A PROCESS REUSE IDENTIFICATION FRAMEWORK USING AN ALIGNMENT MODEL

by

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Dedicated to my husband Jaco,

whose generous love and support

left fond memories

about this study

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ABSTRACT

This thesis explores the potential to unify three *emerging disciplines*: enterprise engineering, enterprise architecture and enterprise ontology. The current fragmentation that exists in literature on enterprise alignment and design constrains the development and growth of the *emerging disciplines*. Enterprises need to use a multi-disciplinary approach when they continuously align, design and re-design the enterprise.

Although enterprises need to be aligned internally (across various enterprise facets), as well as externally (with the environment), most alignment approaches still focus on business-IT alignment, i.e. aligning the business operations with the information and communication technologies and systems of the enterprise. This study focuses on a popular business-IT alignment approach, called the *foundation for execution* approach, and its associated artefact, called the *operating model*. The study acknowledges the theoretical contribution of the *operating model* to establish the required level of business process integration and standardisation at an enterprise in delivering goods and services to customers. Highlighting the practical problems in selecting an *operating model* for an enterprise, and more specifically the practical problems of identifying process reuse potential at an enterprise, a thesis statement is formulated: *The operating model concept, as part of a business-IT alignment approach, can be enhanced with a process reuse identification framework, when a business-IT alignment contextualisation is used.*

The study is divided into two research questions. The first research question addresses the current fragmentation that exists in the literature, which impairs reuse of the existing business-IT alignment knowledge base. An inductive literature review develops the Business-IT Alignment Model to provide a common contextualisation for current business-IT alignment approaches. The second research question addresses the practical problems of the *operating model* regarding the identification of process reuse potential at an enterprise. Applying the newly developed Business-IT Alignment Model as a contextualisation instrument, the study demonstrates the use of design research in developing the Process Reuse Identification Framework.

The conclusion after the investigation of the two research questions is that the thesis statement was confirmed, i.e. the *operating model* concept, as part of a business-IT alignment approach, can be enhanced with a process reuse identification framework, when a business-IT contextualisation is used.

Key words: Enterprise engineering, enterprise architecture, enterprise ontology, enterprise design, enterprise alignment, business-IT alignment, operating model, process standardisation, process modelling, reusable process models.

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ABBREVIATIONS

AAEM	Alignment Approach Enhancing Method
ABACUS	Architecture Based Analysis of Complex Systems
ACMM	Architecture Capability Maturity Model
ADL	Architecture description language
ADM	Architecture Development Method
ARIS	Architecture of Integrated Information Systems
BIAF	Business-IT Alignment Framework
BIAM	Business-IT Alignment Model
BPMN	Business Process Modelling Notation
BPM	Business Process Management
BPR	Business Process Reengineering
CIMOSA	Computer Integrated Manufacturing Open System Architecture
CIO	Chief information officer
CobiT	Control Objectives for Information and related Technology
CORBA	Common Object Request Broker Architecture
CRUD	Create, read, update, delete
CSIR	Council for Scientific and Industrial Research
DCOM	Distributed Component Object Model
DEMO	Design and Engineering Methodology for Organisations
DODAF	Department of Defence Architecture Framework
DSDM	Dynamic Systems Development Methodology
DYA	Dynamic Architecture
E	Enterprise integrating (as used by Lapalme (2011))
E2AF	Extended Enterprise Architecture Framework
EA	Enterprise architecture

EAP	Enterprise Architecture Planning
EARF	Enterprise Architecture Research Forum
EBA	Enterprise business architecture
EDM	Enterprise Design Methodology
EE	Enterprise engineering
EEMs	Methodologies for enterprise engineering
EETs	Enterprise engineering tools
EIA	Enterprise information architecture
EiE	Enterprise ecological adaptation (as used by Lapalme (2011))
EIT	Enterprise IT architecting (as used by Lapalme (2011))
EMLs	Enterprise modelling languages
EMs	Enterprise models
EMOs	Enterprise modules
EO	Enterprise ontology
EOS	Operational system of the enterprise
ESA	Enterprise solutions architecture
ETA	Enterprise technical architecture
e-TOM	Enhanced Telecom Operations Model (see www.tmforum.org)
EPCs	Event-driven Process Chains
ERP	Enterprise Resource Planning
FEA	Federal Enterprise Architecture
FEAF	Federal Enterprise Architecture Framework
FEAPMO	FEA Program Management Office
GAO	General Accountability Office
GEAF	Gartner Enterprise Architecture Framework
GERA	Generalised Enterprise Reference Architecture

GERAM	Generalised Enterprise Reference Architecture And Methodology
GIM	GRAI Integrated Methodology, developed by the GRAI laboratory of the University of Bordeaux (France)
HOD	Head of department
IAF	Integrated Architecture Framework
IAM	Interaction model
ICT	Information and communication technologies
IDEF	Integrated Definition Language
IE	Information Engineering
IFAC	International Federation Of Accountants
IFIP	International Federation For Information Processing
III-RM	Reference Model for Integrated Information Infrastructure
IS	Information systems
IT	Information technology
ITIL	IT Infrastructure Library
JAD	Joint Application Development
JTA	Joint Technical Architecture
OAM	Ontological aspect model
OM	Operating model
OMB	Office of Management and Budget
OMG	Object Management Group
PA	Process architecture
PERA	Purdue Enterprise Reference Architecture
PRIF	Process Reuse Identification Framework
QSR	Qualitative systematic review
RACI	Responsible, accountable, concerned, informed

RAD	Rapid Application Development
RUP	Rational Unified Process
SAD	Structured Analysis and Design
SAM	Strategic Alignment Maturity
SIB	Standards Information Base
SOA	Service Oriented Architecture
SCOR	Supply Chain Operations Reference
TOGAF	The Open Group Architecture Framework
TRM	Technical Reference Model
UML	Unified Modelling Language
VCOR	Value Chain Operations Reference
XML	Extensible Markup Language

PREFACE

Firstly, this thesis applies active voice, rather than passive voice, as advised by Hofstee (2006) in his book, titled: *Constructing a good dissertation*. In addition, abbreviations are only declared using capital letters, if the original authors used the abbreviation as a name. As an example, the *operating model* has not been named as OM by the original authors (Ross, Weill, & Robertson) of the *operating model.* Yet, OM is used as an abbreviation in this thesis due to its frequency of occurrence.

Secondly, it should be noted that this study already produced a number of articles in journals and conference proceedings prior to the final compilation of this thesis. The articles, published in accredited journals include:

- De Vries, M., & Van Rensburg, A. C. (2009). Evaluating and refining the 'Enterprise Architecture as Strategy' approach and artefacts. *South African Journal of Industrial Engineering, 20*(1), 31-43.
- De Vries, M. (2010). A framework for understanding and comparing enterprise architecture models. *Management Dynamics, 19*(2), 17-29.

Articles, published in conference proceedings include:

- De Vries, M., Van der Merwe, A., Gerber, A., & Kotzé, P. (2010). Refining the operating model concept to enable systematic growth in operating maturity. In C. Schutte (Ed.), *Proc. 24th SAIIE Conference* (pp. 32-46). Glenburn Lodge, Gauteng: SAIIE.
- De Vries, M., Van der Merwe, A., Gerber, A., & Kotzé, P. (2011). Using the interaction model to identify replication potential between business units. In C. S. L. Schutte & L. Pretorius (Eds.), *Proc. 1st International Conference on Industrial Engineering, Systems Engineering and Engineering Management for Sustainable Global Development (ISEM)* (pp. 134_131 - 134_114). Stellenbosch: ISEM.
- De Vries, M., Van der Merwe, A., Kotzé, P., & Gerber, A. (2011). A method for identifying process reuse opportunities to enhance the operating model. In *IEEE International Conference on Industrial Engineering and Engineering Management (IEEM) 2011* (pp. 1005-1009). Singapore: IEEE.

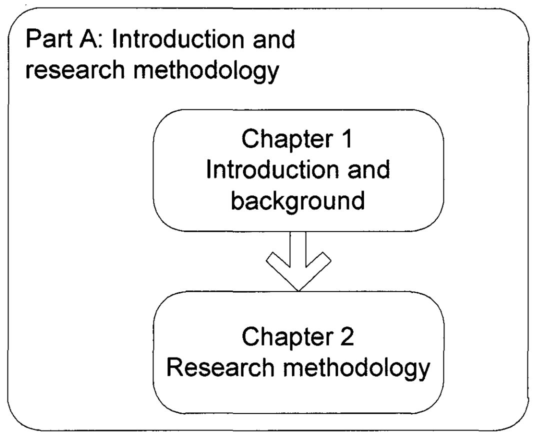
A compact disk (CD) is included with the thesis that contains the Appendices and the abovementioned articles published during the study.

PART A: INTRODUCTION AND RESEARCH METHODOLOGY

Solving a problem simply means representing it so as to make the solution transparent. ~ Herbert Simon

Part A of this thesis introduces the theoretical background, research rationale, research questions and research methodology for this study.

- Chapter 1 provides an introduction to the thesis, including a theoretical background, research rationale and research questions. The chapter also delineates the structure used for presenting the content of this study.
- Chapter 2 presents the research methodology used for completing this study.



1.1 INTRODUCTION

This thesis focuses on the enhancement of the operating model concept within the context of a business-IT alignment approach. The study resides within the *industrial and systems engineering* discipline, with the focus on *systems engineering*. Two systems are of concern, (1) the enterprise system and (2) the information, communication and technology (ICT) system.

Enterprise systems of the 21st century are exceedingly complex, and in addition, these systems need to be dynamic to stay ahead of competition. Information technology opened up new opportunities for enterprises to extend enterprise boundaries in offering complementary services, entering new business domains and creating networks of collaborating enterprises. The extended enterprise however still need to comply with corporate governance rules and legislation and need to be flexible and adaptable to seize new opportunities (Hoogervorst, 2009).

In the past, a reductionist approach was often used to study enterprise problems; researchers from various different disciplines studied a single sub-system or perspective of the enterprise. *Industrial engineers,* for example, traditionally considered only the production subsystem, whereas *organisational scientists* investigated the structure of an organisation. *Behavioural scientists* studied the productivity effects of interacting workers, management policies and work environment, whereas *information sciences* studied the design and management of information systems (Giachetti, 2010). However, both researchers and practitioners realise that there is a need for an overall view of the enterprise (Liles, Johnson, & Meade, 1995; Martin, 1995; Rouse, 2004; Towill, 1997). An overall cross-disciplinary enterprise-view would lead to a better understanding of enterprise problems within the context of the enterprise as a whole.

In support of an overall view of the enterprise, three disciplines emerged: enterprise engineering (EE), enterprise architecture (EA) and enterprise ontology (EO). Although limited literature is available on EO, a number of publications exist for EE and EA. In spite of the publications, there is still a lack of shared meaning in terms of the *theoretical foundations*, *definitions* and *business benefits.* This lack of agreed-upon meaning creates challenges in searching for relevant literature and assessing the maturity of EE and EA (Kappelman, McGinnis, Pettit, Salmans, & Sidorova, 2010; Lapalme, 2011). Even though EE and EA pose a number of *potential business benefits* in designing and aligning the enterprise, Kappelman et al. (2010) state that claims are not consistently theoretically grounded. Although alignment between business and IT is a strong theme in enterprise alignment, and numerous business-IT alignment approaches and frameworks exist (Schekkerman, 2004), it remains difficult to compare the alignment approaches or extend a current alignment approach with knowledge from the existing business-

IT alignment knowledge base. Comparing and enhancing alignment approaches is one of the fundamental problems addressed in this research.

The next section (section 1.2) provides additional theoretical background to define business-IT alignment and related concepts. Section 1.3 provides the rationale for this study, as related to business-IT alignment, followed by the research questions and the main thesis outputs in section 1.4. The scope and limitations of the study are given in section 1.5, and the main contributions are provided in section 1.6. A research methodology is presented in section 1.7 to solve the research questions, concluding with section 1.8 to provide structural guidance to read this thesis.

1.2 THEORETICAL BACKGROUND

EE is not a new field, but neither is it a discipline yet (if compared to electrical engineering or civil engineering). Both enterprise engineering and organisation(al) engineering are practiced-based and aims at studying enterprises in a multidisciplinary and *engineering-driven* way, but often without much scientific foundation (Dietz, 2006).

EA and the word 'architecture' exemplify the inconsistency in definition. According to Kappelman et al. (2010) the most common understanding of the term 'architecture' for an enterprise, is *collection of artefacts* (models, descriptions etc.) to define the *as-is* model of the enterprise. Bernard (2005) on the other hand, equates EA with the *process* of defining standards and creating *as-is* models, whereas Kappelman (2007) avers that EA creates and use a *shared language* to discuss and document important aspects of the enterprise (also see section 4.3.2.1 for other EA benefits/means). According to Sidorova & Kappelman (2010) the presence of a *multiplicity of definitions* suggests that EA is a highly complex dynamic construct that encapsulates both technical and social dimensions, the present and future, as well as the logical and physical aspects of the enterprise.

Rather than focusing on the disparities that exist, this study acknowledges the current deficiencies in *theoretical foundations*, *definitions* and *business benefits* and search for common grounds in the pursuit for consistent enterprise design and alignment. To illustrate the domain, Figure 1 highlights contributing theories, root disciplines and *emerging disciplines* (EE, EA and EO) that create the body of knowledge for enterprise design and alignment. The common aspect in the three *emerging disciplines* is the *enterprise*, which will be defined next.

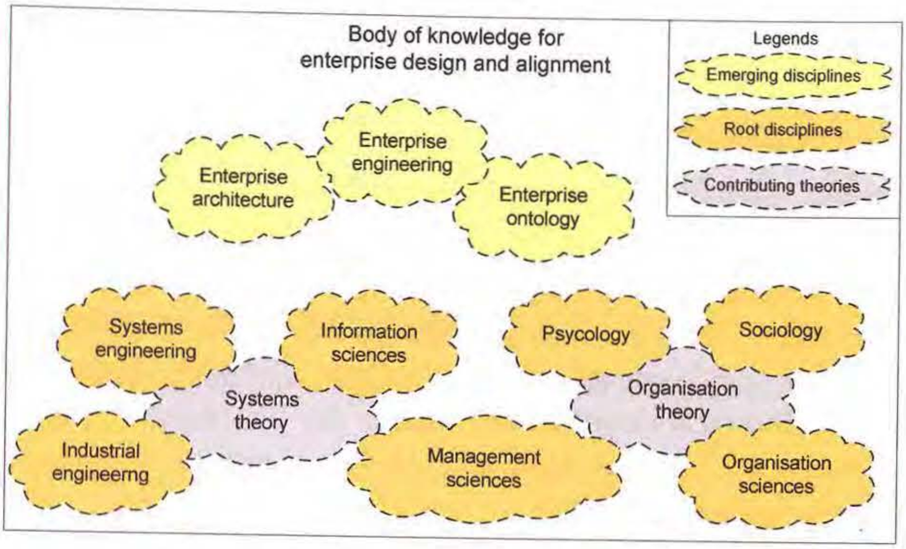


Figure 1: Contributing theories, root disciplines and emerging disciplines in enterprise design and alignment, based on Bernard (2005) and Giachetti (2010)

1.2.1 An enterprise

An *enterprise* is "a complex, *socio-technical system* that comprises interdependent resources of people, information, and technology that must interact with each other and their environment in support of a common mission" (Giachetti, 2010, p. 4). Defining the enterprise as a *system*, requires knowledge about *systems theory* and this theory will be covered in section 3.2.1. For understanding the scope of this study, definitions of a *system* and *sub-system* are provided.

A *system* is "a set of discernable, interacting parts or subsystems that form an integrated whole that acts with a single goal or purpose". A boundary is used to encapsulate a system; everything outside of the boundary forms part of the external environment (Giachetti, 2010, p. 29).

Sub-systems are systems in their own right, but they are also part of a larger system. Although there may be several ways to define a sub-system for an enterprise system (e.g. using a functional viewpoint or a geographical viewpoint), enterprise design should aim to find optimal ways to structure the enterprise into sub-systems (Giachetti, 2010). Figure 2 demonstrates that any given system (e.g. an enterprise system) may be a sub-system to a larger system (e.g. the environmental system) and contain sub-systems (e.g. an ICT system).

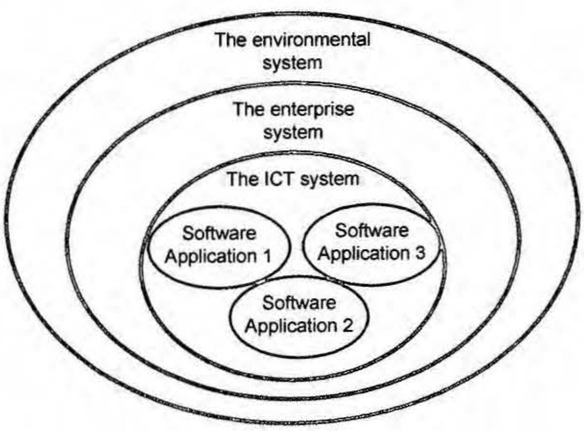


Figure 2: Enterprise as a sub-system and composed of sub-systems

A concept that is related to the enterprise system is the *business*. The term *business* is often used to define certain aspects of the enterprise or beyond the boundaries of the enterprise. However, the boundary of *business* as a system is not clear. In addition, the term *business* is often used interchangeably with the term *organisation*. The following section provides different views on *business* versus *organisation.*

1.2.2 Business versus organisation

The term *business* is used in various ways. In understanding the term *business* and its scope, a list of popular *business architecture* definitions as found in literature, is given below:

- "Business architecture is a *general description of a system*. It identifies its purpose, vital functions, active elements, and critical processes and defines the nature of the interaction among them" (Gharajedaghi, 2006, p. 152).
- "It is a definition of what the *enterprise must produce* to satisfy its customers, compete in a market, deal with its suppliers, sustain operations, and care for its employees. It is composed of models of architectures, workflows, and events" (Whittle & Myrick, 2007, p. 31).
- "...business architecture is fitting the major elements of a business together"..."a set of *interrelated views of how a business works*" (McWhorter, 2008, p. 11). Supporting the latter, business architecture is "a *formal blueprint* of governance structures, business semantics, and value streams across the extended enterprise" (OMG's BAWG in Ulrich, 2008: 38).

From the definitions provided, it can be deduced that the scope of the term *business* is unclear. Another term, which is often used interchangeably with the term business or enterprise, is *organisation*. Similar to the position taken by Giachetti (2010), this thesis refrains from using the word organisation as a substitute for enterprise, unless directly quoted from literature.

This thesis uses the term *organisation* in a similar way than Dietz (2006) does, where Dietz defines the enterprise system as a heterogeneous system that contains several sub-systems. The two enterprise sub-systems of concern are the *organisation* sub-system and the *ICT* sub-system. Within the *organisation* sub-system, Dietz (2006) encapsulates three aspect systems: the business-organisation, the intellect-organisation and the document-organisation. The *business-organisation* system encapsulates the *essential operation* of the enterprise within the *internal boundaries* of the enterprise, producing essential acts, such as decisions and judgements. The intellect-organisation system produces information-related acts, such as reproducing, deducing, reasoning and computing, whilst the document-organisation system produces data-related acts, such as storing, transmitting, copying and destroying. Section 3.3.6 provides additional theory about the three aspect systems.

