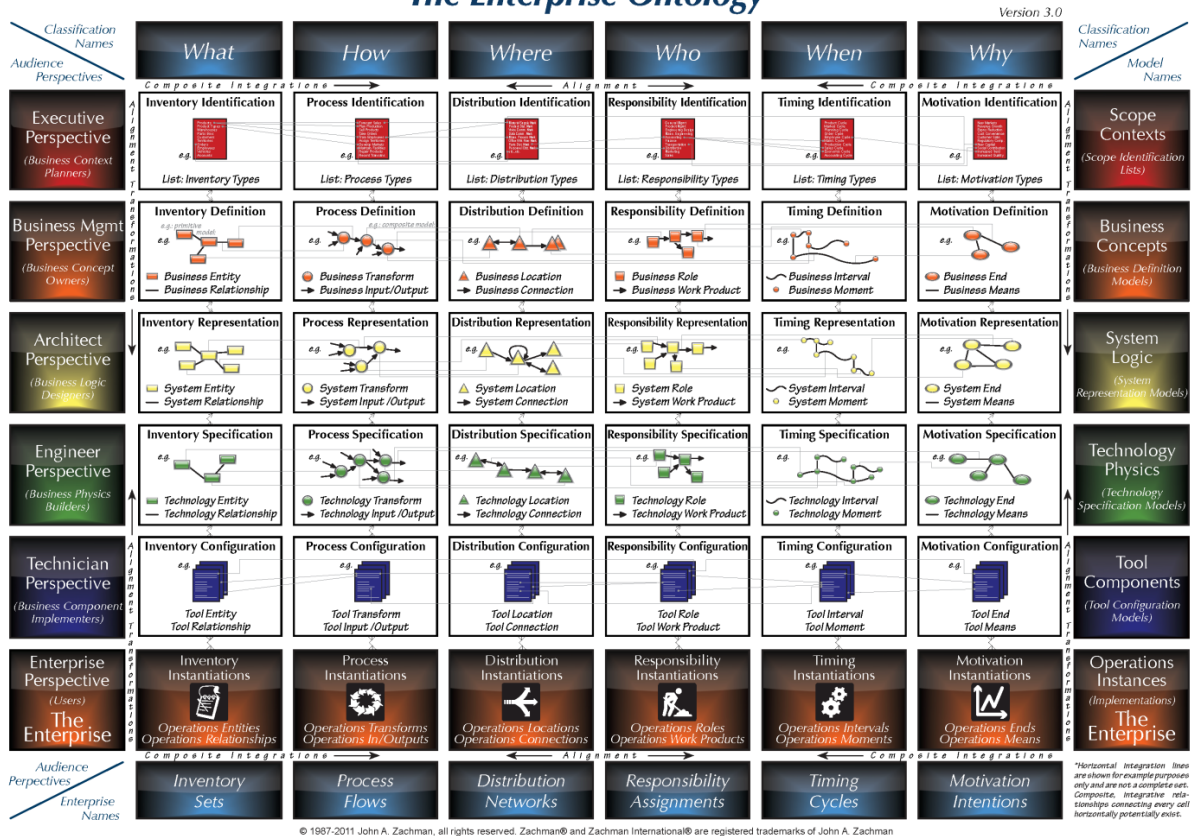
- knowledge of the 'product' of the enterprise – description of the purpose and deliverables of an enterprise;
- knowledge of the enterprise itself – its description data; and
- knowledge about the enterprise engineering and manufacturing systems of the enterprise – underlying rationale and concepts for technical data.

Zachman (2006) explains the dimensions of his classification schema through architecture perspectives (rows) and abstractions/classification names (columns) and states that they are fixed lists and should not be viewed as hierarchies. The set of representations that figures in a two-dimensional schema (Figure 2.2) are the abstractions in the form of six questions (what, how, where, when, who and why) to establish focus and units of measurement, depicting the independent variables used to comprehensively describe a complex subject or object. The six perspectives represent the organisational audience perspectives in order to fulfil the business of the enterprise. The meaning of the rows is that the whole process of engineering and manufacturing of complex products should be relevant to various architecture perspectives or audiences.

The Zachman Framework for Enterprise Architecture is a classification schema and does not provide prescribed methods and processes. According to Zachman (2010d), his framework provides an enterprise with a detailed description or architectural plan necessary to understand its own composition and complexity. Enterprises are dynamic and changing entities. Just as architectural drawings are used to change buildings, The Zachman Framework for Enterprise Architecture can be used to provide an enterprise with basic architectural descriptions to understand its processes and functions in order that complexity and facilitating change can be managed (Figure 2.2).

# The Zachman Framework for Enterprise Architecture™

## The Enterprise Ontology™



**Figure 2.2: The Zachman Framework for Enterprise Architecture (Zachman, 2011a)**

The abstractions represent:

- what – inventory sets (description of entities and relationships);
- how – process transformations or flows (description of operational transformation and in- and outputs);
- where – distribution networks (locations and connections);
- who – responsibility assignments or organisation groups (work roles and work products);
- when – timing cycles (intervals and moments); and
- why – motivational intentions (ends and means).

The architecture audience perspectives linked to various work level actions are:

- executives or strategists – business scope and context planners;
- business management leaders – business concept owners and managers;
- architects – business logic designers/facilitators;
- engineers – business technology (physics) builders;
- technicians – business component implementers; and
- users.

According to Zachman (2006), each cell of the framework has a primitive meaning; i.e. it is a model of a single abstraction (variable) viewed from a single perspective (set of constraints). EA is the total set of descriptive models or representations relevant for describing the enterprise.

The various outcomes (models and lists) of The Zachman Framework for Enterprise Architecture representing perspectives of the different abstractions are summarised in Table 2.1. Perspective views that are represented are:

- The *executive* perspective where a bigger picture of an enterprise is needed in the form of information about enterprise resources and their scope, scope of normative business processes, the enterprise business domain, scope and boundaries of involved organisations, events significant to the business of the enterprise and goals, and objectives and strategies important to the enterprise in its context of business.
- The business *management* perspective that involves models representing all activities of the executive perspective in more detail for business-management and decision-support purposes.
- The *architect* level, where models and schematic representations of enterprise resources, systems, processes and relationships between all entities are needed for a perspective of how the business and IM of the enterprise interrelate and rules, work roles, work role deliverables and processing events and cycles describe enterprise operations and their relation to IT support.
- The *engineer* perspective that provides blueprints of all business, IM and IT relation and integration.
- The *technician* perspectives that include instruction lists of how business entities relate, business functions' instruction configurations and configurations of all technical components needed for business and IM operations.
- Finally, a *user's* perspective comprising instances and instantiations of business processes and operations and a *user and worker* experience of the enterprise business goals and work environment.

Outcomes of the abstractions represented in The Zachman Framework for Enterprise Architecture (Zachman, 2011a) are:

- Inventory sets in EA describe the enterprise's business view (*what* abstraction) to different stakeholders, providing a different perspective at each level – entity and data models are examples of descriptive entities for the '*what*' of an enterprise.
- Process flows in the form of transformation models provide the '*how*' or functional view of process descriptions in EA to perspective audiences in an enterprise.
- The distribution of networks (*where*) provides perspective audiences (rows) with geographical and distributions models of where all processes and functions in organisations occur.
- Responsibility assignments of people (*who*) and work role deliverables in the form of work flow models or presentation architecture are examples of representations for different perspective views in organisations (rows).
- Timing cycles in the form of control structures, cyclical and dynamic models represent the '*when*' of functions and procedures in organisations.
- According to Zachman (2010d), there are few examples of models available for describing the motivational intentions of enterprises (*why*) with referral to the different audience perspectives.