Using the conceptualisation of Dietz (2006), the next section defines the concept of *business-IT alignment* as compared to enterprise alignment.

1.2.3 Business-IT alignment versus enterprise alignment

In terms of the various systems that are related to the enterprise, most of the current alignment approaches aligns four system layers: (1) the business-organisation, (2) intellect-organisation, (3) document-organisation, and (4) ICT (see Figure 3, arrows in light yellow) (Lapalme, 2011). The enterprise achieves a *business-IT alignment* state, when the *business-organisation* system is aligned via several system layers, with the *ICT system*, i.e. business and IT are "integrated, in harmony, converged, linked, fused, synthesized" (Luftman & Kempaia, 2008, p. 102).

Although *not* the focus of this thesis, Hoogervorst (2009) emphasises that enterprises need to expand the scope of alignment beyond the boundary of the *business-organisation* system. *Enterprise alignment*, not only aligns the essential operation (*business-organisation* system) with the *ICT system,* but also require alignment with other enterprise aspects, such as norms, convictions and culture. In addition, *enterprise alignment* also needs to align the enterprise with the environmental system (see Figure 3, arrows in bright yellow).

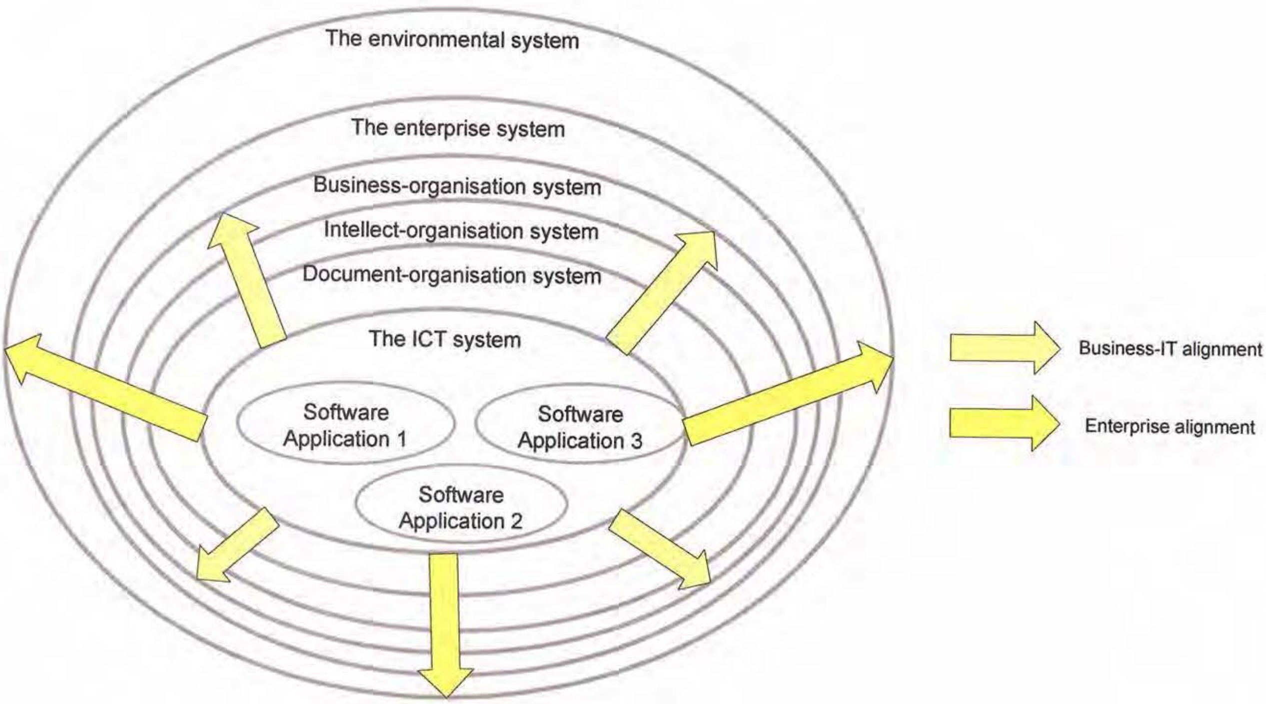


Figure 3: Business-IT alignment vs. enterprise alignment scope

The purpose of this study is to enhance an existing business-IT alignment approach with an element from another business-IT alignment approach. The problem is that existing fragmentation in the *emerging disciplines* (EE, EA and EO) creates difficulties when reusing knowledge from the existing knowledge base. Disciplines that contribute towards enterprise alignment do not use a common vocabulary (Lapalme, 2011). The fragmentation is partly due to different origins of EA and EE. EA originated within the *information systems domain* (Kappelman, 2010) and consequently the value-creating paradigm for using EA was IT-focused. The Open Group (2009, p. 6) for instance provide three main business benefits for using EA: (1) a more efficient IT operation, (2) better return on existing IT investment, coupled with reduced risk for future investment, and (3) faster, simpler and cheaper procurement of multi-vendor open

IT systems. EE on the other hand, developed as a sub-discipline of the *systems engineering* domain (Giachetti, 2010).

An extension of the fragmentation problem is that various alignment approaches exist, each with its own alignment intent, scope and means for alignment. Lapalme (2011) identified three schools of thought in the enterprise architecture community, but are also evident in current alignment approaches. The three schools of thought primarily differ in alignment scope. The first school (enterprise IT architecting) emphasises alignment of components related to the enterprise IT assets, whereas the second school (enterprise integrating) considers alignment of all facets of the enterprise (IT assets being one asset). The third school (enterprise ecological adaptation) expands the extent of alignment even further by adding the environment as an alignment component.

Although various theoretical alignment approaches or frameworks exist in literature, a study performed by OVUM (Blowers, 2012) indicates that 66% of enterprises had developed a customised framework, with one third of the participants making use of two or more frameworks. Although practitioners combine elements from various alignment approaches, a lack of theoretical backing about these combinations exist (Dumay, Dietz, & Mulder, 2005, p. 94). Mingers & Brocklesby (1997) state that the most effective contribution in dealing with the richness of the real world requires use of more than one approach/methodology, in whole or in part, and possibly from different paradigms. However, mixing approaches is not simple due to paradigm incommensurability, possible ineffectiveness in theoretical fitting and practicality in requiring a wide range of knowledge, skills and flexibility of practitioners. Prior to assessing the feasibility of mixing approaches, a *common frame of reference* is required to understand/compare different approaches. This thesis suggests the enhancement of one business-IT alignment approach (the *foundation for execution* approach) with another, using a common frame of reference.

The *foundation for execution* approach was developed by Ross, Weill, & Roberson (2006) and provided a unique element, called the operating model (OM). The OM articulates a vision of how the enterprise should operate, by defining the required levels of process standardisation and integration. The required OM drives the implementation of a whole set of strategic initiatives. A study about the practicality of defining an OM and its translation (the core diagram), however, indicated several OM deficiencies (De Vries & Van Rensburg, 2009). Although the construction of both artefacts (OM and core diagram) were problematic (De Vries & Van Rensburg, 2009), the core diagram is dependent on the OM and translates the process standardisation and integration requirements of the OM into the core diagram components. Since the core diagram is a derivative of the OM, the study directed its focus to the OM alone, providing a rationale for enhancing the OM concept.

A follow-up study (De Vries, Van der Merwe, Gerber, & Kotzé, 2010), highlighted that the OM deficiencies could be categorised as *process reuse* and *data sharing* deficiencies respectively. The *process reuse* deficiencies related to the inability of identifying reusable process components in the enterprise, whereas the *data sharing* deficiencies associated with the inability to identify reusable data components in the enterprise. The next section elaborates on the need to address the OM deficiencies.

1.3 RATIONALE FOR THIS STUDY

There is a need to enhance the OM concept by addressing the OM deficiencies (specifically pertaining to *process reuse* and *data sharing*), by using knowledge from the existing business-IT alignment knowledge base.

From the factors discussed in the previous sections, the rationale is summarised as follows:

- Fragmentation exists in the *emerging disciplines* (EE, EA and EO), which creates difficulties in reusing knowledge from the existing knowledge base. In addition, numerous alignment approaches exist, each with its own alignment intent, scope and means for alignment.
- Enterprise alignment approaches differ in alignment scope. Most of the alignment approaches still focus on business-IT alignment. Therefore, the main focus of this study is also confined to business-IT alignment (see Figure 3, constructs in light yellow).
- There is a need to combine elements from various alignment approaches. Although practitioners already combine elements from different alignment approaches, there is a lack of theoretical backing about these combinations.
- One of the business-IT alignment approaches, called the *foundation for execution* approach, provides an operating model (OM). Due to its inherent deficiencies, there is a need to enhance the OM within the context of business-IT alignment.
- Given that many enterprises have already seized the opportunity of *sharing data* (Hoogervorst, 2009; O'Kane, Radcliffe, & White, 2012; Smith & Fingar, 2003), this study focused on deficiencies pertaining to the identification of *process reuse opportunities.*

The thesis statement is that *the operating model concept, as part of a business-IT alignment approach, can be enhanced with a process reuse identification framework, when a business-IT alignment contextualisation is used.*

1.4 THE RESEARCH QUESTIONS, OBJECTIVES AND OUTPUTS

Contrary to other business-IT alignment approaches where IT supports strategy (Lapkin, 2005; Rosser, 2004), Ross et al. (2006) maintain that strategy rarely offers clear direction for development of stable IT infrastructure and business process capabilities. Strategic priorities shift as enterprises attempt to respond to competitor initiatives or seize new opportunities. Ross *et al.* (2006) state that management needs to make a strategic decision on the required operating model (OM) of the enterprise, that would guide systematic development of the supporting ICT system. A decision about a required OM would assist in creating a *foundation for execution*, i.e. rationalising and digitising the routine, everyday processes and competitively distinctive capabilities of the enterprise. The stable *foundation*, created according to the selected OM, enables an enterprise to become a "a proactive – rather than reactive – force in identifying future strategic initiatives" (Ross et al., 2006, p. 43).

The OM concept requires that senior management select an appropriate OM that will leverage reusable capabilities, driving profitable growth. A poor choice of OM, i.e. one that is not viable in a given market, will have dire consequences (Ross et al., 2006). Since, the OM is a key artefact used during strategic decision-making; this study focuses on the deficiencies of the OM, and more specifically the deficiencies pertaining to *process reuse*. A *design process* was needed to address the *process reuse* deficiencies in developing a *process reuse identification framework.*

In support of the *design process* and the aim to reuse fragmented knowledge from the *emerging disciplines* (EE, EA and EO), the study also provides a business-IT alignment contextualisation to contextualise current alignment approaches.

The research questions defined for the study are as follows:

Primary Research Question:

What constructs are required for a process reuse identification framework to enhance the operating model concept within the context of business-IT alignment?

Secondary Research Questions:

1. What model is required to contextualise different business-IT alignment approaches?
2. What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

The following *research objectives* are applicable in solving the research questions:

- The construction of a business-IT alignment model to contextualise different business-IT alignment approaches:
    - Identifying an appropriate research design to develop a business-IT alignment model.
    - Data-gathering to construct the Business-IT Alignment Model (BIAM).
    - Verifying the use of BIAM.
- The construction of a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model.
    - Identifying an appropriate research design to develop a process reuse identification framework, enhancing the operating model concept.
    - Using the Business-IT Alignment Model (BIAM) as an instrument to contextualise current alignment approaches and evaluate their compatibility while constructing the Process Reuse Identification Framework (PRIF).
    - Data-gathering during the construction of the Process Reuse Identification Framework (PRIF) to verify inclusion of PRIF constructs.

The *main outputs* of this study are a framework, called the PRIF (process reuse identification framework), and a model, called the BIAM (Business-IT Alignment Model). In using the terminology *framework* and *model*, the Cambridge Dictionary provides the following definitions:

- A framework "is a system of rules, ideas or beliefs that is *used to plan or decide* something or a supporting structure around which something can be built" (Cambridge Dictionary, n.d.-a).
- A model "is a *representation* of something, either as a physical object which is usually smaller than the real object, or as a simple description of the object which might be used in calculations" (Cambridge Dictionary, n.d.-b).

The PRIF, in accordance with the definition of a *framework*, provides a set of requirements and derived *method, mechanisms and practices* that is *used to plan or decide* whether process reuse standardisation opportunities exist that may be exploited in an enterprise.

The BIAM is a *model* that provides a *representation* of a class of alignment approaches that aim towards the alignment of business and IT components in an enterprise. According to the classification provided by Giachetti (2010), the BIAM is a *non-analytical* model. The *non-analytical* model is a descriptive model that is used for qualitative analysis, such as comparing different designs.

1.5 THE SCOPE AND LIMITATIONS OF THE STUDY

This section defines the scope and limitations of the study, with reference to the main outputs of the thesis, i.e. the PRIF (Process Reuse Identification Framework), and the BIAM (Business-IT Alignment Model).

1.5.1 Scope of the PRIF

The PRIF is developed for the purpose of identifying *process reuse* opportunities, to enhance the operating model (OM). Even though the PRIF may be applicable to identify process reuse opportunities for different reasons than augmenting the OM, this study does not claim such general use. The rationale is that the *requirements* for the PRIF are primarily related to the deficiencies of the OM, as defined in section 7.4. Yet, the *requirements* for the PRIF may be extended as part of future research, to increase generality of identifying process reuse opportunities at an enterprise.

1.5.2 Scope of the BIAM

As stated in section 1.3, the main focus of this study is confined to business-IT alignment. In a previous section (section 1.2.3), the concept of business-IT alignment was discussed in terms of layered systems. Figure 4 repeats Figure 3 to illustrate six system layers: environmental system, enterprise system, business-organisation system, intellect-organisation system, document-organisation system and ICT system. Most of the current alignment approaches aligns four system layers: the business-organisation, intellect-organisation, document-organisation, and ICT (see Figure 4, arrows in light yellow) (Lapalme, 2011). The enterprise achieves a *business-IT alignment* state, when the *business-organisation* system is aligned via several system layers, with the *ICT system*, i.e. business and IT are "integrated, in harmony, converged, linked, fused, synthesized" (Luftman & Kempaia, 2008, p. 102). This study is also concerned with business-IT alignment (Figure 4, arrows in light yellow).

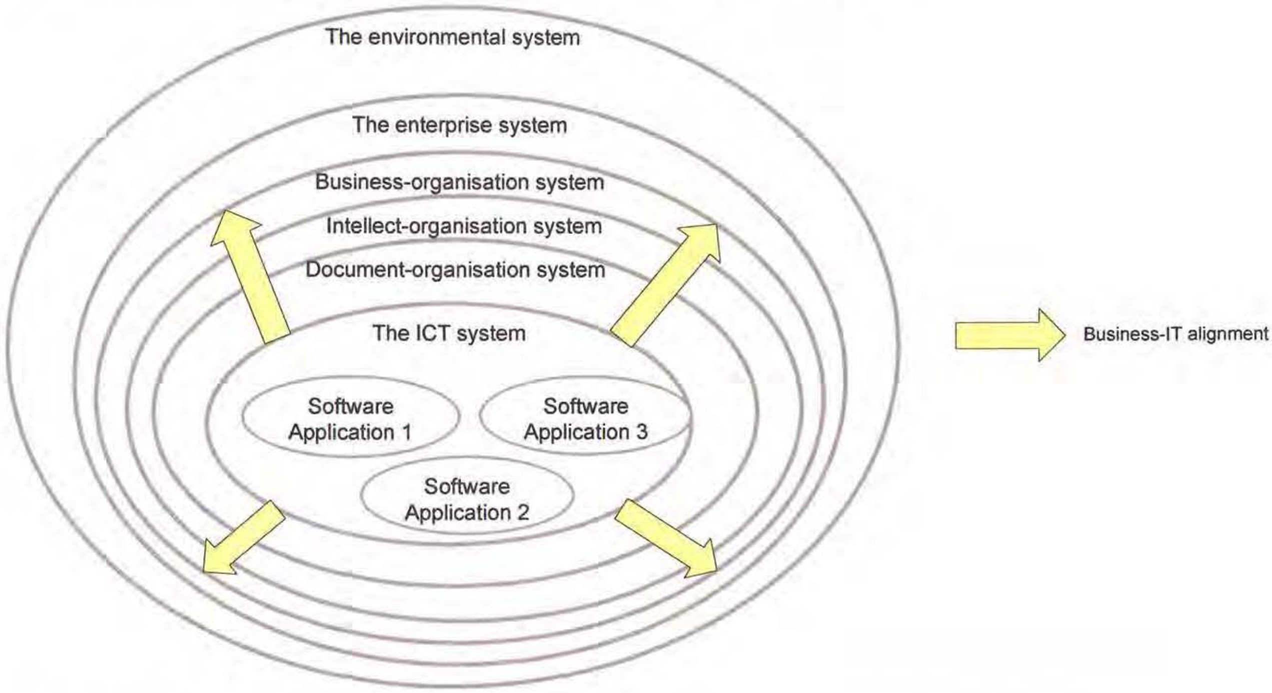


Figure 4: Business-IT alignment scope of this study

Hoogervorst (2009, p. 262) emphasises that business and IT alignment can only be achieved within the overall enterprise governance context. The rationale is that incremental IT developments occur collaboratively, iteratively, and concurrently with other enterprise developments. Martin (1995, p. 380) also supports the notion that the whole enterprise, "all of its business, social, and technical systems must be dealt with in a holistic and integrated way".

Although the BIAM is sensitive to the enterprise as a whole, and may even be representative of enterprise alignment beyond business-IT alignment, BIAM only claims representation for contextualising business-IT alignment approaches.