**Table 2.1: The Zachman Framework for Enterprise Architecture Outcomes**

Architecture Perspectives	ABSTRACTIONS					
	THE 'WHAT' OUTCOMES	THE 'HOW' OUTCOMES	THE 'WHERE' OUTCOMES	THE 'WHO' OUTCOMES	THE 'WHEN' OUTCOMES	THE 'WHY' OUTCOMES
Executive perspective	Enterprise resources boundary list  List of enterprise resources and their scope in context	Enterprise functions boundary list  List is a normative scope of business processes and functions in context providing an inclusive and exclusive viewpoint	Enterprise networks boundary list  Enterprise domain is described from an inclusive and exclusive viewpoint	Enterprise organisations boundary list  List of organisations, boundaries and their scope in context  Enterprise domain is identified from an inclusion or exclusion viewpoint	Enterprise timings boundary list  List of events significant to the business of the enterprise determining the timing scope of events	Enterprise motivations boundary list  List of business goals, business objectives and strategies determining organisational scope in context
Business management perspective	Enterprise resources semantic model  Semantic model describing the enterprise resources and providing the business perspective of the enterprise	Enterprise functions semantic model  Semantic model describing enterprise business processes, outcomes and relationships	Enterprise networks semantic model  Semantic model describing the enterprise business connections and business locations	Enterprise organisations semantic model  Semantic model describing the organisational business work roles for example in a workflow model	Enterprise timings semantic model  Semantic model or master schedule describing the organisational business events' cycles	Enterprise motivations semantic model  Semantic model describing the organisational business plan to reach goals and objectives
Architect perspective	Enterprise resources schematic model  Model is a schematic representation of enterprise resources and relationships	Enterprise functions schematic model  Model is a set of functions and schematic representation how the outcomes of one system process relates of another system process	Enterprise networks schematic model  Model is a set of networks of systems locations and systems connections	Enterprise organisations schematic model  Model is a schematic representation of enterprise work roles and work role deliverables to establish a system perspective	Enterprise timings schematic model  Model is a schematic representation of enterprise systems events, systems timings and processing cycles	Enterprise motivations schematic model  Model is a schematic representation of enterprise business rules with structural and action assertion included

<p style="text-align: center;"><b>Engineer perspective</b></p>	<p>Enterprise resources blueprint model</p> <p>Model is the blueprint and technology specification of enterprise resources</p>	<p>Enterprise functions blueprint model</p> <p>Model relates one technical process outcome to another technical process</p>	<p>Enterprise networks blueprint model</p> <p>Model is the technology architecture of hardware and software components</p>	<p>Enterprise organisations blueprint model</p> <p>Model is the blueprint specification of enterprise organisations resources</p>	<p>Enterprise timings blueprint model</p> <p>Model is the blueprint specification of enterprise technology timing specifications such as control structures and execution cycles</p>	<p>Enterprise motivations blueprint model</p> <p>Model is the blueprint of technology design motivations and means</p>
<p style="text-align: center;"><b>Technician perspective</b></p>	<p>Enterprise resources instruction listing</p> <p>Lists of instructions linking one entity to another via a component relationship</p>	<p>Enterprise functions instruction listing</p> <p>Instruction configuration of enterprise functions</p>	<p>Enterprise networks instruction listing</p> <p>Configuration of network locations</p>	<p>Enterprise organisations instruction listing</p> <p>Contiguous organisational listing (entry in a list) relating one component role through a component work to another peer component role</p> <p>Instruction configuration of a set of organisations</p>	<p>Enterprise timings instruction listing</p> <p>Timing definitions describing component and physical machine timing configurations</p> <p>Outsourcing can influence timings configurations</p>	<p>Enterprise motivations instruction listing</p> <p>Component motivations and rule specifications through technical means</p>
<p style="text-align: center;"><b>Enterprise perspective (Users)</b></p>	<p>Enterprise resources existence instance</p> <p>Instances of contiguous enterprise resource components in existence and operational</p>	<p>Enterprise functions existence instance</p> <p>Instances of how operations processes are linked in existence</p>	<p>Enterprise networks existence instance</p> <p>Instantiation of enterprise networks to provide an operations perspective for workers and users</p>	<p>Enterprise organisations existence instance</p> <p>Instances of enterprise organisations relating organisational operations to work as realised by workers and users</p>	<p>Enterprise timings existence instance</p> <p>Instances of timing moments and cycles of enterprise operations as realised by workers and users</p>	<p>Enterprise motivations existence instance</p> <p>Instances of operational motivations and means as realised by workers and users</p>

The perspective audience descriptions of The Zachman Framework for Enterprise Architecture (Zachman, 2011a) as well as the abstractions of *Who* (organisational boundary lists and organisational models) and *Why* (organisational motivations) are important basic points of departure for the purpose of my research, which will be explained in more detail in Chapter 5.

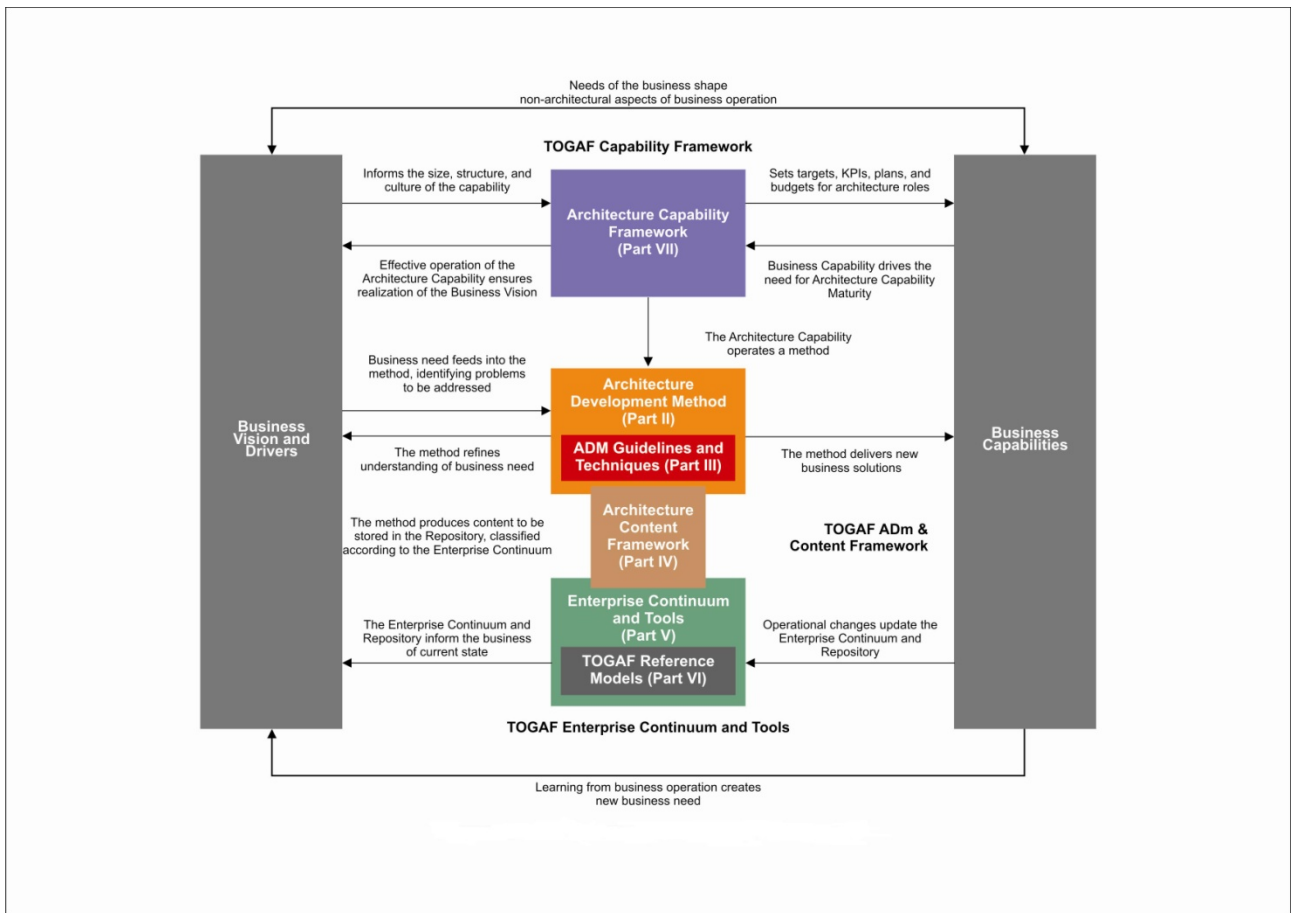
## 2.5.2 The Open Group Architecture Framework