1.6 SUMMARY OF SCIENTIFIC CONTRIBUTIONS

As mentioned earlier, the main purpose of this study is to enhance the OM (within an existing business-IT alignment approach) with an element from another business-IT alignment approach. The study meets the primary purpose, by delivering two artefacts: the PRIF (process reused identification framework) and the BIAM (Business-IT Alignment Model). However, due to the research process itself, five scientific contributions are presented (see Figure 5):

- Contribution 1: A model for approach contextualisation
- Contribution 2: Classification categories for approach comparison
- Contribution 3: An Alignment Approach Enhancement Method (AAEM), using the BIAM

- Contribution 4: Requirements for enhancing the OM for process reuse identification
- Contribution 5: A *method, mechanisms and practices* to enhance the OM concept

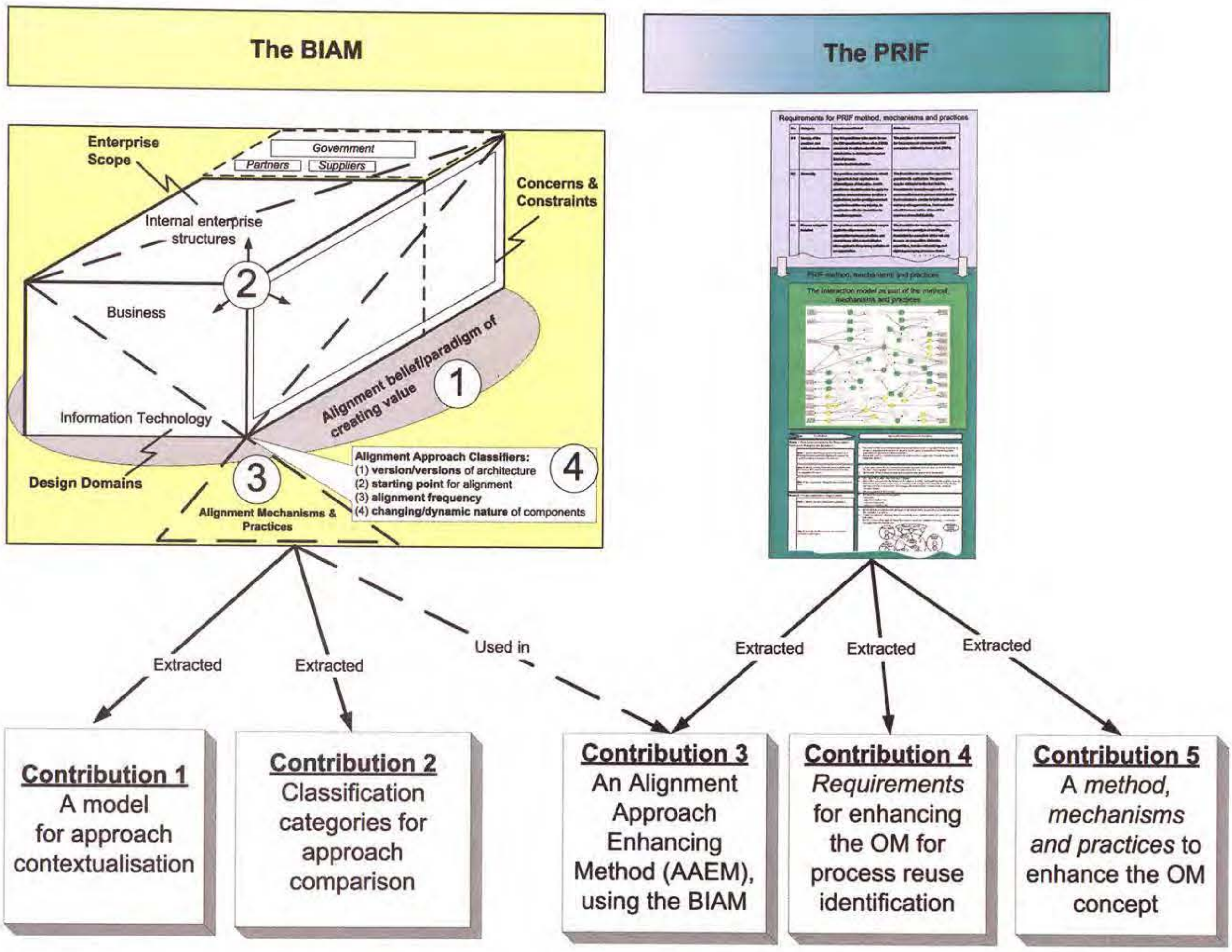


Figure 5: Thesis contributions

The contributions are discussed in more detail in Chapter 11.

1.7 RESEARCH METHODOLOGY

The study applies a mixed methods design, based on the definition provided by Morse (2010), which suggests that a mixed methods design consists of a complete design method (i.e. the *core component*), plus one (or more) incomplete design methods(s) (i.e., the *supplementary component*(s)) (see Figure 6). The result of the supplementary component provides explanation or insight for the core design component.

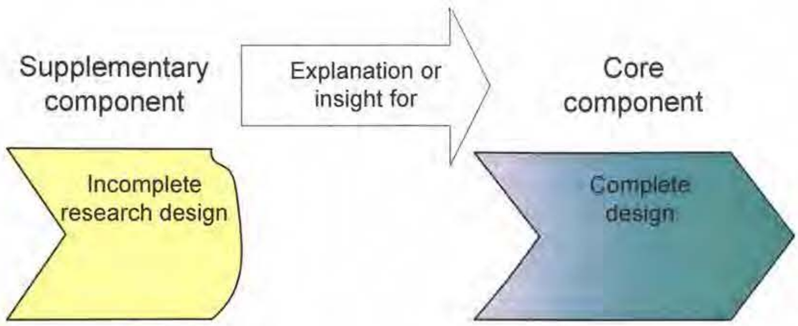


Figure 6: Supplementary and core component of mixed methods research, based on Morse (2010)

In this study, the deficiencies of the current OM initiated the development of the main artefact, the PRIF. The development of the PRIF as the main artefact thus required a *core component* (complete design) as a research design. This thesis (see section 2.6.2) motivates the use of *design research* as the *core component*. Since this study primarily intended to enhance the OM within a business-IT alignment context, reusing knowledge within the business-IT alignment discipline, a supplementary component was required. The prime purpose of the supplementary component was to provide a business-IT alignment contextualisation instrument (BIAM), to provide explanation or insight for the development of the PRIF. Due to its supplementary role, an incomplete research design, i.e. *exploratory design*, was sufficient in developing the BIAM. Section 2.6.3 provides a motivation for using *exploratory design* as the *supplementary component*.

1.8 STRUCTURE OF THIS THESIS

Figure 7 illustrates the structure of this thesis in terms of four main parts:

- Part A: Introduction (this chapter) and research methodology
- Part B: The BIAM (Business-IT Alignment Model)
- Part C: The PRIF (Process Reuse Identification Framework)
- Part D: Scientific contribution and conclusion

The main parts (B and C) address the secondary research questions (Research Questions 1 and 2) respectively. Part B also provides the theoretical framework and develops the BIAM (Business-IT Alignment Model) to extend the knowledge base (Figure 7, vertical yellow bar, *Extended knowledge base*). The *extended knowledge base* (including the BIAM) is then applied in part C. Correspondingly, the development of the PRIF (part C) often refers back to Part B during re-visitation of the *extended knowledge base* (Figure 7, yellow arrow, *EKB re-visitation*).

The next chapter is the second chapter in Part A, presenting theory about research methodology and its application in this thesis.

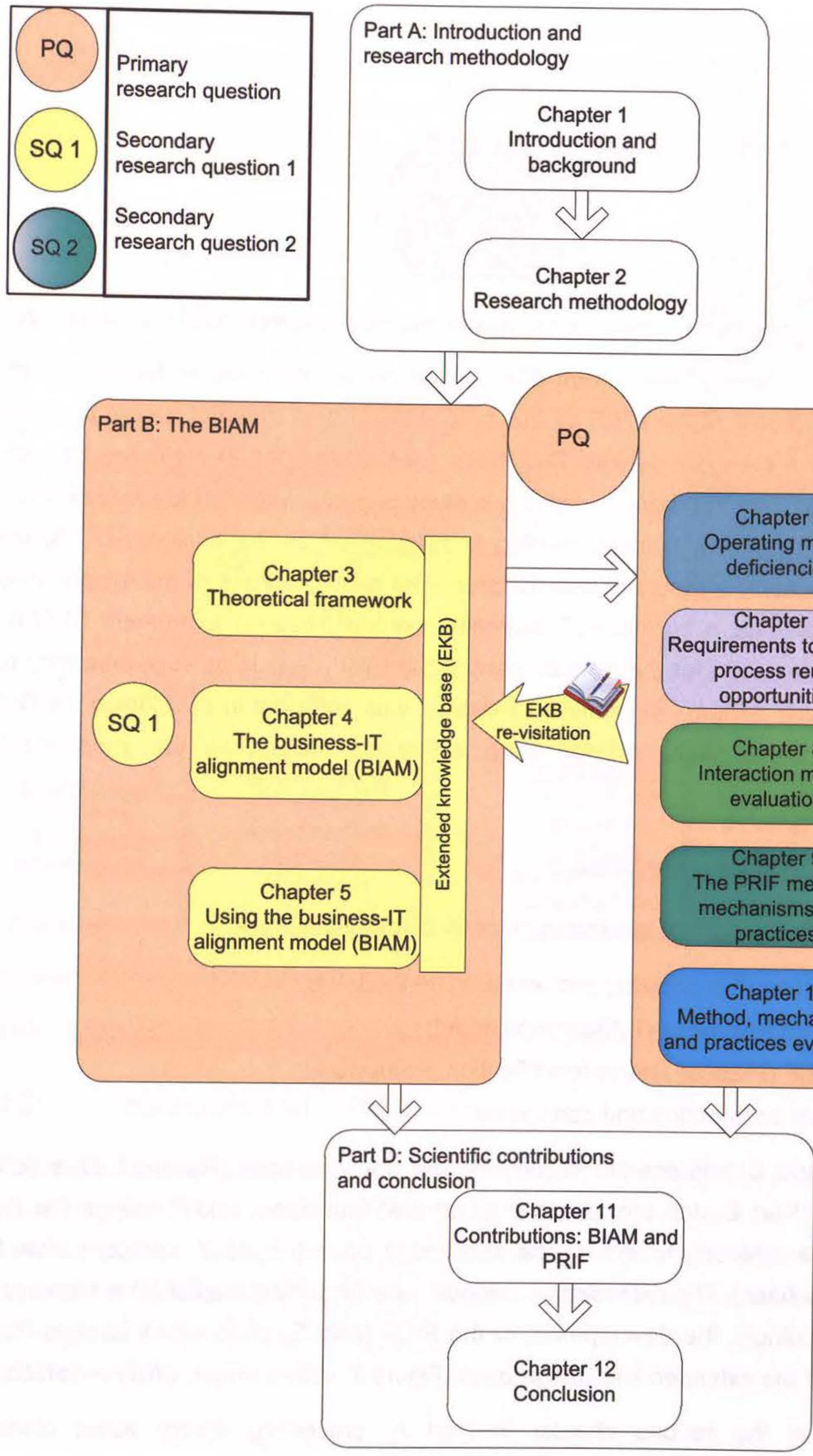


Figure 7: Structure of the thesis

2.1 INTRODUCTION

Chapter 1 introduced the theoretical background and research questions of the study. This chapter provides a *research methodology* to answer the research questions.

According to Creswell & Plano Clark (2006), one requires a distinction between a research methodology, paradigm, design and methods for conducting a study. According to Figure 8, a *methodology* aggregates the paradigmatic framework and entire process of research in a study. Research *design* refers to the plan of action that links paradigmatic assumptions to specific *methods*. *Methods* relate to techniques for data collection and analysis.

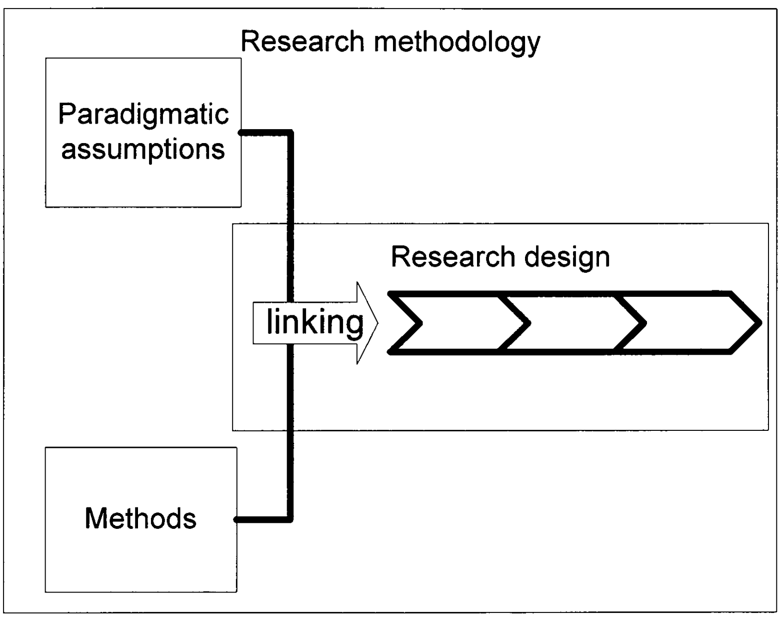


Figure 8: Research methodology concepts, based on Creswell & Plano Clark (2006)

This chapter starts with a presentation of research *methodology theory*, followed by an *application of theory* in devising a thesis research methodology. Section 2.2 provides a paradigmatic framework for discussing research assumptions. Section 2.3 discusses mixed methods design, design research, and exploratory design, whereas section 2.4 relates to theory on a sub-set of data collection methods. Sections 2.5 and 2.6 apply the theoretical concepts portrayed in sections 2.2, 2.3 and 2.4 to the specific paradigm, research design (mixed methods) and data collection methods used in this study. Section 2.7 refers to ethical procedures that were followed and the chapter concludes in section 2.8.

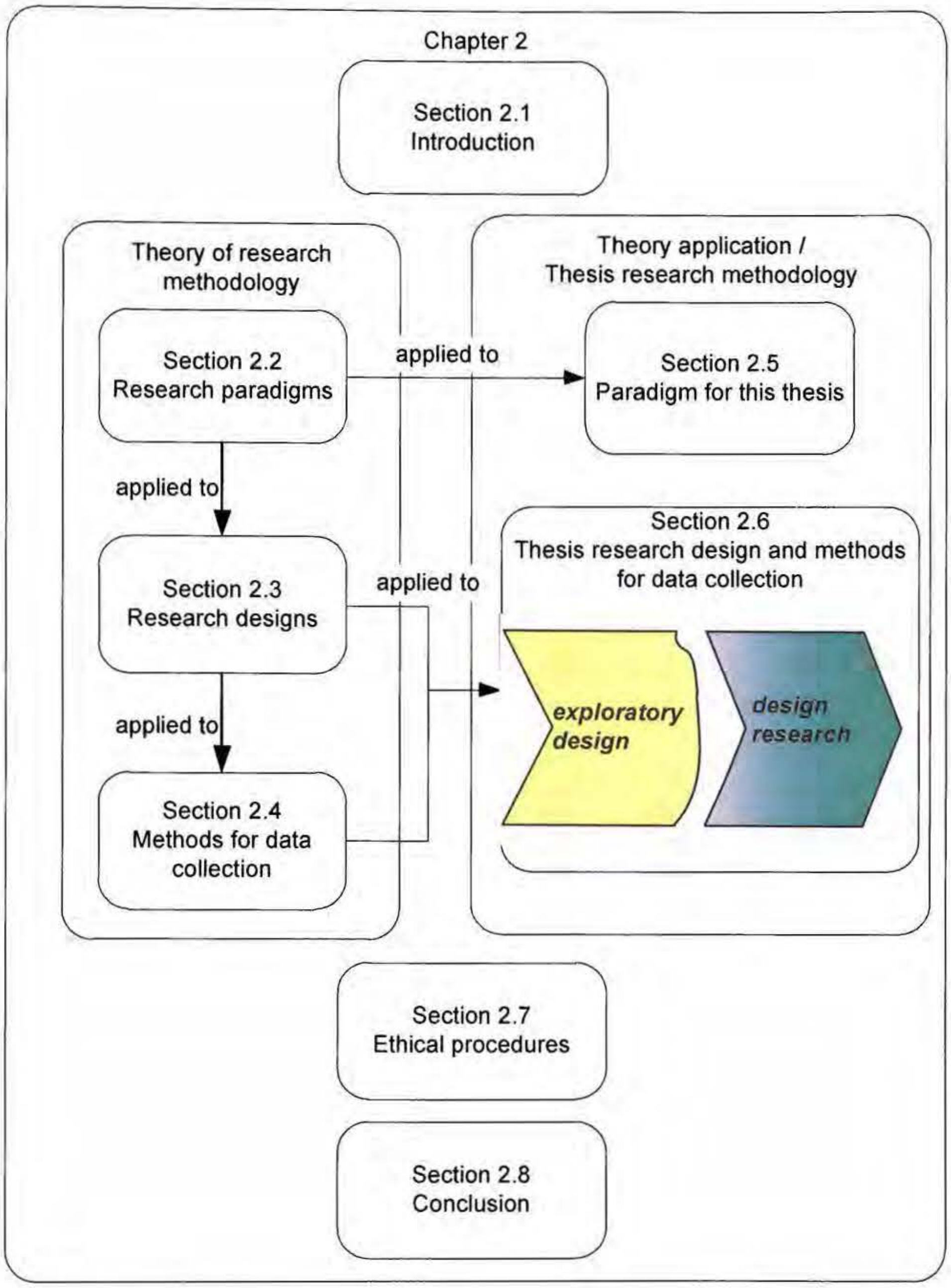


Figure 9: Chapter map for Chapter 2

2.2 RESEARCH PARADIGMS

Research philosophy and paradigms refer to the different "ways of knowing" (Vaishnavi & Kuechler, 2004/5). This section defines a single *paradigmatic framework* for discussing the paradigmatic assumptions embedded in the standard research designs covered in section 2.3 and the paradigmatic assumptions that may apply to this study (later in section 2.5).

This study applies a paradigmatic framework taken from three sources: (1) paradigmatic differentiators provided by Burrell & Morgan (1979) on sociological paradigms, (2) the paradigmatic framework provided by Iivari (1991) on the paradigmatic analysis of information systems development and (3) differentiators on research philosophy provided by Trochim (2006). The paradigmatic framework includes *ontology*, *epistemology*, *methodology, ethics* and *reasoning*. The various positions related to the paradigmatic framework is summarised in Table 1 and discussed subsequently.

Table 1: Paradigmatic framework

Framework differentiators	**Positions**		
Ontology	Realism	Nominalism	Constructivist
Epistemology	Positivism	Anti-positivism	
Methodology	Nomothetic	Ideographic	Constructive
Ethics	Means-ends	Interpretive	Critical
Reasoning	Inductive	Deductive	

Three positions exist in the case of *ontology*: *realism, nominalism* and *constructivist. Realism* suggests that the social world is external to individual cognition, consisting of hard, tangible and relatively immutable structures. The realist believes that the social world exists independently of an individual's appreciation of it and has an existence that is as hard and concrete as the natural world (Burrel & Morgan, 1979). *Nominalism*, in contrast, assumes that the social world external to the individuals appreciation, is made of names, concepts and labels which are used to structure reality (Burrel & Morgan, 1979). Searle (1995) adds a third ontological position, the position of the *constructivist*. Constructivism resides between the extremes of realism and nominalism. Constructivists agree with the nominalist that there is no absolute objective reality, but rather a semiobjective reality, called intersubjective reality, built and adapted via social consensus among subjects. The nominalist and constructivist agree that we cannot say how the world is, only how people see it (Gibbs, 2007).

Two *epistemological* positions exist: *positivism* vs. *anti-positivism. Positivism* aims at explaining and predicting what happens in the social world by searching for regularities and causal relationships between its constituent elements (Burrel & Morgan, 1979). *Anti-positivism* holds that only individuals who are directly involved in the activities which are studied, could provide a true understanding of the social world. The anti-positivist rejects the standpoint of the 'observer', which characterises positivist epistemology, as a valid vantage point for understanding human activities. Anti-positivists maintain that one can only 'comprehend' by taking the frame of reference of the participant in action; understanding from the inside rather than the outside (Burrel & Morgan, 1979).

Three categories of *methodology* are identified: *idiographic* methods, *nomothetic* methods and *constructive* methods. Burrell and Morgan (1979) identified the two categories idiographic and nomothetic. *Idiographic* methods highlight the unique elements of an individual phenomenon (G. Marshall, 1998). *Nomothetic* methods aim at providing more general law-like statements about social life, by imitating the logic and methodology of the natural sciences (G. Marshall, 1998). Iivari (1991) provides an additional method (*constructive*), which complements the idiographic and nomothetic methods, but creates a future rather than an existing reality. Focusing on IS development, Iivari's *constructive* methods (1991) could be used in either conceptual or technical developments. Whereas conceptual development refers to the development of various models and frameworks for creating a new reality, which does not necessarily have a physical realisation (e.g. an IS development methodology), technical development produces physical artefacts as output (e.g. executable software, such as a CASE environment).

Three *ethical* positions are distinguished: *means-ends*, *interpretive*, and *critical* (Iivari, 1991). The *means-ends* position provides means knowledge to achieve certain ends (goals), without questioning the legitimacy of the ends. The *interpretive* stance tries to provide and understanding of action, i.e. the goal-statements follow upon action. *Critical* research tries to remove domination and ideological practice by providing a critical analysis of goals (ends) (Iivari & Venable, 2009).

Trochim (2006) defines two ways of *reasoning* when conducting research: *inductive* versus *deductive* reasoning (see Figure 10). According to Charmaz (2006), *inductive reasoning* begins with the study of a range of individual cases and extrapolates patterns from them to form a conceptual category. This type of reasoning requires one to work back and forth between the themes and the data until one establishes a comprehensive set of themes (Creswell, 2007; Trochim, 2006). The tentative hypothesis (about theoretical themes) is transformed into general theory (Trochim, 2006). In contrast, *deductive reasoning* stipulates analytic categories beforehand according to an existing framework. Deductive reasoning works from the existing theoretical framework to define more specific hypotheses, collecting observations that leads to a confirmation (or not) of the original theory (Patton, 2002; Trochim, 2006).

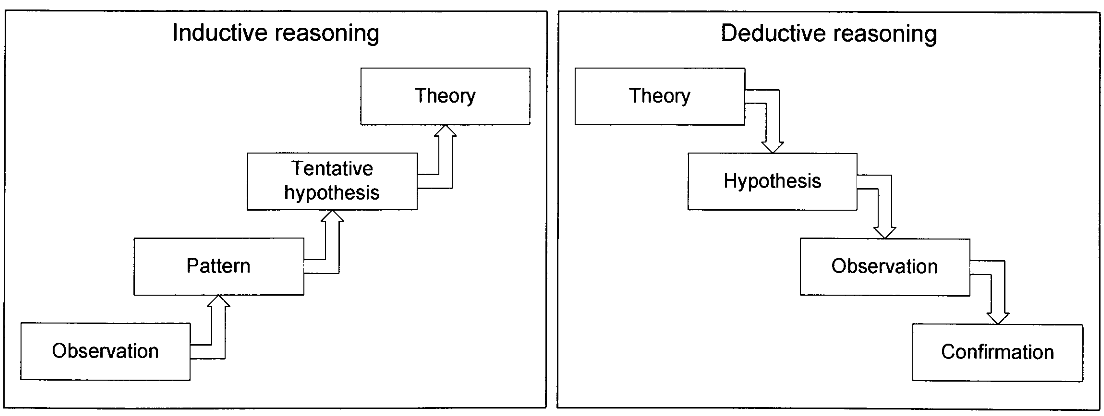


Figure 10: Inductive versus deductive reasoning (Trochim, 2006)

Inductive reasoning is by nature more open-ended and exploratory, while deductive reasoning is concerned with testing or confirming of hypotheses and thus narrower in nature (Trochim, 2006).

This section defined a paradigmatic framework consisting of five differentiators to frame the paradigmatic assumptions of a study: ontology, epistemology, methodology, ethics and reasoning. The paradigmatic framework is used to discuss the paradigmatic assumptions that apply to this study (later in section 2.5).

2.3 RESEARCH DESIGNS

According to the definition used by Creswell & Plano Clark (2006) the research design refers to the plan of action that links *philosophical assumptions* to specific *methods*. A research design may incorporate both quantitative and qualitative information to address the concerns of the main research question. Mouton (2001) states that *quantitative information* and methods are usually associated with the physical sciences, where time, density, costs and other measures may be meaningfully expressed as numbers and manipulated mathematically. In contrast, *qualitative information* and methods are usually associated with people orientated research, emphasising words, feelings, the quality of an event or experience.

This section provides theory about mixed methods designs (section 2.3.1) and the possible combination of two separate research designs in one study. Sections 2.3.3 and 2.3.2 cover two separate research designs, design research and exploratory design respectively.

2.3.1 Mixed method designs

According to Morse (2010) there is no real consensus regarding the definition of mixed method design. Whereas some authors define mixed methods as the combined use of qualitative and quantitative methods (e.g. Creswell & Plano Clark (2006)), others consider mixed methods to be of use when completing two separate research projects within the same study (Leech, 2010). Depending on the mixed methods design, mixed methods research could assume several worldviews / research paradigms (Creswell & Plano Clark, 2006).

Morse (2010) suggests that a mixed methods design consists of a complete design method (i.e. the *core component*), plus one (or more) incomplete design methods(s) (i.e., the *supplementary component*(s)) that cannot be published alone, within a single study. Another criterion for using a mixed method (*core component* plus *supplementary component(s)*) is that the "gap between the core method and supplemental project is too wide for any blending of the data of the core and supplemental project to be possible. Analyses must always be conducted separately" (Morse, 2010, p. 486).

The *supplementary component* usually provides *explanation or insight* within the context of the core component and consists of an incomplete research design, such as a particular style of interview. The *supplementary component* cannot be interpreted or utilised alone, due to an inadequate sample or lack of saturation. In addition, the supplementary component only continues until the researcher is certain enough that the sub-question (related to the supplementary component) is answered (Morse, 2010). See Figure 11 for a graphical representation of the *supplementary* and *core* component.

According to Morse & Niehaus (2009, p. 14), a mixed method design is a strong design, "as the supplementary component enhances validity of the project per se by enriching or expanding our understanding".

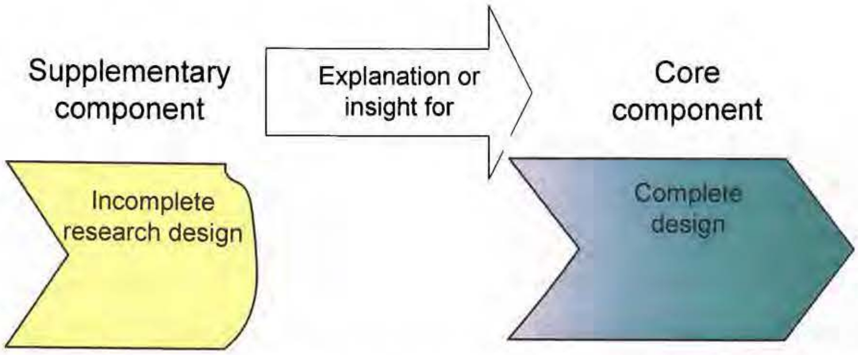
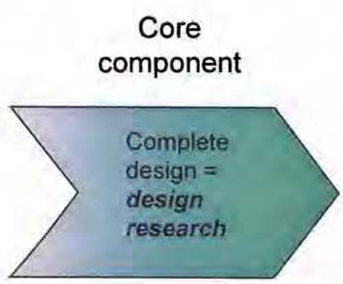


Figure 11: Supplementary and core component of mixed methods research, based on Morse (2010) (duplicate of Figure 6)

Mixed methods design allows for the simultaneous or sequential development of the *supplementary component*, depending on the research question and the strategy that would best enable the research question to be answered. Morse (2010) allows for the combined use of *two distinct qualitative designs* within one study (e.g. using grounded theory as the core component design and an interview as the supplementary component design). Likewise, this thesis demonstrates the combined use of design research (*qualitative*) as the *core component* and exploratory design (*qualitative*) as the *supplementary component* within a single study (see section 2.6).

2.3.2 Design research

Since design research will be used as the core component, within the mixed methods design of this thesis, this section provides more theory on design research as a research approach, followed by a philosophical discussion related to the paradigmatic framework defined in section 2.2.



Design science, as a problem-solving research approach, has its roots in engineering and the sciences of the artificial (Simon, 1996). Simon (Simon, 1996, p. 55) differentiated design science from other paradigms: "Whereas natural sciences and social sciences try to understand reality, design science attempts to create things that serve human purposes". Design science reflects on *design as a topic* of investigation to explore almost any design related subject, whereas *design research* uses *design as a method* for investigation (Kuechler & Vaishnavi, 2008), aiming to create "solutions to specific classes of relevant problems by using a rigorous construction and evaluation process" (Winter, 2008, p. 471). Although design research (especially IT-based design) received attention and development within the IS discipline, some also reason that design research may contribute to organisational theory development and improvement of professional practice (Romme, 2003; Van Aken, 2005). Keuchler & Vaishnavi (2008) are also in favour of a broader scope for design science research than its current focus on creating low level artefacts (IT mechanisms).

The following sections provide some background on design research as a research approach, followed by a philosophical discussion related to the paradigmatic framework defined in section 2.2.

2.3.2.1 Design research methodology and outputs

Although Vaishnavi & Kuechler (2004/5, p. 78) acknowledge the required alignment between business and information technology, they restrict their discussion of design science to the "activities of building the IS infrastructure within the business organisation". Highlighting the applicable use of design-science based research within the context of business-IT alignment, this thesis uses design-science based research to solve one of the research questions (see application of design research theory in section 2.6.2).

The fundamental principle of design-science based research (in short, design research) is that "knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact" (Henver, March, Park, & Ram, 2004, p. 82). Knowledge and action form a cycle, in which knowledge is used to create works, and works are evaluated to build knowledge (Owen, 1997).

Figure 12 demonstrates the reasoning in the design cycle. A design begins with *awareness of a problem*, followed by *suggestions* drawn from the existing knowledge/theory base for the problem area. An artefact may be implemented according to the suggested solution during the *development* process step. Implementations (partially or fully) are then *evaluated* (according to the requirements depicted in the *suggestion* description). Development and evaluation may lead to re-visitation of the problem (circumscription arrow in Figure 12) and further suggestion. Several iterations may be required before a design project reaches the *conclusion* step. Circumscription is an important process in design research as it creates an understanding that could only be gained from the construction-act. When the design process gets interrupted, valuable constraint knowledge is derived to gain a better understanding of the incomplete theories that initiated the original research problem (Vaishnavi & Kuechler, 2004/5).

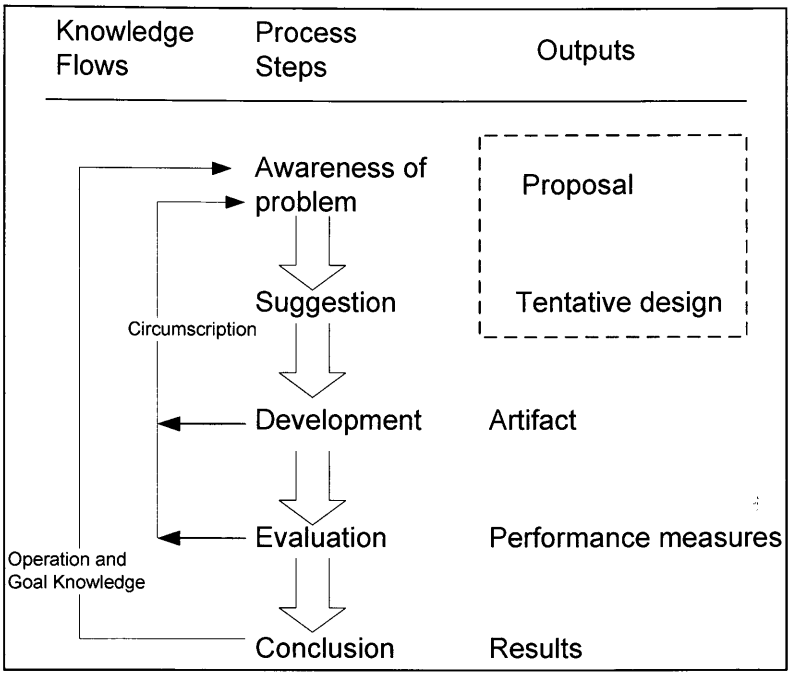


Figure 12: Reasoning in the design cycle, based on Vaishnavi & Kuechler (2004/5)

March & Smith (1995) identify four design artefacts/outputs produced by IS-related design-science research, including *constructs*, *models*, *methods*, and *instantiations*. *Constructs* offer a language for defining problems and situations. *Models* make use of constructs to depict a real world situation, frequently representing the connection between the problem and solution components. *Methods* define processes or guidance on how to solve problems, ranging from mathematical algorithms to informal, textual descriptions of "best practice". *Instantiations* are actual working/implemented systems, based on constructs, models, or methods. Instantiations enable researchers to evaluate the artefacts within a real-world environment (Henver et al., 2004). A fifth output, *better theories*, is added by Rossi & Sein (2003) and Purao (2002). Design research can contribute to *better theories* in two ways: (1) providing proof of a method (a methodological construction of an artefact is an object of theorising) or (2) exposing relationships between artefact elements and thereby elaborating previously theorised relationships. Table 2 provides a summary of the main outputs.

Table 2: The outputs of design research, based on Vaishnavi & Kuechler (2004/5)

	Output	**Description**
1	Constructs	The conceptual vocabulary of a domain
2	Models	A set of propositions or statements expressing relationships between constructs
3	Methods	A set of steps used to perform a task – how-to knowledge
4	Instantiations	The operationalisation of constructs, models and methods
5	Better theories	Artefact construction as analogous to experimental natural science

Since this study includes both a *model* (the BIAM), and *better theories (*by providing proof for the PRIF *method* and its associated mechanism and practices), the seven guidelines provided by Henver et al. (2004) (see Table 3) for constructing design-research outputs, were also useful. According to Henver et al. (2004), the guidelines, may be helpful to identify the *appropriate approach* for a research project, but should not be used in a mechanistic way.

Table 3: Design-science research guidelines, based on Henver et al. (2004)

Guideline	Description
Guideline 1: Design as an artefact	Design-science research must produce viable artefacts in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design evaluation	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.
Guideline 5: Research rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.
Guideline 6: Design as a search process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

The seven guidelines of Henver et al. (2004) (see Table 3) provide guidance on viable artefacts, problem relevance, *design evaluation*, the research contribution, research rigor, the search process within the problem environment, and communication of research results. In terms of *design evaluation*, Henver et al. (2004) propose design evaluation methods that may be applicable in evaluating an artefact. One of the proposed design evaluation methods, a controlled experiment, is used to study an artefact in a controlled environment for qualities, such as usability (Henver et al., 2004). Data collection methods that could be used in combination with a controlled experiment to obtain artefact evaluation results include questionnaires (discussed in section 2.4.1) and interviews (discussed in 2.4.3).

2.3.2.2 Paradigmatic assumptions of design research

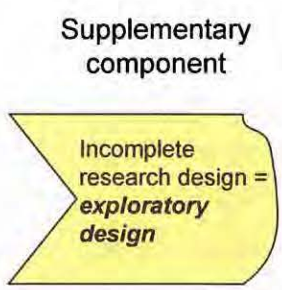
Design research complements both positivistic and interpretivistic perspectives (Niehaves, 2007; Vaishnavi & Kuechler, 2004/5). A study performed by Niehaves (2007) used the seven guidelines (see Table 3 in the previous section) for design-science research compiled by Henver et al. (2004) to reflect on how an intepretivist could still adhere to the guidelines by applying Klein and Meyer's (1999) set of principles of interpretive field studies. The possible pluralism in philosophical stance is due to the socio-technologist type of problems that are addressed and the constructional/developmental method that goes hand-in-hand with design research (Gregg, Kulkarni, & Vinze, 2001). Although Vaishnavi & Kuechler (2004/5) define design research as a third paradigmatic perspective, Iivari & Venable (2009, p. 7) disagrees, stating that design research "may be based on more or less" 'positivistic' or 'anti-postivistic' assumptions.

Applying the paradigmatic framework defined in section 2.2, Iivari & Venable (2009) debates the philosophical pluralism inherent in design research. In terms of *ontology,* design research adopts *constructivism*, i.e. building social consensus about a specific part of reality (Vaishnavi & Kuechler, 2004/5). Although design research produces general solution concepts, typical of a positivistic *epistemology*, an anti-positivistic *epistemology* may be assumed during the evaluation of designed artefacts. Although both nomothetic and idiograpic *methods* are proposed (Henver et al., 2004), the third category of methods (constructive) is exemplary of design research. In terms of *ethics*, design research is mostly means-ends-oriented and may also take a critical position to challenge existing power structures through the development of new artefacts (Iivari & Venable, 2009). The type of *reasoning* as defined by Trochim (2006) may require either/both *inductive* and *deductive* reasoning depending on the type of artefact constructed.

This section motivated the possible philosophical pluralism inherent in design research, when the paradigmatic framework (defined in section 2.2) is applied to design research. Later in section 2.5, the philosophical stance of this study is motivated.

2.3.3 Exploratory design

Since exploratory design will be used as the supplementary component (not the core component), within the mixed methods design of this thesis, this section provides an introduction on exploratory design.



Mouton (2001, p. 22) states that exploratory research looks for ideas, patterns or themes to explore a current phenomenon/event/issue/problem. Exploratory studies are the first step in a research program designed "to develop a new theory or model that has broad applicability". Exploratory information that reveals patterns may be developed into a theory to explain how various elements contribute to patterns. Some research designs (e.g. case study research), may be explorative in nature, but may not be representative of all the characteristics of the concept required for generalisation.

The broad definition of exploratory design impairs classification according to the paradigmatic framework defined in section 2.2. However, in terms of reasoning, an exploratory design starts with an *inductive* reasoning to identify existing patterns or themes.

2.4 METHODS FOR DATA COLLECTION

According to Cresswell & Plano Clark (2006) *methods* relate to techniques of data collection and analysis. This section provides theory about three data collection methods used in this study: literature review (section 2.4.1), questionnaires (section 2.4.2) and interviews (section 2.4.3).

2.4.1 Literature review

According to Webster & Watson (2002) a *literature review* creates a firm foundation for advancing knowledge by facilitating theory development. Booth, Papaionnou, & Sutton (2012, p. 2) define a *literature review* as a method for "identifying, evaluating and synthesising the existing body of completed and recorded work produced by researchers, scholars, and practitioners". Booth et al. (2012) state that a literature review offers numerous opportunities to engage and interact with theory. They identified eleven different types of review; one is called the *qualitative systematic review* (QSR). The QSR integrates and compares findings from qualitative studies, with the objective to find themes or constructs in or across individual studies. The analysis process may include conceptual models (Booth et al., 2012). One of the examples presented by Booth et al. is a study performed by Damschroder et al. (2009) to combine constructs across published theories with different labels, removing redundancy and overlap. The result of the meta-model by Damschroder et al. was an overarching typology for implementation research.

Later, section 2.6.3 applies the *qualitative systematic review* as a data-gathering method for constructing the Business-IT Alignment Model (BIAM).

2.4.2 Questionnaires

Questionnaires are often based on the desire to collect information from a sample of respondents from a well-defined population. The questionnaire typically contains a series of questions for the respondents to answer (Czaja & Blair, 2005). Questionnaire information can be collected via various means (e.g. mails, web-based, telephone and interviews), using different formats (i.e. closed-ended and open-ended). Closed-ended questions provide a fixed list of alternative responses and ask the respondent to select according to the predefined alternatives. In contrast, the open-ended questions do not provide a pre-existing response, allowing the respondent more latitude in responding (Rea & Parker, 2005).

Whitten & Bentley (2007, p. 221) listed several advantages and disadvantages when a systems analyst uses a questionnaire for data-gathering (see Table 4). As evident in Table 4, questionnaires allow for relative inexpensive data-gathering from a large number of individuals. However, due to its inflexible nature, a questionnaire does not produce the same level of richness and opportunities for further expansion/explanation that is possible with an interview.