The Open Group Architecture Framework (TOGAF) is a framework supported by the The Open Group. TOGAF provides enterprises with a process methodology of constructing architecture documentation that can be used to describe the structure and content of an architecture capability within an enterprise (TOGAF, 2009:3).

TOGAF is a structured document consisting of seven main parts (TOGAF, 2009:4):

- an introduction specifying TOGAF's terminology and key concepts;
- the Architecture Development Method (ADM) describing TOGAF's approach to architecture development for enterprises;
- ADM guidelines and techniques;
- the TOGAF architecture content framework;
- the enterprise continuum and tools;
- TOGAF reference models; and
- architecture capability framework.

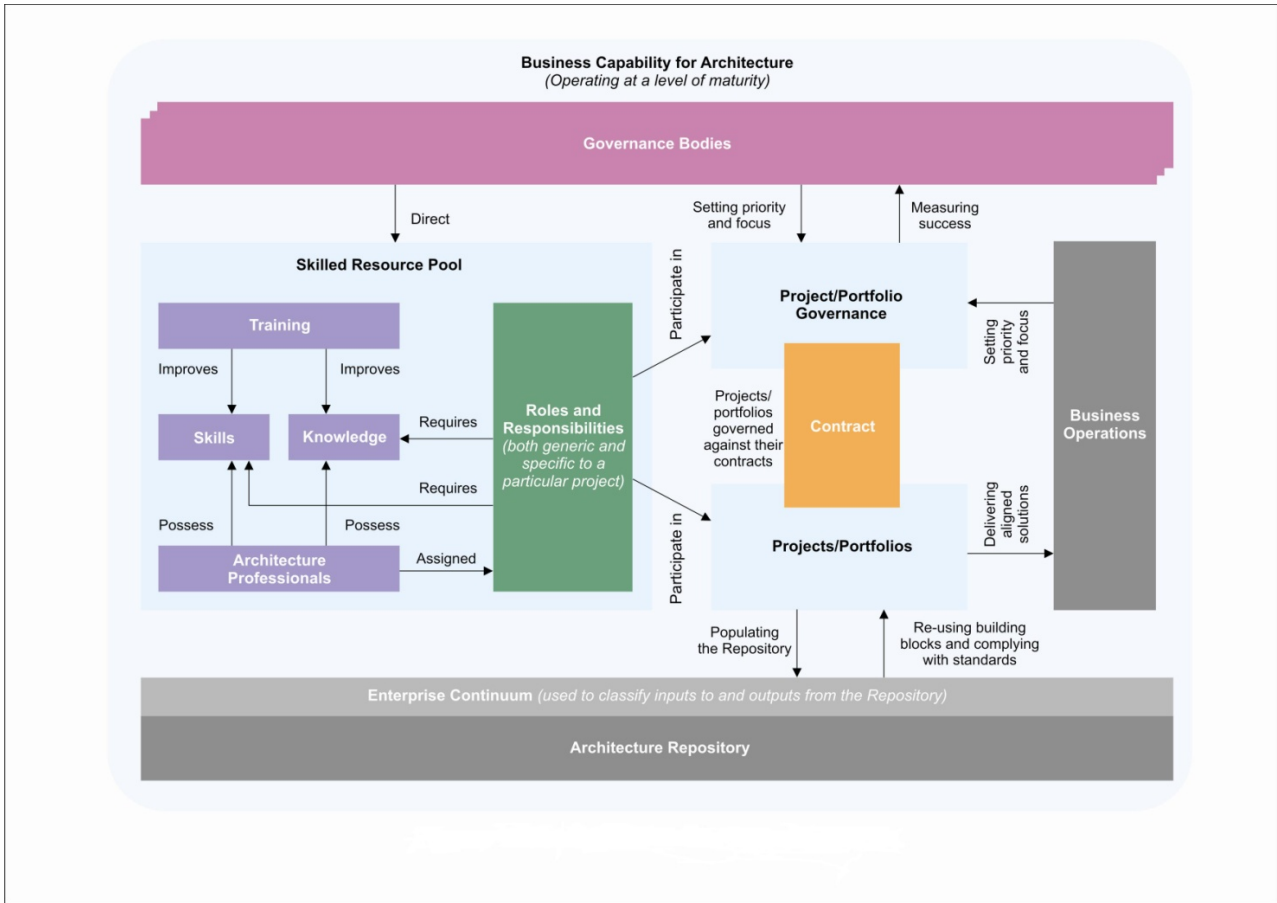
The TOGAF process consists of five basic distinguishable sections: the architecture capability framework; the architecture development method; the architecture content framework; the enterprise continuum and the TOGAF reference models (Figure 2.3). The business vision and business needs of an enterprise are drivers for and direct the non-architectural and architectural functions. From an architectural viewpoint, business vision, needs and drivers set the size, structure and culture of architecture capability frameworks into action. Architecture capability frameworks set targets, plans, KPIs and budgets for architecture roles that will be needed for architecture development. Business needs and problems are input to the ADM where business needs are addressed and solutions developed. Content are stored in a repository according to the continuum classification directives (TOGAF, 2009:4).



**Figure 2.3: Structure of the TOGAF document (TOGAF, 2009:4)**

Business vision, goals, requirements and drivers initiate the need for identifications and descriptions of architectures through TOGAF's *architecture capability framework* (Figure 2.4). The architecture capability framework is supported by the ADM and the establishment of architecture capabilities is an ongoing architecture delivery practice within an organisation. The priorities and focus of contracts are set by governance bodies, people and their work roles are identified, repositories are populated or building blocks are reused, and aligned business solutions are delivered (TOGAF, 2009:631).

Skills and knowledge of stakeholders are continuously developed through training. Enterprise architects and other related experts are responsible for assigning generic and project specific roles and responsibilities to people to ensure that business-, data-, application- and technology architectures are established and/or updated. The ADM phases act as guidelines to establish architecture practices. For example, the focus for a business architecture practice should include an architecture ontology, the architecture process, architecture viewpoints and views, the architecture- framework, accountability matrix, performance metrics and the architecture governance framework (TOGAF, 2009:633).

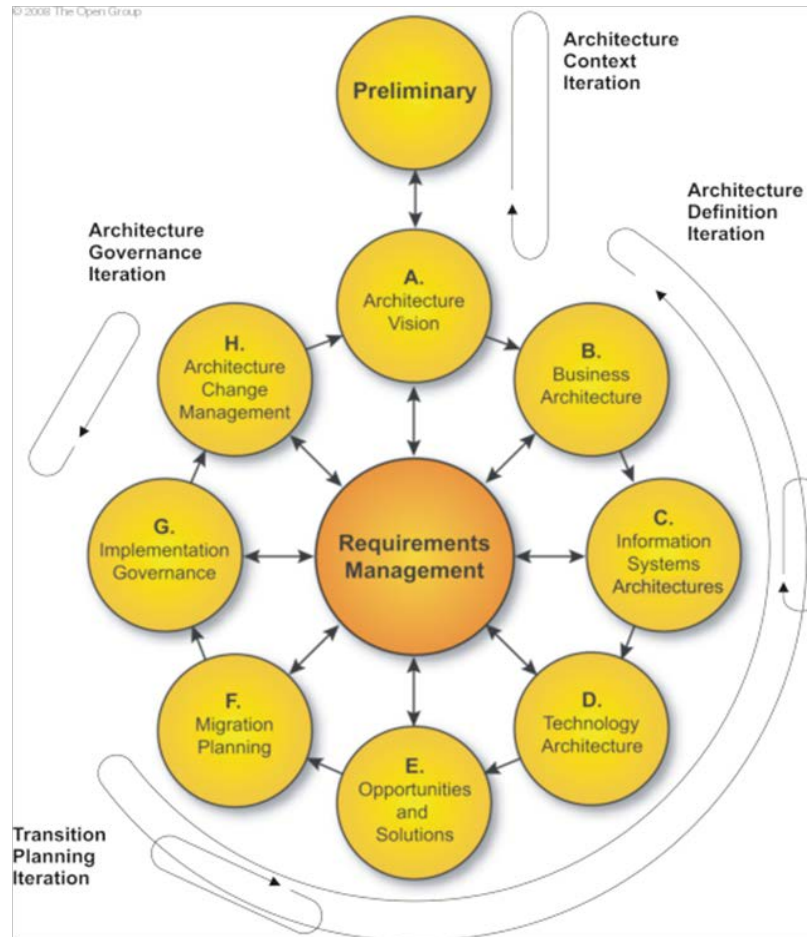


**Figure 2.4: TOGAF’s Architecture Capability Framework (TOGAF, 2009:630)**

Business requirements, business capabilities, plans and roles are identified after which the TOGAF *Architecture Development Method* (ADM) is set into operation (figures 2.3 and 2.5). The ADM provides a method for the development of enterprise architecture and forms the core of TOGAF (2009:51). The ADM consists of a preliminary phase to prepare for and initiate enterprise architecture. After an enterprise architecture vision for an organisation has been set, seven phases of architecture development and actions are proposed in an architecture development cycle. Requirements management happens through implementation of interacting phases and iterations (Figure 2.5). The ADM is used to provide organisations with detailed, recurring processes, techniques and tools for architecture practice (TOGAF, 2009:54).

The ADM is a description of a method assisting an organisation in the development of enterprise architecture. TOGAF’s enterprise architecture practice consists of four major categories: business architecture (Phase B); information systems architecture (consisting of data architecture and application architecture); (Phase C), and technology architecture (Phase D) (TOGAF, 2009:55).

Business architecture describes the ‘as-is’ of an organisation’s business, the ‘to-be’ business goals and what is needed to bridge the gap. Business architecture deals with organisational structure, governance, information requirements, processes and products. Information systems architecture consists of data architecture and application architecture, to be explained in the paragraphs that follow.



**Figure 2.5: The TOGAF ADM – (TOGAF, 2009:216)**

Data architecture is a description of data types and data sources and it defines the enterprise continuum (consisting of the architecture continuum and solutions continuum) and repository. The enterprise continuum provides a view of the repository where organisation-specific information about architectures and solution artefacts can be found. The purpose of an enterprise continuum is to assist organisations with understanding and communicating of how and where all the elements and assets of the architectural venture feature. The repository records all information of an organisation in the context of its resources, procedures and processes. This information is useful for understanding and change purposes as it provides re-usable architectures and solutions (TOGAF, 2009:51).

Application architecture addresses functionality and application services. Application systems responsible for business data processing, interaction between the individual systems and their relationships to and support of organisational business processes and humans, are described (TOGAF, 2009:127).

“Technology architecture” denotes the technical infrastructure of hardware components and software applications supporting the architecture applications and the enterprise continuum (TOGAF, 2009:631).

Architecture principles with the purpose of guiding organisational change and quality of architecture work are applied at three levels, depending on an individual organisation: enterprise level, IT level and

architectural level. Every architectural phase of the ADM is described in terms of input, steps, output and relationships between products, processes and applications (TOGAF, 2009:265).

Levels of governance necessary and described in TOGAF are corporate, IT, technology and architecture (TOGAF, 2009:673). Success factors for architecture governance are listed here:

- use of best practices for every aspect of architecture from adoption to re-use and reporting, from policies to skills, roles, processes, procedures and organisational structures;
- organisational buy-in, responsibilities and structures supporting architectures;
- integration of tools and processes;
- control measures for architecture governance processes and all stakeholder-involved activities such as service level agreements; and
- requirements for internal and external efficiency, effectiveness, confidentiality, availability, reliability and compliance of all governance-related information, services and processes.