Table 4: Advantages and disadvantages of using questionnaires (Whitten & Bentley, 2007)

Advantages	Disadvantages
• Most questionnaires can be answered quickly. People can complete and return questionnaires at their convenience. • Questionnaires are a relatively inexpensive means of gathering data from a large number of individuals. • Questionnaires allow individuals to maintain anonymity. Therefore, individuals are more likely to provide real facts, rather than telling you what they think their boss would want them to. • Responses can be tabulated and analysed quickly.	• The number of respondents is often low. • There is no guarantee that an individual will answer or expand on all of the questions. • Questionnaires tend to be inflexible. There is no opportunity for the systems analyst to obtain voluntary information from individuals or reword questions that may have been misinterpreted. • It is not possible for the systems analyst to observe and analyse the respondent's body language. • There is no immediate opportunity to clarify a vague or incomplete answer to any question. • Good questionnaires are difficult to prepare.

The ultimate goal of the questionnaire-based research is to allow the researchers to generalise about a large population by studying only a sample of the population. Accurate generalisation requires orderly procedures for statistical analysis and also require identification of variables/parameters that require measurement. Depending on the type of variable/parameter, different measurement scales may be applicable, e.g. nominal scale (using labelled categories), *ordinal scale* (using ordering/ranking) and interval scale (exact measure in terms of a standard unit of value). An *ordinal scale* that is often used to measure the attitude of the respondent is called the Likert scale, which entails a five-, seven-, or nine-point rating scale (Rea & Parker, 2005). An example of a five-point scale is:

Value	**Description**
1	Strongly disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly agree

Once collected via the questionnaire, descriptive statistics are used to describe characteristics of the sample data (x) and thereby provide an indication of the characteristics of the larger population. Descriptive statistics usually measure the *central tendency* and *dispersion* of the data. Although various measures are used to measure *central tendency* (e.g. mode, median and average), the *average* (arithmetic mean) is most often used by the general public. The *average* is the mathematical centre of the data. Likewise, various measures are used to measure *dispersion* (e.g. range and standard deviation), but the *standard deviation* is most often used. The *standard deviation* represents the mean distance of each value in the sample from the *average*. The more dispersed the data are, the greater is the *standard deviation* (Rea & Parker, 2005).

The *average* and *standard deviation* formulas are given below:

(1) *Average*, $\bar{x} = \frac{\sum x}{n}$

(2) *Standard deviation*, $S = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$

Two prerequisites for generalisation, based on the statistical analysis of a sample, are an adequate *sample size* and selection of a *representative sample*, discussed in sections 2.4.2.1 and 2.4.2.2 respectively.

2.4.2.1 Sample size

The appropriate sample size is determined by the level of accuracy required to make inferences from the sample to the entire population. Using a sample, rather than the entire population, introduces the risk of making erroneous inferences about the population (Rea & Parker, 2005). This thesis does not aim to confirm or reject a hypothesis based on statistical results, but rather use descriptive statistics to highlight areas that require further research. Therefore, this section will not elaborate further on the requirements for an adequate sample size.

2.4.2.2 Representative sample

Sampling methods can be categorised into *probability sampling* and *nonprobability sampling* (Rea & Parker, 2005).

If a study has the objective to generalise findings scientifically, *probability* sampling is required. In *probability sampling*, every member of the working population should have an equal chance of being selected as part of the sample. Probability sampling requires knowledge of the composition and size of the population (Rea & Parker, 2005).

If a study does *not* aim to generalise findings scientifically (i.e. with a known degree of accuracy), *nonprobability sampling* would be adequate. In *nonprobability sampling*, every member of the working population does *not* have an equal chance of being selected as part of the sample. In addition, the research may not have knowledge about the composition and size of the population. One type of nonprobability sampling is *convenience sampling*. According to Hesse-Biber & Leavy, (2011) a *convenience sample* is a sample of informants that are available, who have some specialised knowledge of the setting, and are willing to serve in a specific role.

This study applied questionnaires as part of a qualitative analysis, retrieving experience-based knowledge from the research participants. Section 2.6.2 elaborates on the use of questionnaires in this study. Questionnaires tend to be inflexible in nature, disallowing opportunities for further expansion/explanation. Interviews are more flexible and may be used as a complementary data-gathering tool.

2.4.3 Interviews

The research interview is an "*interview* where knowledge is constructed in the *interaction* between the interviewer and the interviewee" (Kvale, 2007, p. 1). Hesse-Biber & Leavy (2011) define various different types of interviews, i.e. in-depth interviews, semistructured interviews and structured interviews. The *in-depth interview* is used when the interviewer seeks knowledge from the interviewee's point of view. The interview questions are open-ended and the degree of structure to the interview depends on the extent to which interviewers have a specific agenda. The *semistructured interview* contains specific research questions, selected by the interviewer to guide the interview, but used based on discretion. The *structured interview* starts with a pre-defined set of questions posed to every interviewee. If the participant strays away from the topic at hand, the interviewer will guide the conversation back to the interview questions.

Whitten & Bentley (2007, p. 223) listed several advantages and disadvantages when a systems analyst uses an interview for data-gathering (see Table 5).

Table 5: Advantages and disadvantages of using interviews (Whitten & Bentley, 2007)

Advantages	Disadvantages
• Interviews give the analyst an opportunity to motivate the interviewee to respond freely and openly to questions. By establishing rapport, the systems analyst is able to give the interviewee a feeling of actively contributing to the systems project. • Interviews allow the systems analyst to probe for more feedback from the interviewee. • Interviews permit the systems analyst to adapt or reword questions for each individual. • Interviews give the analyst an opportunity to observe the interviewee's nonverbal communication. A good systems analyst may be able to obtain information by observing the interviewee's body movements and facial expressions as well as by listening to verbal replies to questions.	• Interviewing is a very time-consuming, and therefore a costly, fact-finding approach. • Success of interviews is highly dependent on the systems analyst's human relations skills. • Interviewing may be impractical due to the location of interviewees.

As can be seen from Table 5, interviews are very time-consuming, but allows for communicative interaction between the interviewer and the interviewee in obtaining a richer data set than with a questionnaire.

This section provided theory on different data collection methods that are applicable to this study. The section is also the concluding section as related to the theory of research methodology. The following two sections (sections 2.5 and 2.6) apply the theory of research methodology to the specific research methodology for this thesis. Section 2.5 delineates the paradigm of this thesis, whereas section 2.6 details the research design and data collection methods for this thesis.

2.5 PARADIGM FOR THIS THESIS

A mixed methods design is appropriate to answer the main research question of this thesis, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept within the context of business-IT alignment?

The mixed methods design, as defined by Morse (2010), requires two design components to answer the main research question. According to Morse (2010), the two design components (a *core component* and *supplementary component*) may be used sequentially or simultaneously. The *supplementary component* continues until the researcher is certain enough that the sub-question (pertaining to the *supplementary component*) is answered.

This study started with the *core component* (*design research*) in answering *Research Question 2*, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

Since an appropriate business-IT contextualisation model could not be found, the study also initiated a *supplementary component* (*exploratory design*), to develop a business-IT contextualisation model, thus answering the *Research Question 1*, namely:

What model is required to contextualise different business-IT alignment approaches?

Thus, the *supplementary component* (*exploratory design*) was used *simultaneously* with the *core component* (*design research*) to answer the main research question. As suggested by Morse (2010), the *supplementary component* (*exploratory design*) only continued until the sub-question (*Research Question 1*) was answered.

Using a mixed methods design (see Figure 13), the core component (*design research*), developed the PRIF (Process Reuse Identification Framework), and a supplementary component (*exploratory design*), developed the BIAM (Business-IT Alignment Model). Even though Morse (2010) states the supplementary component may not be publishable within a single study, the result of the supplementary component (initially called the Business-IT

Alignment Framework (BIAF)) was published as a single study (De Vries, 2010). Yet, the result of the supplementary component (BIAM) was a prerequisite in providing *business-IT alignment insight* for the core component.

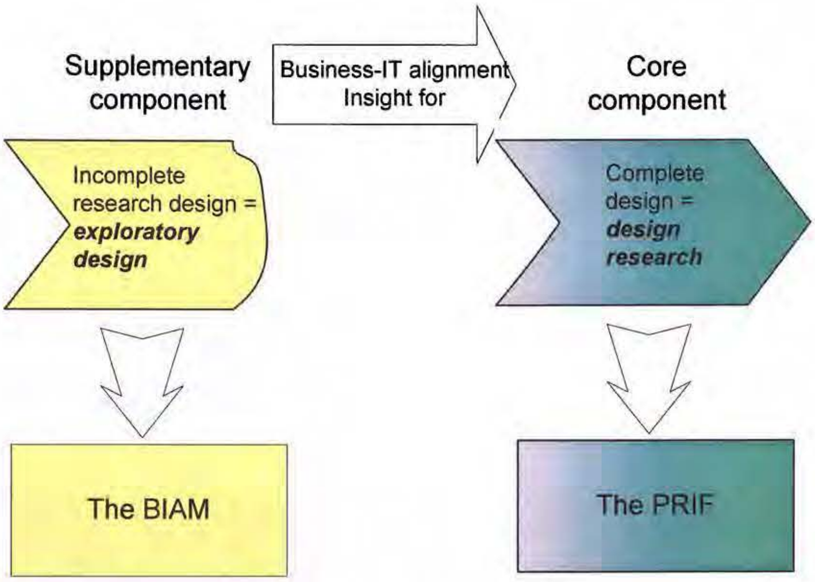


Figure 13: Components of a mixed methods design for this thesis

Referring back to section 2.2, the paradigmatic framework includes *ontology*, *epistemology*, *methodology, ethics* and *reasoning.* Table 6 presents the paradigmatic framework, as applied to this thesis (shaded cells on Table 6) and is discussed subsequently.

Table 6: Paradigmatic framework applied to this thesis

Framework differentiators	Positions		
Ontology	Realism	Nominalism	Constructivist
Epistemology	Positivism	Anti-positivism	
Methodology	Nomothetic	Ideographic	Constructive
Ethics	Means-ends	Interpretive	Critical
Reasoning	Inductive	Deductive	

My *ontological* belief is that of *constructivism.* Constructivists agree with the nominalist that there is no absolute objective reality, but rather a semiobjective reality, called intersubjective reality, built and adapted via social consensus among subjects. Although the construction of the PRIF (Process Reuse Identification Framework) applies positivist-related methods during the evaluation of the PRIF, an anti-positivistic stance is taken to construct an intangible artefact that is useful to a very specific community, i.e. enterprise architecture practitioners using the operating model (OM). The development/construction of the BIAM (Business-IT Alignment Model) follows *inductive reasoning* using exploratory design, which requires an *anti-positivist* *epistemological* stance. The inductive reasoning process gathers knowledge from different existing alignment approaches, each based on its own worldview.

Both nomothetic and constructive *methods* were used in this thesis. Nomothetic methods aim to generalise, which is the purpose of constructing both the BIAM and PRIF. Constructive methods are typical of design research (used to construct the PRIF), which assist in creating a new reality, rather than describing and existing reality. The *ethical* position is both means-ends and critical. The means-ends position relates to the development of the BIAM; the BIAM (means) could be used to contextualise an existing alignment approach in terms of business-IT alignment (ends). The means-ends position also relates to the PRIF (means) which could be used to identify process re-use opportunities at an enterprise (ends). The critical position relates to the fact that an application of the PRIF could lead to process standardisation implementation, which could challenge existing power structures.

Finally, in terms of reasoning, the BIAM and PRIF required both *deductive* and *inductive reasoning*. Both artefacts (BIAM and PRIF) required *inductive* reasoning during the development and construction of the artefacts and *deductive* reasoning during the application/evaluation of the artefacts.

2.6 THESIS RESEARCH DESIGN AND METHODS FOR DATA COLLECTION

This study applied a mixed methods design as delineated in section 2.3.1. The purpose of this section is to outline the specific design/research plan for this study, based on the theoretical concepts about research design (covered in section 2.3) and data collection methods (discussed in section 2.4).

Section 2.6.1 describes the mixed methods design and the constituent two components, *design research* and *exploratory design*. Sections 2.6.2 and 2.6.3 provide more detail about the two components and their associated data collection methods.

2.6.1 A mixed methods design

The mixed methods design (see Figure 14) consists of a core component (*design research*), which develops the PRIF (Process Reuse Identification Framework), and a supplementary component (*exploratory design*), which develops the BIAM (Business-IT Alignment Model). Figure 14 show that the *exploratory design* component produces the BIAM, which provides *business-IT alignment insight* (Figure 14, horizontal arrow) for the *design research* component and subsequent development of the PRIF. According to Morse (2010), the supplementary component (*exploratory design*) may consist of an incomplete design (e.g. using literature review alone as data collection instrument). The core component (*design research*), however, requires a complete design (e.g. adhering to the guidelines of Hevner et al. (2004) in doing design research, and using questionnaires and interviews as appropriate).

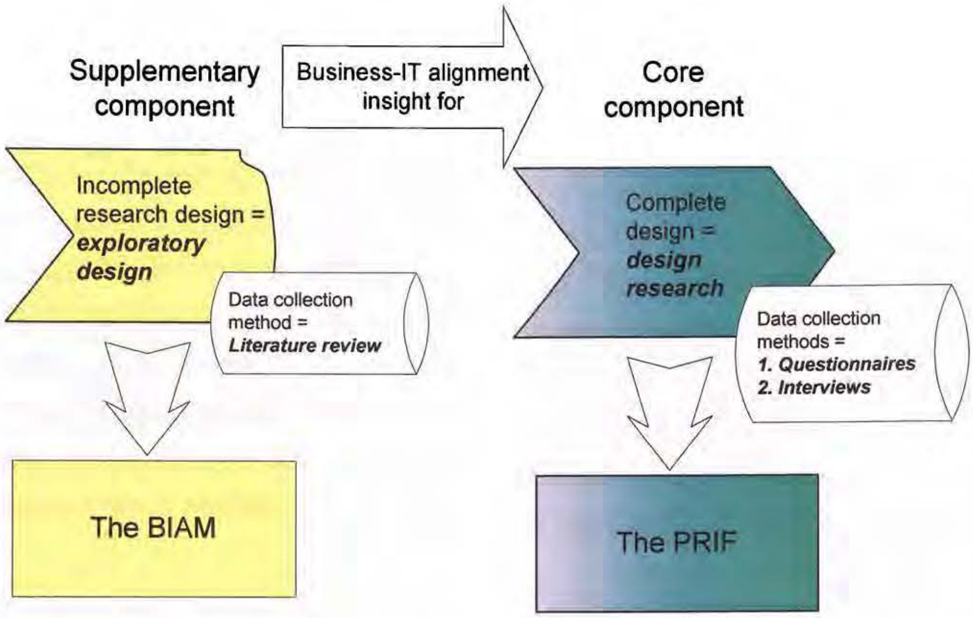


Figure 14: Components and data collection methods for this thesis

2.6.2 Design research and data collection for building the PRIF

This study applied design research as a complete research design (core component) to develop the PRIF (Process Reuse Identification Framework). The main design research cycle (Figure 15, column 1, *The main cycle*) consists of five steps to address *Research Question 2* of this thesis: (1) awareness of problem, (2) suggestion, (3) development, (4) evaluation and (5) conclusion. The *development* step of the main cycle contains three sub-cycles (Figure 15, column 2, *Sub-cycles*), each contributing systematically to the development of the whole PRIF:

- Sub-cycle 1 applies a BIAM contextualisation to the *foundation for execution approach* (Ross et al., 2006) to demarcate and derive requirements for the PRIF.
- Sub-cycle 2 applies the BIAM contextualisation to the *essence of operation approach* (Dietz, 2006) to ensure compatibility with the OM. In addition, Sub-cycle 2 evaluates the use of the interaction model (part of the *essence of operation approach*) as a suitable process representation language for the *method, mechanisms and practices* of PRIF.
- Finally, Sub-cycle 3 develops a *method, mechanisms and practices* that incorporates the interaction model (evaluated in Sub-cycle 2), and adhere to the requirements stipulated in Sub-cycle 1.

During the main cycle and Sub-cycles 1 and 2, the *problem awareness* steps require re-visitation of the extended knowledge base (Figure 15, yellow arrow, *EKB Re-visitation*). A re-visitation of knowledge leads to suggestions to incorporate existing knowledge within the context of developing the PRIF.

The design research components are colour-coded to map the components to Part C chapters of this thesis. In addition, the colour-coded sub-cycles (Figure 15, column 2, *Sub-cycles*) also map to the colour-coded parts of the PRIF (Figure 15, column 3, *The PRIF*).

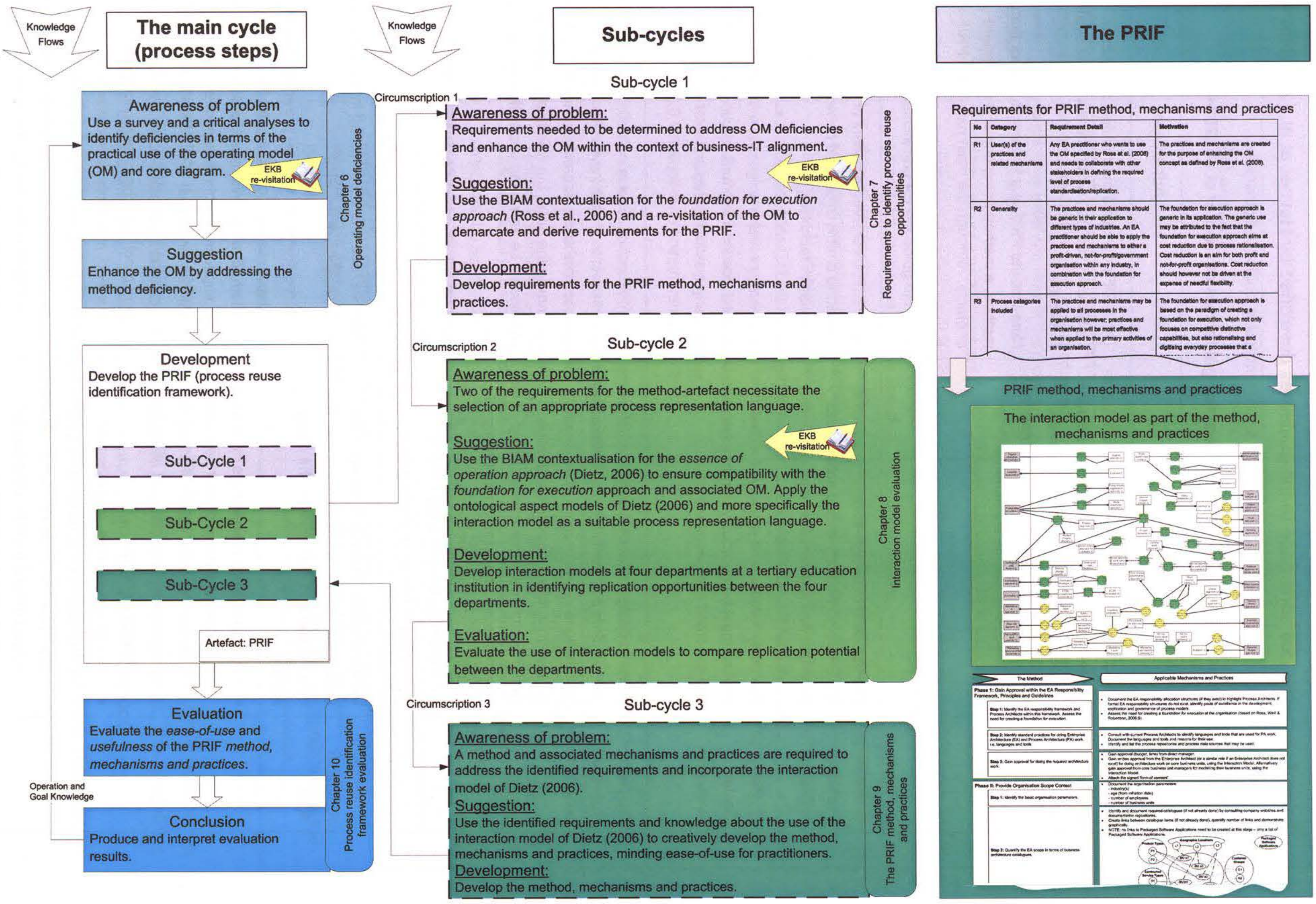


Figure 15: Design research for building and validating the PRIF

Table 7 demonstrates adherence to the guidelines developed by Hevner et al. (2004) on doing design research.