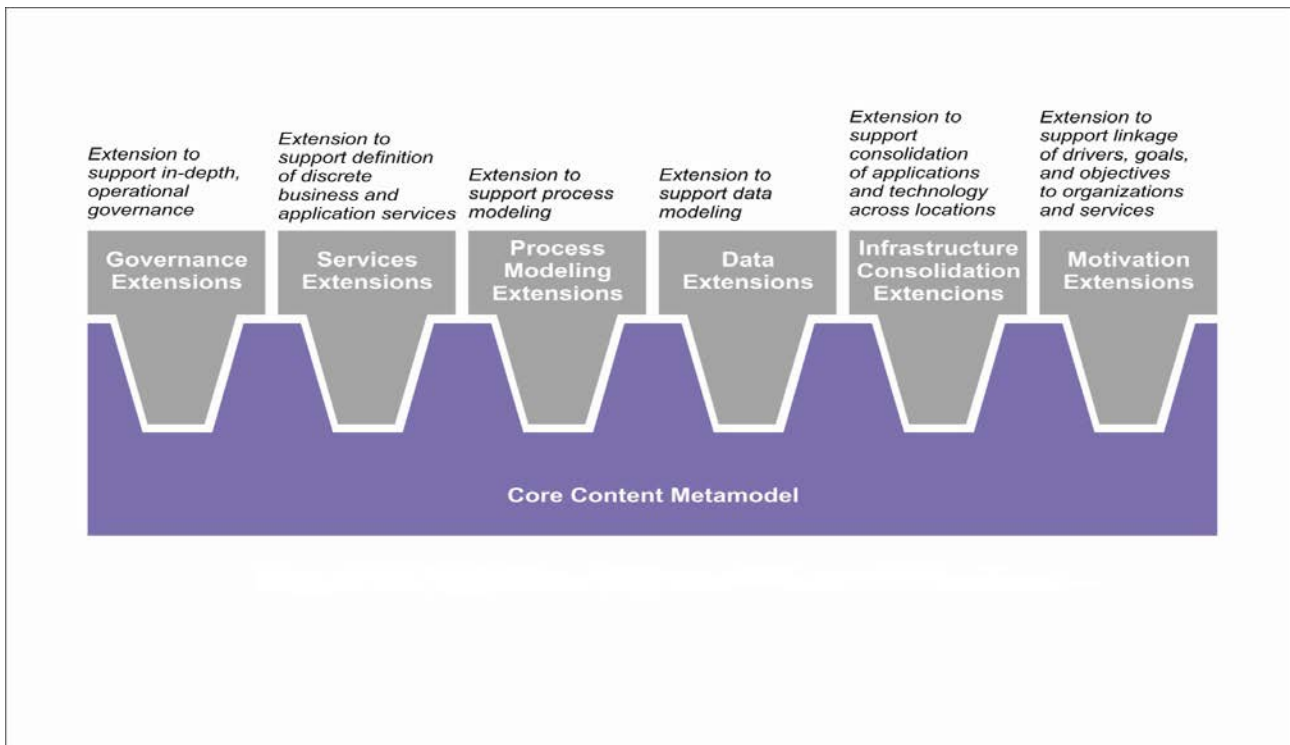
TOGAF (2009:361) describes an architecture content framework that can be a stand-alone framework or be used in combination with other frameworks such as The Zachman Framework for Enterprise Architecture to guide and assist organisations with architecting when using the Architecture Development Model (ADM) and architecture tools. The *architecture content framework* provides output for a repository of information in three categories:

- information deliverables of projects;
- artefacts in the form of catalogues or lists, matrices and diagrams; and
- building blocks representing detail of possible reusable business, IT or architectural components.

*Deliverables* are typical results of projects or work that has been agreed upon by different stakeholders. After completion of a project or work agreement, outputs in the form of reference models, standards or copies of the revised architecture will be moved to an architecture repository.

*Artefacts* are physical descriptions of architecture work and representations of work from specific viewpoints. A description of a business plan and its IT support and interaction, is an example of an artefact.

*Buildings blocks* are potential reusable, descriptions of functional work processes and products used to address requirements and meet business needs. They are defined as successful working practices and will be different from organisational entity to organisational entity or from architecture to architecture. The content metamodel (Figure 2.6) shows the basic architecture core model and then provides a spectrum of the typical architecture building blocks that arise from a core content model. Extension models are optional and depend on organisational needs and requirements for architecture. Core metamodel entities are described for example, an actor, an actor's work role, a technology component and a business service (a defined interface for a specific organisation). Relationships between entities are also described. One example of a relationship description is when the extent of a term such as "function" is described in all business capabilities at all levels such as value chain, capability, processes, etc. (TOGAF, 2009:369).

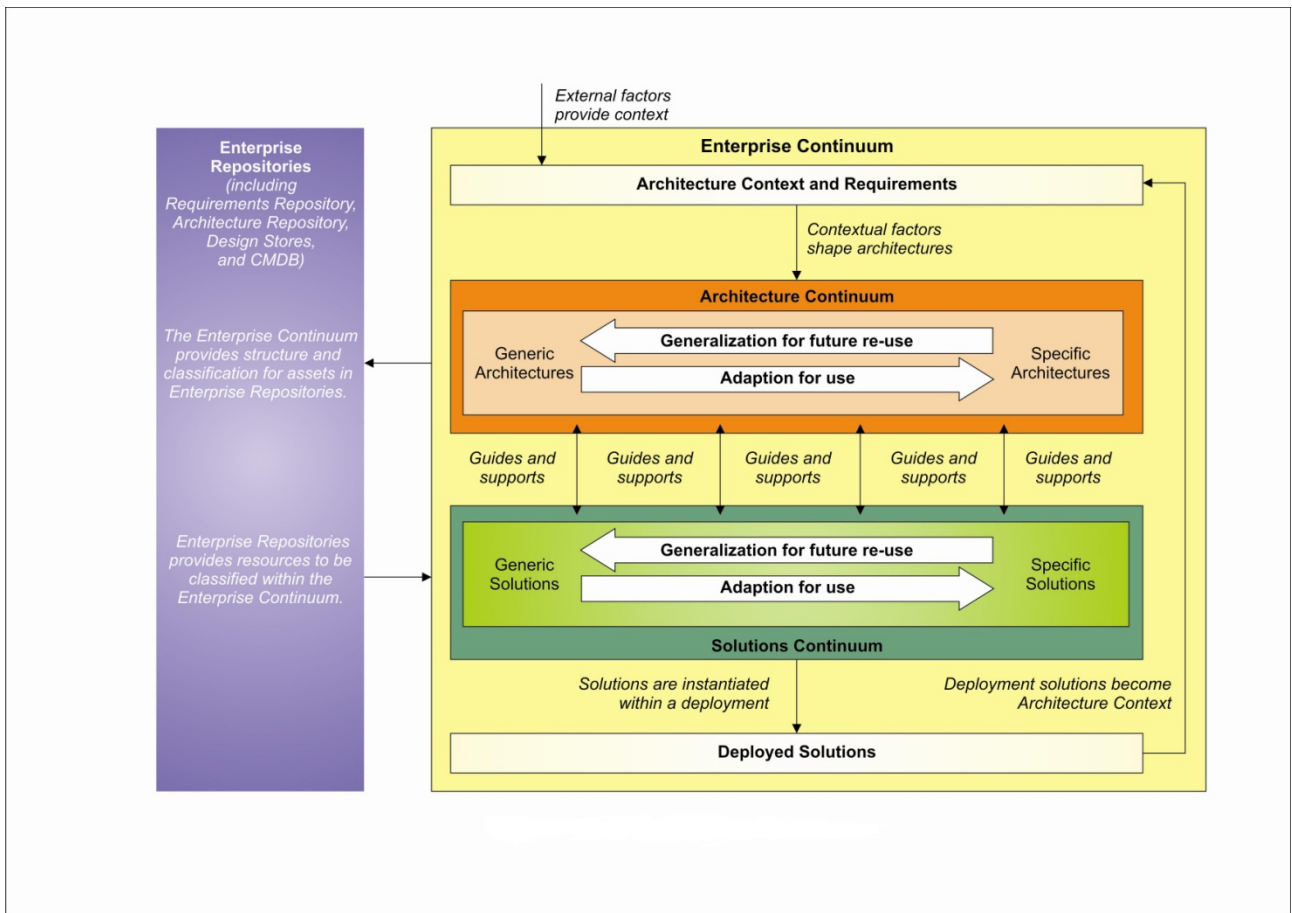


**Figure 2.6: TOGAF Content Metamodel and Predefined Extension Modules** (TOGAF, 2009:380)

The TOGAF enterprise continuum (Figure 2.7) is a model for constructing different architectural repositories for different organisational purposes. External factors and organisational requirements usually set the context for the need of an architecture asset- and solutions repository. The enterprise continuum is classification- and representation architecture of all the internal as well as external assets important for an enterprise's operations and well-being. Examples of external assets are new technology and competitive strategies of other organisations and examples of internal assets are new business strategy and organisational transformation. The enterprise continuum spans the architecture- and solutions continuums and provides structure and classification for organisational assets. The architecture- and solutions continuums comprise architectures for foundation, common systems, and industry as well as organisation specific architectures (TOGAF, 2009:535).