Table 7: Adherence to the design-science research guidelines of Hevner et al. (2004)

Guideline	Description	Adherence
Guideline 1: Design as an artefact	Design-science research must produce viable (innovative, purposeful) artefacts in the form of a construct, a model, a method, or an instantiation. The artefact must be described effectively, enabling its implementation and application in an appropriate domain.	The PRIF provides a purposeful contribution (enhancing the OM) within the domain of business-IT alignment. Note that the PRIF is a framework, rather than a method, a method being one of the standard artefacts. Although the main part of the PRIF is a method, additional mechanisms and practices were added to guide the EA practitioner.
Guideline 2: Problem relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.	The PRIF, as an enhancement of the OM concept, is used to enable *alignment between business and information technology*.
Guideline 3: Design evaluation	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.	The study provides a rigorous evaluation of the method, mechanisms and practices of the PRIF, by applying questionnaires and interviews based on experimentation (see section 2.6.2).
Guideline 4: Research contributions	Effective design-science research must provide clear and verifiable (implementable) contributions in one or more of the areas of the *design artefact*, design foundations, and/or design methodologies. In terms of the *design artefact*, the artefact must enable the solution of unsolved problems. It may extend the knowledge base of apply existing knowledge in new an innovative ways.	The PRIF enhances a current model (i.e. the OM) with respect to identifying process re-use opportunities at an enterprise. The PRIF extends the knowledge base, but also applies existing knowledge, i.e. using the interaction model in new ways. Refer to chapter 11 for an in-depth discussion of research contributions.
Guideline 5: Research rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact. • Design-science researchers must assess the appropriateness of their performance metrics. The construction of effective metrics is an important part of design-science research. • Constructs, models, methods, and instantiations must be exercised within appropriate environments. Appropriate subject groups must be obtained for such studies. Issues include	Rigorous methods were applied in the construction and evaluation of the PRIF: • A requirements analysis provides effective objectives and constraints for the required *method, mechanisms and practices*. In addition, a suggested method-component (the interaction model) is evaluated prior to its inclusion as part of the *method, mechanisms and practices*. The construction process of the *method, mechanisms and practices* demonstrates adherence to the identified requirements. The *method, mechanisms and practices* apply metrics to evaluate ease-of-use and usefulness of the artefact.

Guideline	Description	Adherence
	comparability, subject selection, training, time and tasks.	• The selected subject group (research participants) received training on business-IT alignment theories and practices, as well as the BIAM and the proposed *method, mechanisms and practices* of PRIF.
Guideline 6: Design as a search process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment. • If the case of a wicked problem (high complexity in the solution space), the design task involves construction of an artefact that 'works well' for the specified class of problems. A search process could then iteratively identify deficiencies and creatively develop better solutions. • The 'goodness' of solutions need to be demonstrated, e.g. comparing solutions with those constructed by expert human designers for the same problem situation.	The study demonstrates the identification of available means (available mechanisms and practices) that may address desired ends, posed by defining PRIF requirements. • The study applies one evaluation-iteration to the PRIF. Yet, additional iterations could lead to adaptations and additional solution improvement. • The study measures the solution (*method, mechanisms and practices*) against the identified PRIF requirements, rather than against other existing solutions.
Guideline 7: Communi-cation of research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences. • Technology-oriented audiences need sufficient detail to enable the described artefact to be constructed (implemented). • Management-oriented audiences need sufficient detail to determine if the enterprise resources should be committed to constructing and using the artefact within their specific enterprise context.	The PRIF is presented effectively: • The *method, mechanisms and practices* of PRIF present sufficient detail to EA practitioners, who had to use the *method, mechanisms and practices* in identifying process re-use opportunities at their enterprises. • The method-artefact includes components to plan the scope of method-application at an enterprise. Research participants had to facilitate discussions with business unit managers and the chief enterprise architect to define the scope of implementation.

As can be seen from Table 7, the research design for the development of the PRIF adheres to the guidelines proposed by Hevner et al. (2004). As proposed by Hevner et al., the guidelines assisted with the identification of an appropriate approach and evaluation methods.

The following sub-sections provide details on the data collection methods that were used as part of the design research process.

2.6.2.1 Data collection in defining the research problem

During the initiation of the study, (Figure 15, column 1, *Awareness of problem*) a *questionnaire* was used (discussed in section 2.4.2), based on experimentation, to evaluate the practicality of defining an OM and high-level representation of the EA (as depicted on a core diagram). This study takes the stance that EA practitioners will be primarily responsible (in consultation with the chief executive officer and business managers) to define a future OM, based on business architecture analyses. Questionnaires would thus be a suitable instrument to obtain feedback from EA practitioners on the practicality of defining the OM, based on guidelines provided by Ross et al. (2006). The questionnaires incorporate both closed-ended and open-ended questions (see Appendix A).

The research participants received training to ensure that they were knowledgeable on business-IT alignment, strategic decision-making, and the *foundation for execution* approach and associated artefacts as defined by Ross et al. (2006). A *convenience sample* (see definition in section 2.4.2.2) of *thirty* graduate participants was used, of which fifty-two percent (52%) of the participants had previously obtained an engineering degree, thirty-two percent (32%) a technical diploma, twelve percent (12%) a Bachelor of Science (BSc) degree, and four percent (4%) a Bachelor of Commerce (BCom) degree (De Vries & Van Rensburg, 2009).

2.6.2.2 Data collection to evaluate the use of the interaction model

The second sub-cycle (Figure 15, column 2, *Sub-cycle 2*) required evaluation of the interaction model as a component of the *method, mechanisms and practices* of PRIF. According to the set of requirements generated in sub-cycle 1 (Figure 15, column 2, *Sub-cycle 1*), the *method, mechanisms and practices* required a *process representation language* that would adhere to two of seven requirement categories.

This thesis argues the use of the ontological aspect models, and more specifically the interaction model, as a suitable *process representation language*, that could be incorporated as part of the PRIF *method, mechanisms and practices.* EA practitioners would ultimately use the interaction model; therefore, the study required EA practitioners to experiment with the interaction model. One of the two requirements stipulates that *business users* should be able to understand the process representation language that is used in rendering process reuse identification results. The study consequently required evaluation of the interaction model from two viewpoints: (1) the *EA practitioner's* viewpoint and (2) the *business user's* viewpoint.

The experimentation process followed a participative approach, where a sample of four research participants (industrial engineers) represented an *EA practitioner's* viewpoint. The participants received extensive training in the use of the interaction model and the underlying theory. Each participant was responsible for developing an interaction model for a different engineering department at a tertiary education institution, using the ABACUS tool. ABACUS (architecture based analysis of complex systems) is a repository-based modelling tool that supports over 30 public frameworks and notations (Avolution, 2012). ABACUS was selected as modelling tool due to several reasons:

- Availability of the ABACUS tool to the research participants.
- Support from the ABACUS-vendor, Avolution, to develop templates in modelling the ontological aspect models, based on the DEMO-3 specifications (Dietz, 2009).
- The ability to perform comparisons between different models, due to the repository of components and connections, and reporting tools of ABACUS.
- The ability to re-use components and connections within several graphical representations.

For the *business user* perspective, *four* heads of departments (HODs) were involved interactively to evaluate the contents of their departmental interaction model. An introductory presentation ensured that HODs received sufficient training in understanding the theory behind the interaction model (see Appendix B for introductory presentation slides). The HODs were also requested to provide feedback on the ease of understanding of the interaction model in the form of a *semistructured interview* (see definition in section 2.4.3).

2.6.2.3 Data collection to evaluate the PRIF method, mechanisms and practices

During the evaluation process of the main cycle, (Figure 15, column 1, *Evaluation*) a *questionnaire* was used (discussed in section 2.4.2). The questionnaire was based on experimentation, and evaluated the ease-of-use and usefulness of the *method, mechanisms and practices* from an *EA practitioner viewpoint*. The research participants (EA practitioners) also had to explain the use of the *method, mechanisms and practices* to their business unit managers to obtain feedback on its ease-of-understanding from a *business user* viewpoint. The questionnaires incorporated both closed-ended and open-ended questions (see Appendix A, *Task 1* and *Task 2*).

This study had to ensure that the group of research participants were knowledgeable on business-IT alignment, as well as the *foundation for execution* approach (Ross et al., 2006) and the *essence of operation* approach (Dietz, 2006). The participants also received training on the use of the *method, mechanisms and practices*, and the underlying theories (see Appendix B on training notes). A *convenience sample* (see definition in section 2.4.2.2) of *fourteen* post-graduate participants was used. However, two participants were excluded; one participants was absent from both training sessions on the interaction model and underlying theory, whereas the second participant applied a different method than stipulated by the PRIF *method, mechanisms and practices*. Although a small sample, if compared to a sample of 30 participants in the survey pertaining to the practicality of the OM and core diagram (discussed in section 2.6.2.1), training sessions were highly interactive due to the small group, consequently participants gained a thorough understanding of the underlying theories covered during the contact sessions.

The profiles of the *twelve sample* participants indicated that seventy-five percent (75%) of the participants previously obtained an industrial engineering degree, eight percent (8%) a mechanical engineering degree, eight percent (8%) a technical diploma and eight percent (8%) did not indicate the tertiary qualification.

2.6.3 Exploratory design and data collection for building the BIAM

This study applied an exploratory design as a research design to develop the BIAM (Business-IT Alignment Model), solving *Research Question 1.* According to Marshall & Rossman (2011) qualitative methodologists have described three major purposes for research: to *explore*, *explain* or *describe* a phenomenon. An *exploratory* study has one or more of the following objectives (C. Marshall & Rossman, 2011):

- To investigate little-understood phenomena.
- To identify or discover important categories of meaning.
- To generate hypotheses for further research.

In developing the BIAM, exploratory design aims to satisfy the second objective, i.e. to identify or discover important categories for current alignment approaches. A *literature review* (data collection method) *inductively* extrapolated themes from existing data. Figure 16 applies the concepts on inductive and deductive reasoning as described by Trochim (2006). Inductive reasoning required iteration back and forth between the themes and the data until a comprehensive set of themes were established (see Figure 16, *Iterate back and forth* arrow).

This study used *four main data sources* in constructing the BIAM:

1. Six current alignment approaches.
2. Theoretical foundations of the six alignment approaches.
3. The ISO/IEC/IEEE 42010 standards.
4. Lapalme's three schools of thought.

Although not part of the primary data source, this thesis also refers to *other alignment approaches* (discussed in section 3.4) as a *secondary data source*, to provide additional motivation and explanation for some of the BIAM constructs.

The use of BIAM was demonstrated by applying BIAM *deductively* to four diverse approaches:

1. The *Zachman* approach (Zachman, 2009a).
2. The *Open Group* approach (The Open Group, 2009).
3. The *foundation for execution* approach (Ross et al., 2006).
4. The *essence of operation* approach (Dietz, 2006).

The following four sections (sections 2.6.3.1 to 2.6.3.4) present the main data sources for developing the BIAM inductively.

2.6.3.1 Data source 1: Six current alignment approaches

The study analysed six current alignment approaches (Figure 16, *Data source 1*), later discussed in section 3.3, to highlight commonality in terms of business-IT alignment:

1. The *Zachman* approach (Zachman, 2009a).
2. The *Open Group* approach (The Open Group, 2009).
3. The OMB approach ((OMB, 2005, 2007a, 2007b).
4. The Gartner approach ((Bittler & Kreizman, 2005; Gartner, 2008a, 2008b; James, Hander, Lapkin, & Gall, 2005)
5. The *foundation for execution* approach (Ross et al., 2006).
6. The *essence of operation* approach (Dietz, 2006).

2.6.3.2 Data source 2: Theoretical foundations of the six alignment approaches

Since the six alignment approaches (used as data source 1) were also derived from existing theory, the exploratory study also analysed the main theoretical foundations of the six alignment approaches (Figure 16, *Data source 2*), which include systems theory (discussed in section 3.2.1), systems engineering and the basic system design process (discussed in section 3.2.2).

2.6.3.3 Data source 3: ISO/IEC/IEEE 42010 standard

The first version of the BIAM was published in 2010, then called the BIAF (De Vries, 2010), and did not conform to the ISO/IEC/IEEE 42010 standard (ISO/IEC JTC 1/SC 7 committee, 2011) on *architecture description* (see section 3.2.4). In this thesis, BIAM was updated to ensure compliance with the ISO/IEC/IEEE 420 standard on *architecture description.*

2.6.3.4 Data source 4: Lapalme's 3 schools of thought

Although not incorporated in the published version (De Vries, 2010), this study also extended the BIAM, by incorporating the three schools of thought of Lapalme (2011). The three schools of thought highlighted different levels of alignment scope and are further discussed in section 3.2.3.

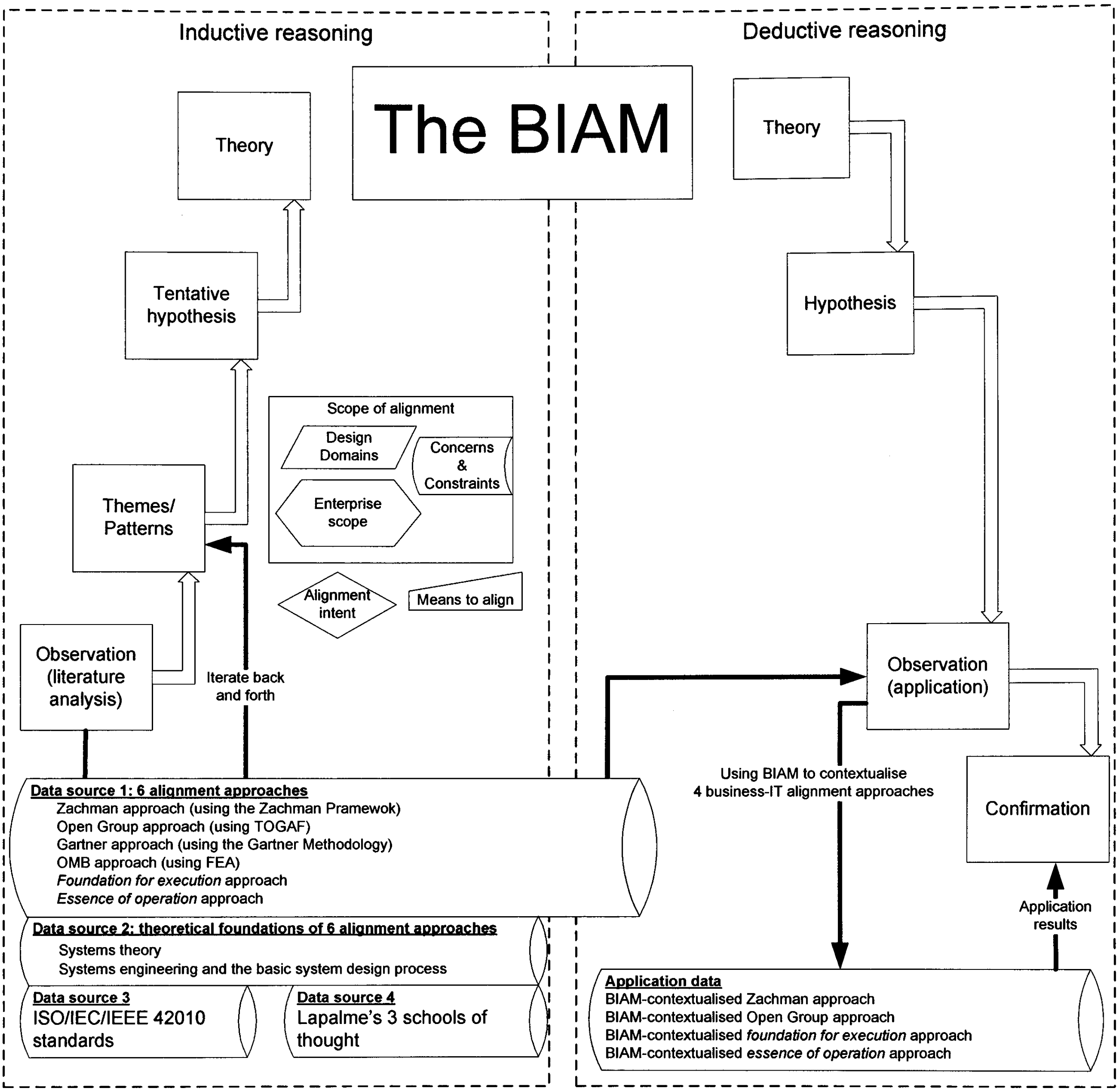


Figure 16: Exploratory design for building and applying the BIAM

Since the study involved humans during interviews and questionnaires, the next section demonstrates adherence to ethical principles and discipline-driven requirements.

2.7 ETHICAL PROCEDURES

The University of Pretoria employs a value system to ensure that researchers (1) should be true to the ethical principles of justice and credibility, and (2) shows research responsibility and duty when involving humans, animals or the environment as subjects of the research (University of Pretoria committee for research ethics and integrity, 2007). Since this study involved humans during interviews and questionnaires, the discipline-driven requirements were followed as stipulated by the Faculty of Engineering, Built Environment & IT. A proposal related to this study was submitted and approved by the ethics committee (see proposal and approval letter attached in Appendix C). The proposal addresses two main ethical concerns, (1) anonymity of participants, and (2) confidentiality of enterprise information.

In accordance with the proposal submitted to the ethics committee, a letter was submitted (headed *Letter of research participation consent)* to every research participant, stating that the questionnaire results would be treated anonymously and that enterprise information will be kept confidential (see Appendix C for signed letters). In addition, a letter was submitted to each research participant (headed *Providing consent for doing architecture work*) that required completion by the participant and his/her direct manager for doing architecture work and obtain information from the business management community (see Appendix C for signed letters).

2.8 CONCLUSION

This chapter provided the rationale for using a mixed methods design as an applicable research design for this study. The first sections incorporated *theory on research methodology* (research paradigms, research designs and methods for data collection), whereas the follow-up sections provided an *application of theory* to deliberate the paradigm that applied to the mixed methods design for this thesis.