TOGAF provides tools and techniques to establish an architecture asset repository and an architecture solutions repository. The ADM describes how to develop specific architectures and solutions from generic architectures. Specific architectures and solutions can be generalised into generic architectures and solutions for reuse in future.

The advantages of the continuums include re-use of architectural assets for example methods, processes and solutions; communication and ambiguity avoidance; information sharing; universal use and understanding of 'business' language; understanding solutions and less disagreement between stakeholders and users (TOGAF, 2009:531).



**Figure 2.7: TOGAF Enterprise Continuum** (TOGAF, 2009:532)

TOGAF provides foundation architecture for technical platform support in the form of its technical reference model and an integrated information infrastructure reference model for information system and application support (TOGAF, 2009:575, 607).

TOGAF stresses the importance of stakeholder identification, stakeholder involvement, stakeholder viewpoints, stakeholder concerns, communication efficiency and stakeholder management. TOGAF (2009:637) proposes the establishment of an architectural board representative of all key stakeholders to oversee all architectural activities.

Architecture skills frameworks are defined in TOGAF for roles, skills and abilities required by architecture teams and stakeholders (TOGAF, 2009:695):

- **Generic skills.** Expert leadership and inter-personal skills are needed by executive board members and architecture sponsors. The enterprise architecture manager as well as the programme/project manager needs expert skills not only in leadership but also in teamwork, interpersonal communication, logical analysis, stakeholder management and risk management. Enterprise architecture team members representing technology, data, applications and business enterprise sections need teamwork, interpersonal communication and logical analysis skills (TOGAF, 2009:696).
- **Business skills.** Architecture board members and the architecture sponsor need to know about the business's culture and legacy investments. The architecture sponsor is also involved in the business case

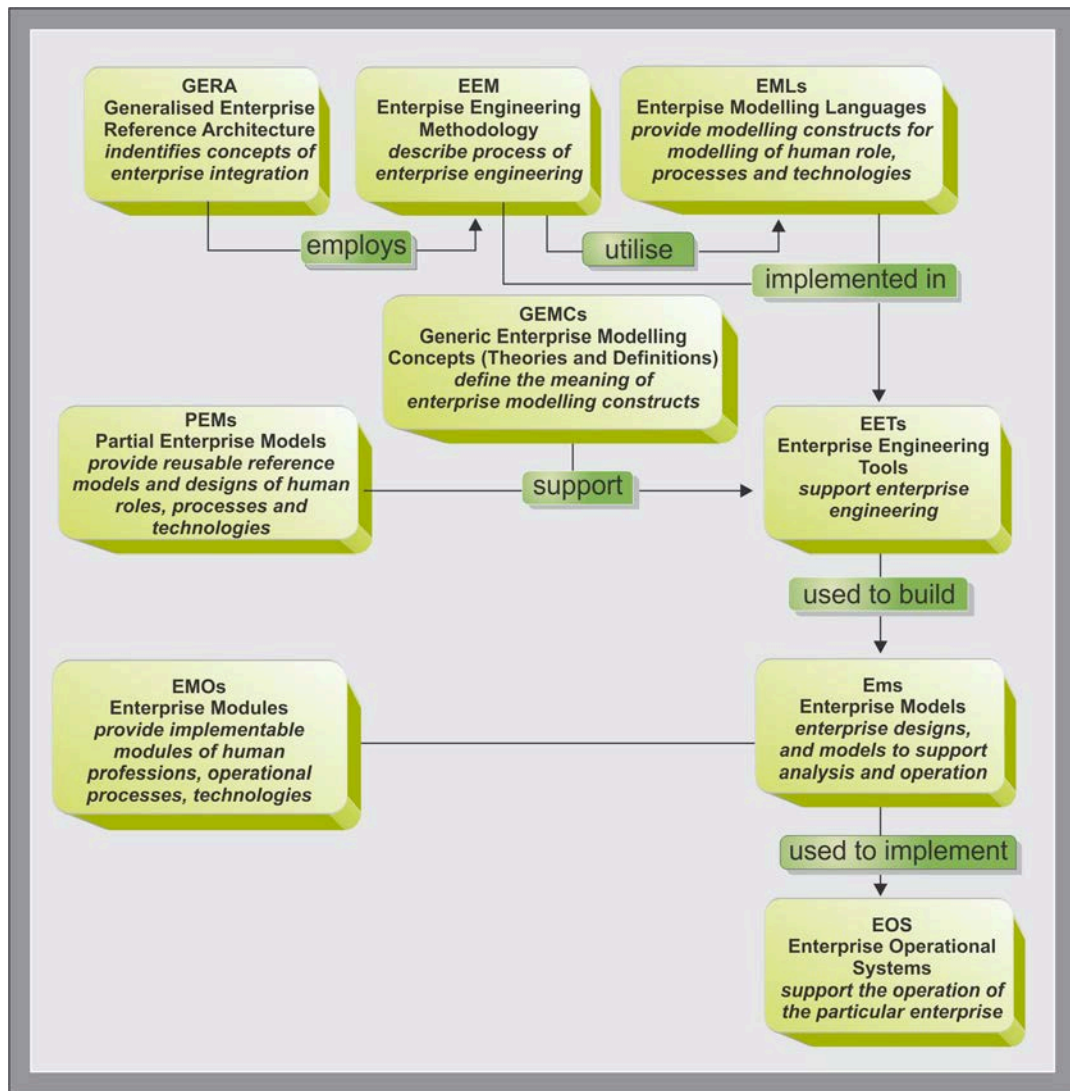
and business metrics. The architecture manager needs business-case-, business-scenario-, organisational-, business-process and-visioning-, business-metrics- and business-culture skills. Programme and project managers involved in EA need business case skills, budget management skills and business metric skills (TOGAF, 2009:697).

- Enterprise architecture skills. Business modelling, design (organisation, business process, role, data, and application), and systems integration skills are needed by enterprise architects and EA team representatives for EA technology, EA data, EA applications and EA business. Programme/project management skills for managers would include project management skills and benefits analysis skills (TOGAF, 2009:697).
- Programme and project management skills. Business change management skills and value management skills are needed by EA board members, architecture sponsor(s) and EA managers while programme/project managers also need those skills but have to concentrate on applying project management skills and tools for business change and value management.
- IT knowledge and skills. Enterprise architects are involved in asset management, service level agreements, enterprise continuums and change migration planning. IT infrastructure and technical skills are needed by engineers and technicians when handling data, technology and applications important for business support in 'as-is' views as well as in 'to-be' enterprise business vision (TOGAF, 2009:698).
- Technical IT skills. Software engineering and data management skills are skills needed by technicians and IT workers (TOGAF, 2009:699).
- Legal environment skills. Enterprise architecture and program/project managers need data protection and fraud skills (TOGAF, 2009:699).

Human factors identified in TOGAF will be discussed in Chapter 5.

### **2.5.3 Generalised Enterprise Reference Architecture Methodology**

The Generalised Enterprise Reference Architecture and Methodology (GERAM) (1999) (Figure 2.8) was developed by the IFIP/IFAC task force with the purpose of organising existing enterprise integration knowledge. By providing and combining necessary methods, models and tools from various architectures, GERAM can be described as an attempt to bridge the disciplinary divide, and guide and assist enterprises in their business, IM and IT engineering and integration efforts (Chen *et al.*, 2008:650). Lankhorst *et al.* (2009:32) list categories of concepts proposed by GERAM for use in EE and integration projects as human oriented, process oriented and technology oriented.



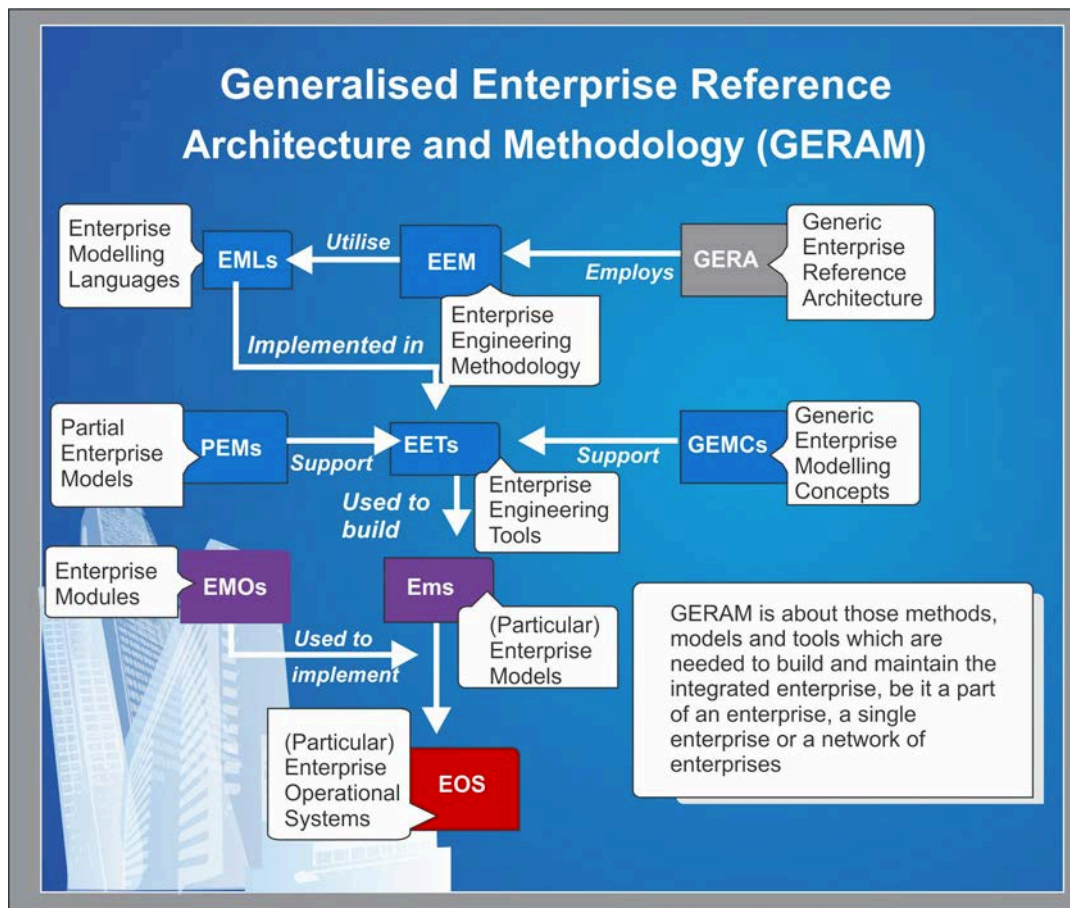
**Figure 2.8: GERAM (1999)**

GERAM combines modelling languages for structures, content and behaviour of enterprise divisions with enterprise engineering methodology. Human work roles, conceptual and language constructs, processes and technologies are described as support entities necessary to implement the integration of business strategies and goals with product generation and output. Considering the entity model views of the GERA modelling framework (Figure 2.8), human involvement is referred to as a resource and has to be considered in the entity model content view. In the entity purpose view, where the mission and purpose of the enterprise is described, the focus is on the customer, product, management and control views. The entity implementation view distinguishes between human activities and an automated view. The physical manifestation view represents a software and hardware view (GERAM, 1999).

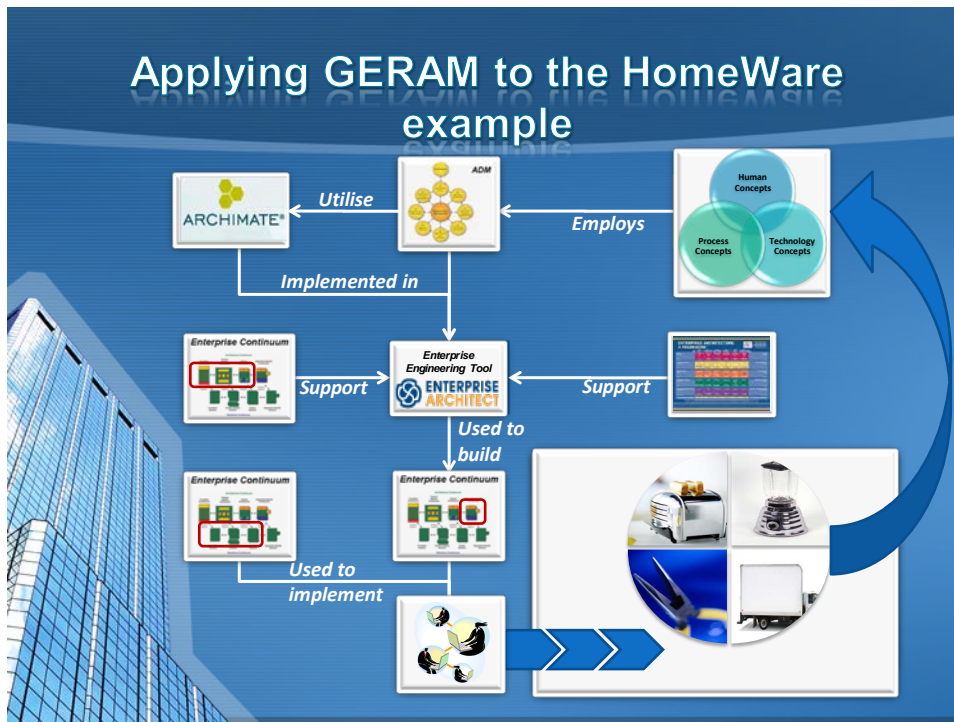
GERAM can be used in combination with other frameworks to address the ‘to-be’ goals, business requirements and needs of users and stakeholders because they rather complement than exclude each other. Gartner (2010), Schekkerman (2010), Zachman (2011a) and Labuschagné (2010) predict that more and more enterprises will adopt a composite EA, where different EA frameworks, approaches and methodologies are simultaneously used in support of business, IM and IT management. Sessions (2007) compares four of the

best known, used EA methodologies and proposed a ‘blended methodology’ where an enterprise takes from each EA methodology only what is relevant and useful in its context and changes it to fulfil its own needs.