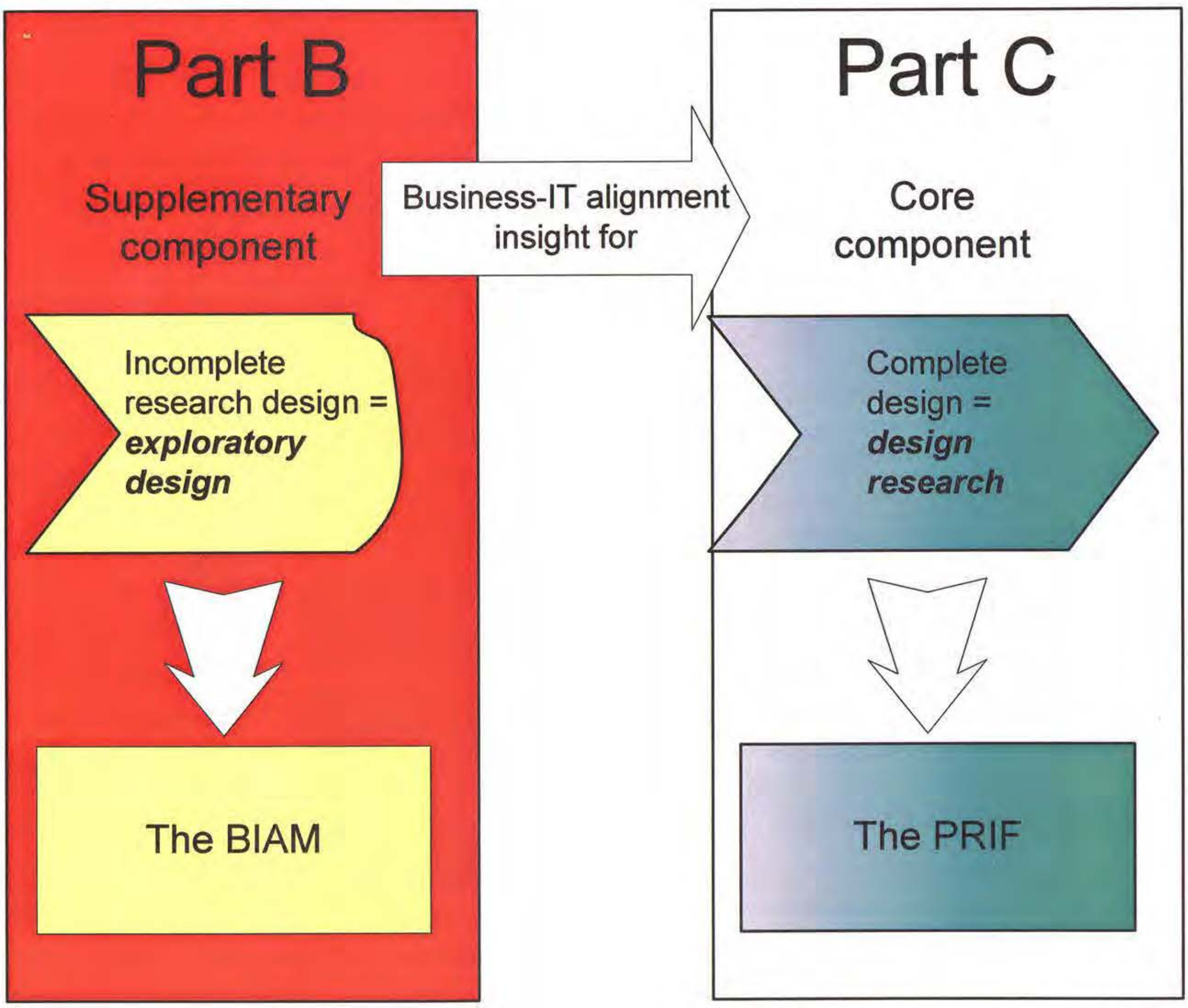
According to the mixed methods design of this thesis, the main research question is addressed by using two research design components. The core component (*design research*) addresses *Research Question 2* by developing the PRIF (Process Reuse Identification Framework). The supplementary component (*exploratory design*) addresses *Research Question 1* by developing the BIAM (Business-IT Alignment Model). The chapter concluded with the ethical procedures that applied to this thesis.

Although *design research* is the core component of this thesis, the next part (Part B) starts with a discussion of the supplementary component in developing the BIAM. The reason for starting with the supplementary component is that its result, the BIAM, is used to provide business-IT alignment insight for the core component.

PART B: THE BUSINESS-IT ALIGNMENT MODEL (BIAM)

All we ever know is our models, but never the reality that may or may not exist behind the models. ...Our models may get closer and closer but we will never reach direct perception of reality. ~ Stephen Hawking

As stated in Chapter 2, this thesis follows a mixed methods design, with two design components: (1) a supplementary component, and (2) a core component. Since the result of the supplementary component, the BIAM, provides insight for the core component in developing the PRIF (Process Reuse Identification Framework), Part B starts with a discussion on the supplementary component.

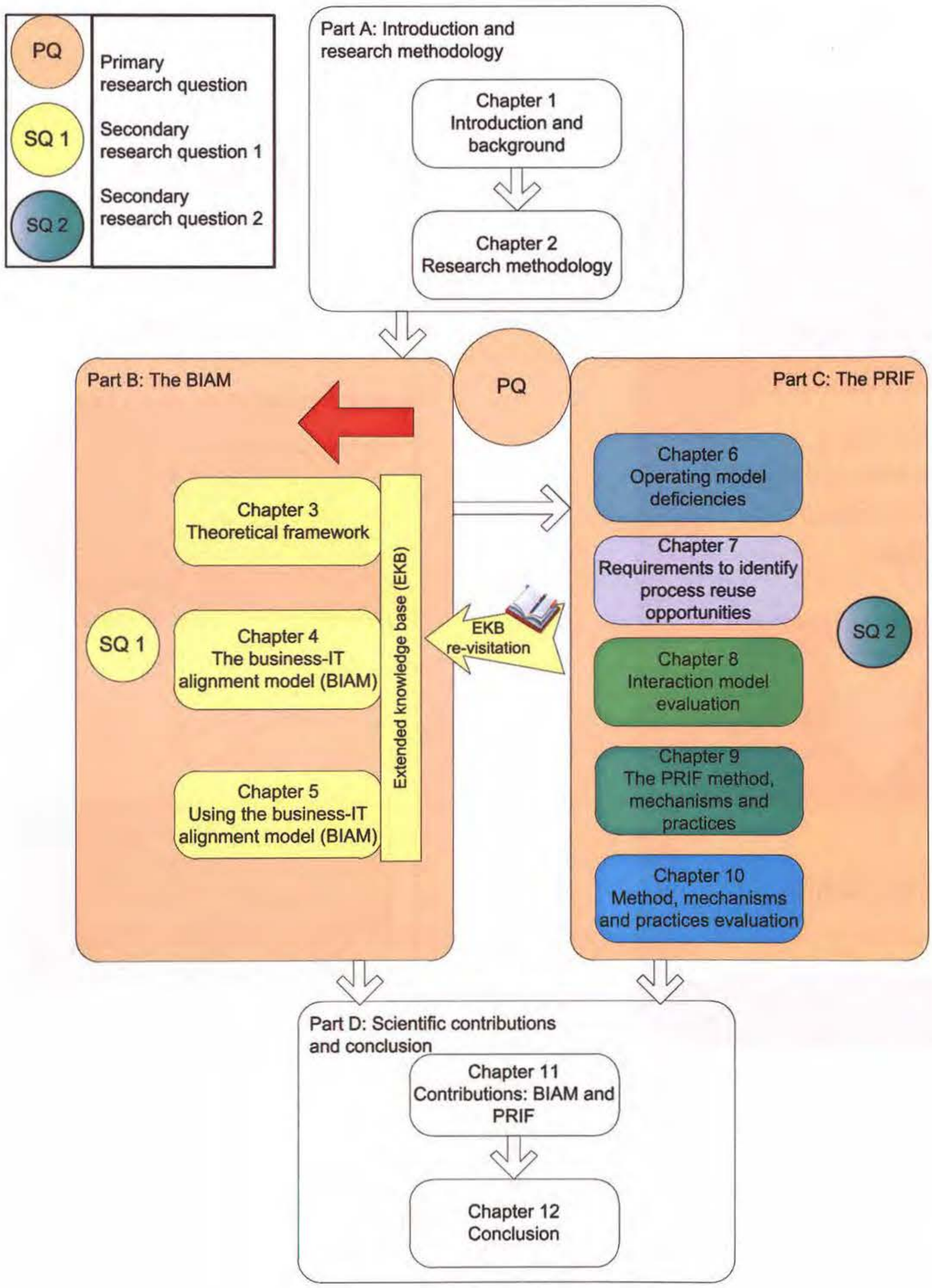


Part B answers *Research Question 1*, repeated from section 1.4:

What model is required to contextualise different business-IT alignment approaches?

Part B contains Chapters 3 to 5 to develop the BIAM (Business-IT Alignment Model), using an exploratory design, as described in sections 2.3.3 and 2.6.3.

- Chapter 3 provides theoretical background for the development of the BIAM.
- Chapter 4 applies the theoretical concepts introduced in Chapter 3 to develop the BIAM.
- Chapter 5 applies the BIAM, contextualising two alignment approaches in terms of the BIAM.



Chapter 3. Theoretical background

3.1 INTRODUCTION

This chapter starts with the theoretical background for applying exploratory design (as the supplementary component) for the development of the BIAM. The development of BIAM will answer the first research question:

What model is required to contextualise different business-IT alignment approaches?

Several authors provide definitions for *business-IT alignment*. According to Luftman and Kempaiah (2008, p. 102), business-IT alignment refers to how business and IT are "integrated, in harmony, converged, linked, fused, synthesized", whilst Wegmann, Regev, & Loison (2005, p. 1) states that business-IT alignment is the "correspondence between a set of components". Nadler & Tushman (1980, p. 40) have broadly defined business-IT fit as "the degree to which the needs, demands, goals, objectives, and/or structure of one component are consistent with the needs, demands, goals, objectives, and/or structure of another component". The latter definition provided by Nadler & Tushman is useful within the context of this thesis, as it accommodates *alignment/fit* of various components, *at various levels* within an enterprise. Many alignment approaches, however, still focus on creating *business-IT alignment*, i.e. creating consistency between the needs, demands, goals objectives, and/or structure of *business* components with the needs, demands, goals, objectives, and/or structure of *ICT* components.

According to the 2010 survey by Luftman & Ben-Zvi (2010), *business and IT alignment* has been a top concern for IT managers for almost 30 years. *Business-IT* alignment has been an important challenge in both private and public/non-profit sectors since the early 1980s (Knoll and Jarnvenpaa, 1994). There is strong evidence of a link between business-IT alignment and enterprise performance (Luftman and Kempaiah, 2007), using the alignment assessment criteria of Luftman (2003).

As stated before, Enterprise Architecture (EA) has several definitions (see section 4.3.2.1), and overlaps with other emerging disciplines (enterprise engineering and enterprise ontology). However, EA is also perceived as a *business-IT alignment* enabler (Gregor, Hart, & Martin, 2007; Ross, 2003; Sauer & Willcocks, 2004; van der Raadt, Hoorn, & van Vliet, 2005). Ballengee (2010) maintains that the penultimate purpose of EA converges around *enabling alignment at several levels*.

A large number of theoretical EA frameworks exist; each has its own alignment focus/intent and possible application within a specific industry or type of enterprise. Examples include the Zachman Framework (Zachman, 1987) or the Open Group Architecture Framework (TOGAF) (The Open Group, 2009). Previous studies however fail to compare existing EA frameworks in terms of alignment intent, scope and means. Although Schekkerman (2004) provided a descriptive comparison between various EA frameworks, and Sessions (2007) compared four prominent EA frameworks/methodologies with one another based on twelve (12) measurement criteria, an alignment-contextualisation model did not exist. An alignment-contextualisation model would be useful if an existing alignment approach (e.g. the *foundation for execution* approach of Ross et al. (2006)) required enhancement from another alignment approach. Therefore, there was a need to contextualise *numerous theoretical approaches* (some being associated with EA frameworks) in terms of *business-IT alignment* by answering three questions:

1. *Why* should the enterprise use the proposed approach to align?
2. *What* should the enterprise align?
3. *How* should the enterprise align?

Some authors delivered major contributions within the domain of business-IT alignment developing very specific frameworks, such as the Zachman Framework (Zachman, 1987) or the Open Group Architecture Framework (TOGAF) (The Open Group, 2009). Since this study focuses on an alignment perspective, and many frameworks and methodologies also enable alignment at several levels (Ballengee, 2010), this thesis uses the term *approach* to refer to the various frameworks and methodologies. As an example, reference is made to the Zachman *approach*, rather than the Zachman framework, highlighting the *alignment aspects*.

This chapter starts with definitions and perspectives on two complementary concepts, alignment and governance, in section 3.2. Section 3.3 introduces four prominent business-IT alignment approaches (the Zachman approach, the Open Group approach, the OMB approach, and the Gartner approach), followed by two less prominent alignment approaches (the *foundation for execution* approach, and the *essence of operation approach*). Section 3.4 briefly discusses eight *other alignment approaches* as secondary data sources for this thesis. The chapter concludes in section 3.5.

3.2 ALIGNMENT AND GOVERNANCE

Alignment, according to Hoogervorst (2009), refers to a certain *state*, which can only be attained through intentional *activities*. One of the key reasons for elusive alignment, is that executives tend to look for one silver bullet that will enhance alignment, whereas enterprises need to address many alignment components concurrently (Luftman & Ben-Zvi, 2010). Incremental IT developments for instance, occur collaboratively, iteratively, and concurrently with other enterprise developments. A larger scope of alignment inquiry could thus contribute to better alignment. Hoogervorst (2009) therefore presents alignment on two levels of scope, *business-IT alignment* versus *enterprise alignment* (see definitions in section 1.2.3).

With reference to Figure 17*, business-IT alignment* and *IT governance* are closely related. Hoogervorst (2009) distinguishes *between corporate governance*, *enterprise governance* and *IT governance*.

Corporate governance is defined as the "totality of internal structures and systems, as well as external rules and regulation, for internal control and risk management that ensures that enterprises exercise their responsibilities towards shareholders effectively and adequately" (Hoogervorst, 2009, p. 155). According to Hoogervorst (2009, p. 187), corporate governance focuses on compliance (financial reporting and internal control). However, he reasons that compliance requirements could only be satisfied as a result of enterprise design and the design of the ICT system, based on considerations such as process excellence, quality, efficiencies and security. Therefore, *enterprise governance* and *IT governance* are prerequisites for compliance.

IT governance is the competence used (the *how*) for continuously creating a business-IT alignment *state*. *IT governance,* as defined by Hoogervorst (2009, p. 221) concerns the integration of skills, knowledge and technology for providing unified and integrated attention for IT development in:

1. establishing IT strategic initiatives,
2. developing IT architecture,
3. designing IT systems,
4. defining a portfolio of subsequent IT projects to implement designs, and
5. implementing IT projects (Hoogervorst, 2009, p. 221).

With reference to Figure 17*, enterprise governance* is the complement of IT governance, but within a wider context creating an enterprise alignment *state*. Comparable to the definition of IT governance, enterprise governance concerns the integrated attention for:

1. developing strategy (establishing strategic choices, initiatives, areas of concern and their related objectives),
2. developing enterprise architecture to guide enterprise design,
3. designing the enterprise,
4. defining the portfolio of subsequent projects, and
5. implementing the projects" (Hoogervorst, 2009, p. 316).

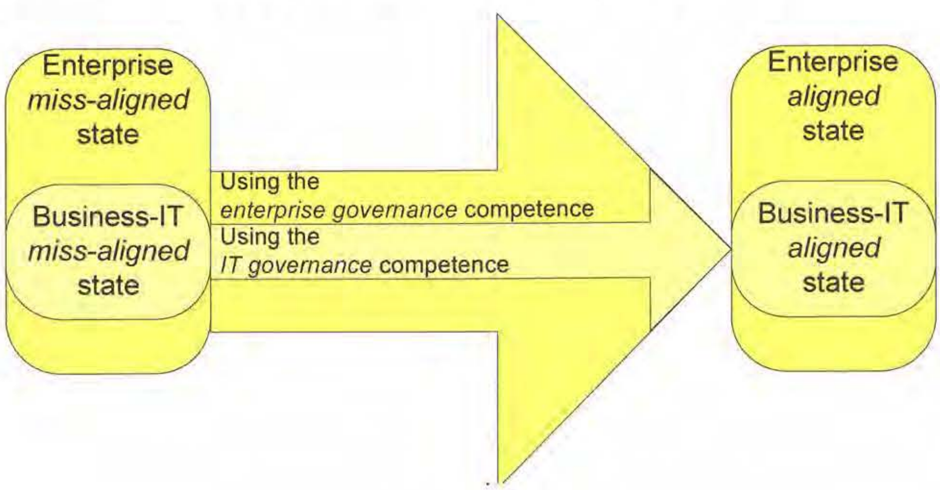


Figure 17: Using IT governance and enterprise governance to enact alignment

Although a number of business-IT alignment approaches exist, each with its own alignment paradigm, alignment scope, alignment mechanisms and practices, Hoogervorst (2009) maintains that miss-alignments can only be addressed from the perspective of the *enterprise as a whole*. The introduction of new information systems not only involve new hardware and software, but also require synchronisation with changes in jobs, skills, management and organisation (Laudon & Laudon, 1998; Martin, 1995). A mechanism is therefore required to understand the whole enterprise and all its components - not only focusing on the business and ICT components.

Since this study intends to develop a mechanism to understand the *components of the business-organisation*, as related to the *ICT components*, the theoretical foundations of current business-IT alignment approaches are abstracted. The theoretical foundations, creating common grounds for conceptual understanding, are:

1. Systems theory (section 3.2.1).
2. Systems engineering and basic system design process (section 3.2.2).
3. Three schools of thought on aligning the enterprise (section 3.2.3).
4. The ISO/IEC/IEEE 42010 standard (section 3.2.4).

Later in this thesis, the theoretical foundations are used in combination with a set of six alignment approaches, to develop a Business-IT Alignment Model (BIAM). Chapter 4 (section 4.3.1 and Figure 46) also provides an indication of how each of the following theoretical sections contributed towards the construction of the BIAM.

3.2.1 Systems theory

Since alignment concerns various components of an *enterprise*, systems theory is discussed as a means to create a common conceptual understanding of an *enterprise as a system* (see section 1.2.1 for a definition of the enterprise as a system).

Various definitions exist for describing a system; Jackson (2003, p. 3) defines a system as "a complex whole, a functioning of which depends on its parts and the interaction between these parts". Others extend the systems definition, stating that the parts are connected to perform a unique function that could *not be performed by the parts alone* (Boardman & Sauser, 2008; Gharajedaghi, 2006; Giachetti, 2010; Maier & Rechtin, 2002). Dietz (2006) emphasizes that the interacting parts or sub-systems *influence* each other. If the parts do not have an interacting effect, the parts merely form an aggregate.