In an example (Figure 2.9 and Figure 2.10) composed by Labuschagne (2010) a small-scale example of a distributed business entity with four distinct branches is used to explain how different models and architecture frameworks and tools work together to successfully integrate business goals, business strategy, business methods and business operations with business needs, stakeholder requirements, IM and IT. The process of integration starts with a business model as described in Ross *et al.* (2006), followed by a description or plan (Zachman, 2008a). TOGAF (2009:744) is an applied methodology that starts with enterprise and stakeholder requirements, uses engineering tools and modelling languages in recurring operations to establish an organisation that is working well and can easily adapt to change. GERAM makes provision for the description of human, process and technology concepts as support systems without which the picture would not be complete.



**Figure 2.9:** GERAM and the integrated enterprise (Labuschagné, 2010)



**Figure 2.10: GERAM example of an integrated enterprise** (Labuschagné, 2010)

## 2.6 EA MANAGEMENT

Buckl (2011:1) defines enterprise architecture management (EAM) as “a strategic management function to describe, analyse, and communicate the current, planned as well as the envisioned target state of EA”. Similarly, Aier (2011:645) and Radeke (2011:498) describe EAM as the management process of enterprise architectures and is concerned with establishing, development and maintenance of EA in organisations.

### 2.6.1 Introduction of Enterprise Architecture into Organisations

EA can be used as an organisational compass when enterprises build a foundation for executing an intended operating model to achieve their business goals (Ross *et al.*, 2006:141). The foundation for execution relates to the technology and information needed to describe and run an organisation’s IM infrastructure and business processes. The two-dimensional business operating model of Ross *et al.* (2006:29) distinguishes between high- and low business-process integration and high- and low business-process standardisation when the four different types of operating models are being outlined (Figure 2.11). Enterprise architecture is a long-term organisational endeavour and it is common practice to introduce EA in a step-wise process starting where it most needed within the organisation. It is therefore important for organisations to define their current business goals and establish how and where EA is needed to support these goals. The four quadrants of the Ross *et al.* (2006:29) operating model, diversification, coordination, unification or replication are useful guides to assist organisations in the description of their need for EA.



development, maintenance and use of EA. EA principles should be goal oriented, implementation should be implicated and measurement of implementations should be possible afterwards.

Fisher *et al.* (2010:193) investigated literature to identify similarities between documented EA principles and identified seven main components of EA principles:

- An EA principle is based on both business and IT strategy.
- The construction of an enterprise is described by EA design principles and requirements refer to the functional aspects of an enterprise.
- EA principles can be attributed to any of an enterprise's layers such as business, technology or IM.
- EA principles are described in principle statements indicating possible improvements.
- Principles are explained in a context of and attached to pre-defined goals and it should be clear why a specific principle will assist in reaching a specific goal.
- Principle implementation actions need to be provided.
- Defined assessment guidelines will determine if a principle was implemented.

One of the well-known frameworks for EA management, TOGAF, has been discussed in Section 2.5.2. TOGAF provides organisations with a method for architecture development (ADM) as well as an enterprise content metamodel (Buckl *et al.*, 2010:39). TOGAF (2009:72) suggests frameworks of operations management methods and solution development methods, to be used in coordination with their ADM. Business capability management is responsible for all three methods as well as overlapping of methods in project or portfolio management.

An enterprise modelling language is used to describe relations within and between entities and concepts, and forms a basis for integration, visualisation and analysis of business, IM and IT enterprise units (Lankhorst M. *et al.*, 2009:87). Lankhorst (2009:85) and Buckl *et al.* (2010:40) state that when TOGAF is used as a EAM method, an enterprise modelling language such as Archimate adds value to the enterprise architecture design initiative by providing a means of describing the infrastructure, behaviour and information of the business, application and technology architectural layers of an enterprise. Winter *et al.* (2007:3) provides a view of how core EA artefacts and their relationships are represented across business, process, integration, software and technology levels of EA. After investigation of essential elements (EA artefacts and dependencies) of importance from three frameworks, interfacing EA with other architectures is proposed. A broad EA perspective and approach (different EAs for different parts of the enterprise) rather than an in-depth EA application is proposed. In a study of four companies the proposed levels of EA were mapped onto existing organisational EA levels.

Buckl *et al.* (2012:241) propose a situational analysis followed by a development method to identify management building blocks (identify a goal, consider the context, adhere to identified conditions for each building block). Buckl (2011:182) describes *building blocks for EA management solutions* (BEAMS). The following steps, which are context-driven and organisation-specific EA management initiatives depending on organisational and stakeholder EA needs, are proposed:

- In an initial step, the enterprise architect will determine the organisational context, identify the EA requirements or needs, and identify and supply existing information sources of importance.

- Next, a method building block (MBB) to address EA needs/problem will be established. Here it is important to define the concepts, relationships between concepts and EA modelling language and allow for stakeholders to obtain a representation of the description to enable understanding and allow input. Stakeholders are assigned to a role within the organisational EA process; rules, techniques and assessment criteria, techniques and tools are set; replication of data and information is eliminated; and the function is integrated into existing EA management functions and analysed.
- Thirdly, management functions should be analysed with respect to stakeholders and implementation possibilities. Management and preservation of architectural descriptions and information is important. Buckl (2011:205) distinguishes between EA information providers (actors) and information consumers (stakeholders). Analysing the EA communication management function assures that the two parties realise the value of EA-related information, and exchange, retain and document all requirements, needs, actions and solutions to problems. EA performance management is measured subjectively from stakeholders' assessments or objectively by means of methods and tests to analyse before and after problem situations.
- In a last instance, the method base is developed and maintained.

Radeke ( 2011:500) used the literature to investigate EAM practices related to planning and implementation of strategic change processes:

- enterprise architects' assessment of strategic business, IM and IT options;
- development of strategic architecture initiatives;
- aligning the target architecture and future vision;
- composing roadmaps;
- updating and prioritising the project portfolio;
- impact analysis and identifying of reusable components;.
- standards-compliance assessment;
- updating existing architectures;
- architecture guidance and implementation review; and
- architecture monitoring, measurement and review.

TOGAF (2009:72) suggests frameworks of operations management methods and solution development methods, to be used in coordination with its ADM. Business capability management is responsible for all three methods as well as overlapping of methods in project or portfolio management.

## **2.7 SUMMARY**

In Chapter 2, EA was defined and its origin and current research trends were discussed. Enterprise ontology and EA form the basis of enterprise engineering. EE is not as yet a universally recognised discipline but describes design and engineering of an enterprise's business operations as well as its internal organisation. Humans are not only responsible for management of business and information exchange operations of enterprises but enterprises are perceived as human-driven. EA is the "blueprint" of an enterprise, an entire

description of the enterprise, its functions and the relationships between all its entities. Future research important for the subject and implementation of EA was discussed.

Chapter 2 not only served the purpose of using literature to discuss EA but also EA frameworks useful for the research and EA management.

Through interaction and discussion with people representing different organisations and different contexts it was evident that human factors impact on EA acceptance. It was the aim of my research to identify human factors affecting acceptance of EA in organisations. It was therefore necessary to not only explore existing EA literature but also to investigate human factors. In Chapter 3, literature is used to discuss human factors and the general socio-technical environment of humans and organisations. Human factors related to EA and found in the literature are discussed in Chapter 3.