Giachetti (2010) maintains that an appreciation of *typical system properties* contribute towards the analysis and design of systems. The discussion of several alignment approaches (see sections 3.3 and 3.4) related to this study, also refers to *typical system properties* and the means to accommodate the *system properties* during enterprise alignment. A list of *typical system properties* include (Giachetti, 2010):

1. *System boundaries.* A system boundary defines what is part of the system and what is not. The boundary is arbitrary, because it depends on the intentions and aims of the observer.
2. *Sub-systems.* Sub-systems are part of another system, but also systems in their own right. The viewpoint of the observer/analyst determines the boundary of a sub-system. Hitchins (2003) recommends that a sub-system should be defined such that the intra-relationships (relationships between parts of the sub-system) should be more than the interrelationships (relationships between parts and other sub-systems). In accordance with Hitchin's viewpoint, a functional structuring of an *enterprise* may define sub-systems, such as marketing, sales and manufacturing. As will be indicated in Part C (Chapter 8) of this thesis, the confinement created by a *sub-system boundary*, usually have adverse implications on streamlining/measuring end-to-end processes.
3. *Holism/complementation.* Holism/complementation is the idea that a system reveals emergent properties and behaviour that one cannot attribute to any one of its parts. For example, the *emergent* property, *performance* of an enterprise, cannot be attributed to a single part of the enterprise (e.g. marketing, operations, logistics etc.). Holism contrasts with reductionism, which decomposes a system into its parts and studies each part individually. Following a holistic approach requires one to focus on the relationships between the parts to understand how the interaction of the parts contributes to the emergent properties.
4. *Open versus closed.* An open system interacts with its environment, whereas a closed system does not interact with its environment. Enterprises as open systems need to observe their environment and perform dynamic adjustment of its system components to remain in a steady state.
5. *Purposefulness.* Purposeful systems have goals and motivations, but also the free will to change their goals. The enterprise, for instance has a mission statement (goal), whereas its employees also have their own goals and motivations. Understanding the purpose of the enterprise requires a deep understanding of the rationale that explains its actions. The rationale also depends on the environment, business culture and social culture.
6. *Feedback and control vs. dynamic interactions.* The field of *cybernetics* conceptualises the feedback and self-regulation mechanisms of a system. In an enterprise, management need to control the enterprise system. Managers usually use *performance measurements* as a feedback mechanism to control the enterprise. Performance measures may however be in conflict, which could lead to counterintuitive behaviour when management implements control actions. However, the basis of an open system model is the *dynamic interactions* of the components, rather than focusing on feedback (Hitchins, 2003). Enterprises change over time. They need to continuously adapt to their environment.
7. *Complexity.* If a system has a large number of parts, the system is *complicated*. The large number of parts makes it difficult to understand, but it is understandable to the skilled designer of the system. *Complexity*, however, occurs when a large number of parts exist, and the interaction between the parts creates *unpredictable behaviour*. According to

Gharajedaghi (2006) complexity inhibits our understanding of cause-and-effect relationships. Complexity leads to counterintuitive behaviour, e.g. actions intended to produce a certain outcome may generate opposite results. The theory of system dynamics developed by Forrester (1968) aims to model the interrelationships between system parts to predict *system behaviour.*

8. *Equifinality.* Enterprises exhibit the property of equifinality, which means that the system can accomplish its objectives with different inputs and different internal processes to produce outputs. Equifinality implies that there is no single best way to reach a goal. In addition, a best practice in one enterprise may not be transferable to another enterprise due to different cultures.

The list of *typical system properties* is referenced in upcoming sections to discuss different ways of addressing the *typical system properties* of an enterprise.

In addition to the *typical system properties*, Dietz (2006) states that two different notions exist for understanding a system: (1) the constructional system notion (see-section 3.2.1.1), which is required to understand the *structure/construction* of a system, and (2) the teleological/functional system notion, which is required to use and *control the system* (see-section 3.2.1.2). Both Dietz (2006) and Hoogervorst (2009) emphasise the *constructional* system notion in their alignment approaches, stating that one needs to have a deep understanding of how an enterprise is constructed prior to requirement elicitation for supporting information systems. The different notions of a system are re-visited when discussing the *essence of operation approach* of Dietz in sections 3.3.6 and 8.2.

3.2.1.1 The constructional system notion

This section applies the *typical system property* regarding *system boundary* discussed above (section 3.2.1) to provide and understanding of the constructional notion of a system. Bunge (1979) uses the *system boundary* property to distinguish between different constructs of a system (as illustrated in Figure 18). Due to a logical/physical *system boundary*, a system consists of a:

- *composition* (parts of the some category, i.e. physical, social, biological etc.),
- *environment* (parts of the same category, but not within the *boundary of the system*), and
- *structure* (a set of influencing bonds between the parts within the *boundary*, and between them and the parts in the environment).

Dietz (2006) added another construct, namely that a system has a definite *production* output (the parts within the *boundary* produce things that are delivered to the parts in the environment). Although not mentioned by Dietz, Hitchins (2003) also highlights that every part or system has a definite *capacity*, which influences *production* output. Capacity is however, an implementation issue, and thus not required for the ontological/essential view of a system.

Applying the constructs of Figure 18 to an enterprise, the *composition* of the enterprise as a social system would be social individuals; the *environment* would be parts of the same category (social individuals) directly linked to the compositional parts, but outside the boundary; whereas the *structure* would be the mutual influencing relations among the system parts (i.e. individuals within the boundary and certain individuals outside the boundary). The *production* would be goods and/or services that are delivered to the environment.

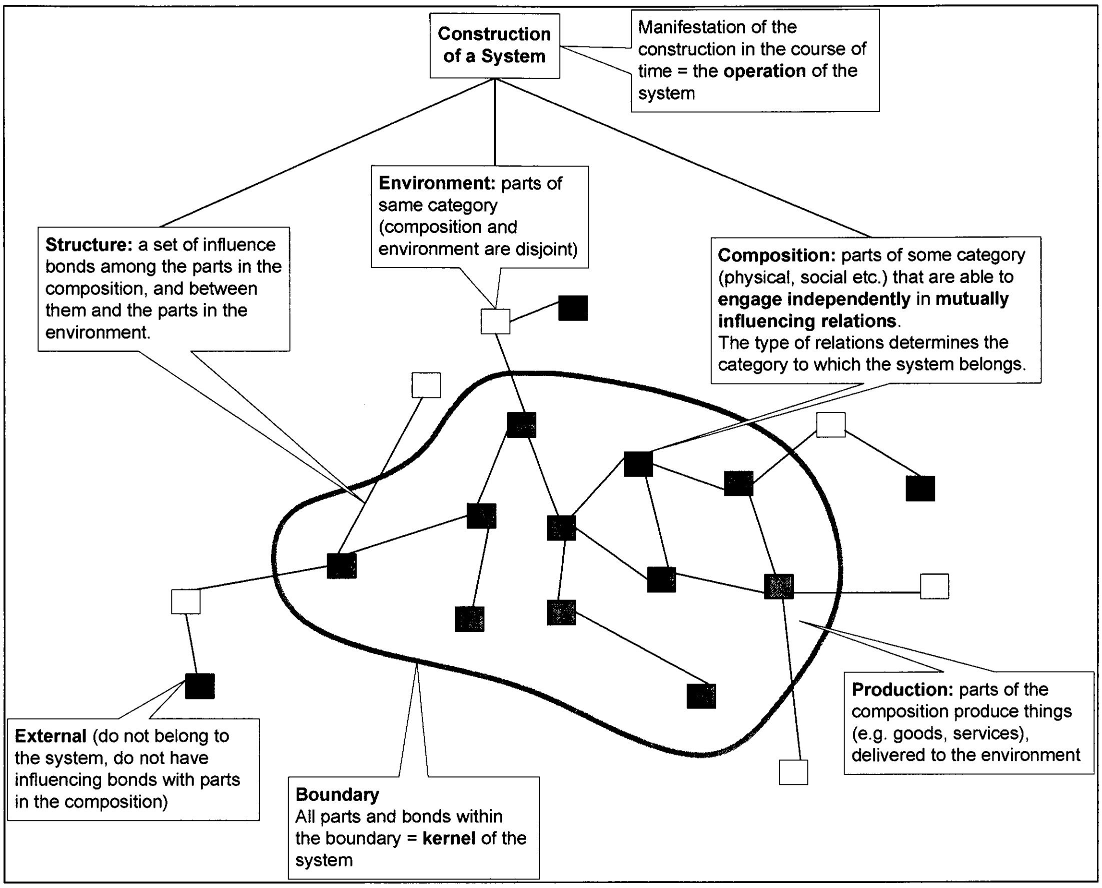


Figure 18: The structure/ontology of a system, based on Dietz (2006)

The constructional notion of the enterprise as a system (as depicted in the previous paragraph) needs to be communicated using appropriate representations. Dietz (2006) suggests the use of *white box models* to provide a conceptualisation of the constructional notion of a system. *White-box models* are used for building or changing/maintaining a system and the dominant type of model in all engineering sciences. An example of a *white box model* is the constructional decomposition model (i.e. bill-of-material) of a car (the car being the system), e.g. a car consists of a chassis, wheels, motor and lamps (Dietz, 2006).

The constructional notion of the enterprise as a system, represented *by white box models,* is thus required to understand how an enterprise is *constructed* and used by the *enterprise designer/engineer* as to build/maintain the enterprise. Only a few alignment approaches emphasise the constructional notion of a system, as highlighted later during the discussion on different alignment approaches.

In addition to the constructional notion of the enterprise, it is also necessary to understand the teleological notion of a system, which is concerned with the *function* and *behaviour* of the system. The subsequent section therefore provides more theory on the teleological notion of a system.

3.2.1.2 The teleological system notion

Evidence of teleology, of purpose/goal-seeking behaviour in enterprises are unmistakable (Hitchins, 2003). An understanding of the behaviour of a system would allow managers to control the system and it is thus the dominant notion used by managers. A number of alignment approaches emphasise the teleological notion of a system (e.g. the Gharajedaghi approach), as highlighted later during the discussion of different alignment approaches. This section provides the teleological notion of a system and re-visits some of the *typical system properties* discussed earlier in section 3.2.1.

Management is usually concerned with the functions of an enterprise and how control of the input variables has an effect on output variables (Dietz, 2006). A *typical system property* emphasised with the teleological system notion, is that of system *feedback and control.* Managers of enterprises typically use performance measurement to gain *feedback and control* over enterprise behaviour.

The teleological notion of the enterprise as a system needs to be communicated using appropriate representations. *Black-box models* are typically used to conceptualise the functions and behaviours of the system *without knowing the detail construction and operation* of the system. An example of a *black box model* is the functional decomposition model of a car (the car being the system), e.g. a car consists of a lightning system, power system, steering system and brake system. *Black box models* are not useful to an engineer when maintaining the system (Dietz, 2006). Examples of black *box models* that describe enterprise behaviour include: process flowcharts and cause-and-effect diagrams, e.g. the sistemigrams of Boardman & Sauser (2008).

3.2.2 Systems engineering and the basic system design process

The previous section (section 3.2.1) on systems theory provided theory to conceptualise the enterprise as a system. i.e. revealing *typical system properties*, and understanding the enterprise from both a *constructional* viewpoint and a *teleological* viewpoint. This section introduces systems engineering and the basic *system design process* to delineate the process required for the development of any system. The purpose is to demonstrate how the *design process* is used as a *vehicle* to align systems with one another, ensuring that the needs, demands, goals, objectives, and/or structure of one system are consistent with the needs, goals, objectives, and/or structure of another system. The *design process* is for example evident in the Zachman approach (Zachman, 2009a) (see section 3.3.1) where Zachman refers to the *process of reification*, which gradually transforms system requirements to implementations. The *essence of operation* approach of Dietz (2006) (see section 3.3.6) also refers to the *design process* as a systematic process for aligning business with IT.

The International Council of Systems Engineering (INCOSE) (2004) defines *systems engineering* as "an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem".

One of the essential mechanisms of *systems engineering* is the basic *system design process*, depicted in Figure 19.

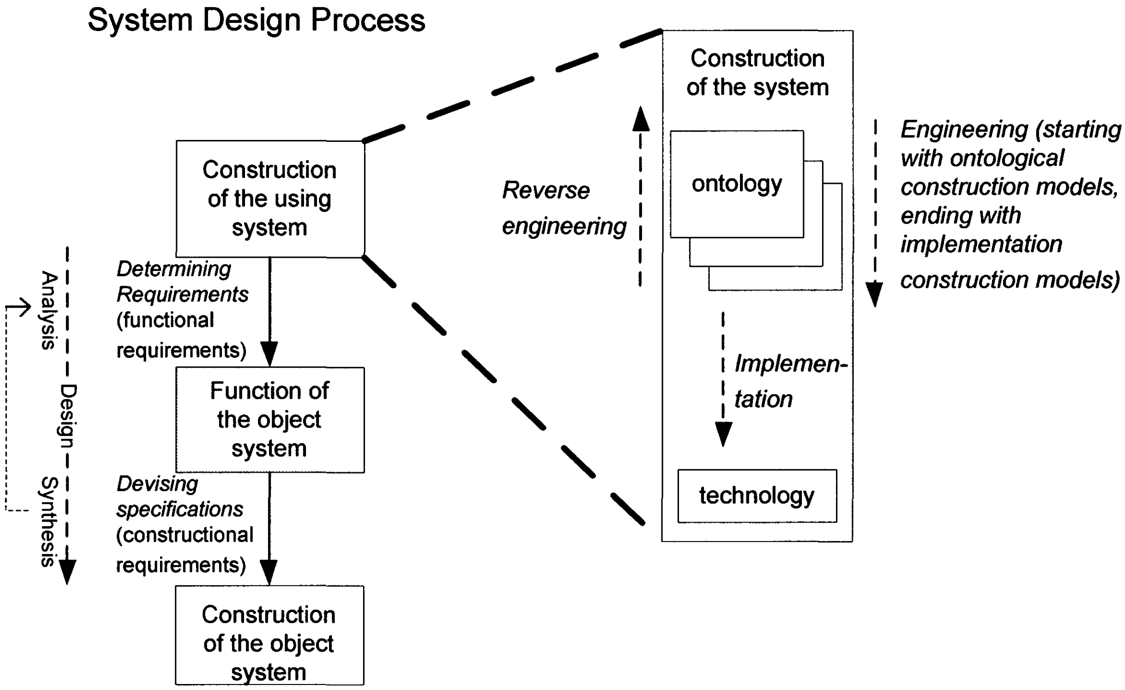


Figure 19: The basic system design process, based on Dietz (2006) and Hoogervorst (2009)

Every system that needs to be designed follows a generic *design process* that incorporates two systems: the *using system* and the *object system.* The object system is used by the using system. As an example, the object system could be an ICT system that needs to be designed and is used by the using system, the enterprise. The first design phase (see Figure 19, *Determining requirements*) involves the definition of the required function of the object system (the function is represented by a *black box model*). The function can only be determined in terms of the construction of the using system. The second design phase (see Figure 19, *Devising specifications*) starts with the function of the object system and concludes with the construction of the object system. Hoogervorst (2009) renames *specifications* as *constructional requirements,* that relate to the constructional design of a system. Dietz (2006) also explains that *design* (Figure 19, *Design* arrow) is the iterative alternation between *analysis* (Figure 19, *Analysis)* and *design* (Figure 19, *Design)*, i.e. design is not a one-way process.

Engineering (used in the narrow sense of the term, contrary to its use in systems engineering) entails the process during which constructional models (*white box models*) are produced (see Figure 19, *Engineering*). Engineers systematically produce a series of *ontological* construction models (e.g. construction models that are *implementation-independent*) and end with implementation construction models, i.e. models that could be linked to technology means (Dietz, 2006).

This section discussed *systems engineering* and the *basic system design process* as vehicles to align different systems with one another. The next section presents different schools of thought that exist in the enterprise architecture community. The rationale is that alignment approach authors differ in their worldview and perception/focus on alignment value-creation.

3.2.3 Three schools of thought on aligning the enterprise

Lapalme (2011) states that the debates on enterprise architecture may be traced back to different schools of thought that exist in the enterprise architecture community. He suggests the use of three schools of thought to create common grounds in our understanding of the different value-propositions offered by enterprise architecture authors.

Lapalme provides a hypothesis that three schools of thought exist (see Table 8):

1. enterprise IT architecting (EIT),
2. enterprise integrating (E), and
3. enterprise ecological adaptation (EiE).

The taxonomy of *three schools of thought* is not meant to be exhaustive and should be viewed as 'ideal' types, i.e. author(s) typically do not fit perfectly in one school, but rather gravitate towards one (Lapalme, 2011). Also, Hoogervorst (2009, p. 120) states that the understanding and designing of enterprises lies in avoiding the either-or scheme by combining the structural-functionalistic perspective (evident in EIT and E) with the interpretative perspective (evident in EiE).

Table 8: A sub-set of qualifiers for the three schools of thought, based on Lapalme (2011)

Enterprise IT architecting (EIT)	**Enterprise integrating (E)**	**Enterprise ecological adaptation (EiE)**
Scope		
Enterprise wide IT platform (EIT). All components (software, hardware, etc.) of the enterprise IT assets.	**Enterprise (E).** The enterprise as a socio-cultural-techno-economic system; hence ALL the facets of the enterprise are considered – the enterprise IT assets being one facet.	**Enterprise-in-environment (EiE).** Includes the previous scope but adds the environment of the enterprise as a key component as well as the bidirectional relationship and transactions between the latter and its environment.

Enterprise IT architecting (EIT)	Enterprise integrating (E)	Enterprise ecological adaptation (EiE)
Purposes (value-creation paradigm)		
Effective enterprise strategy execution and operation through IT-Business alignment. The purpose is to enhance business strategy execution and operations. The primary means to this end is the aligning of the business and IT strategies so that the proper IT capabilities are developed to support current and future business needs.	**Effective enterprise strategy implementation through execution coherency.** The purpose is effective enterprise strategy implementation. The primary means to this end is designing the various facets of the enterprise (governance structures, IT capabilities, remuneration policies, work design, etc.) to maximise coherency between them and minimise contradictions.	**Innovation and adaptation through organisational learning.** The purpose is organisational innovation and adaptation. The primary means is the fostering of organisational learning by designing the various facets of the enterprise (governance structures, IT capabilities, remuneration policies, work design, etc.) as to maximise organisational learning throughout the enterprise.
Motto		
"EA as the glue between business and IT".	"EA as the link between strategy and execution".	"EA as the means for organisational innovation and sustainability".
Principles and Assumptions		
• Reductionism. • Business strategies and objectives are provided by the business and are correct. • Independent design of organisational dimensions. • Disinterest in none-IT dimensions.	• Holism. • Business strategies and objectives are provided by the business and are correct. • Environment as something to manage. • Joint design of all organisational dimensions.	• Holism. • System-in-environment coevolution. • Environment can be changed. • Joint design of all organisational dimensions.

One of the key differentiators between the three schools of thought is the *scope* of alignment. According to Table 8 (*Scope* qualifier), EIT authors emphasise alignment of components related to the enterprise IT assets, whereas the E authors consider alignment of all facets of the enterprise (IT assets being one asset). The EiE authors expand the extent of alignment even further by adding the *environment* as an alignment component. Since Lapalme defines an enterprise as a composition of socio/cultural/techno/economic parts, the environment (according to Bunge (1979)) refers to parts of the same category (social/cultural/technical/economic parts), but not within the composition of the enterprise. When the *scope* of alignment increases, different purposes, mottos, principles and assumptions apply. Since EIT focuses on the IT assets, a *reductionist* paradigm may be appropriate, i.e. decomposing technical systems into parts. However, extending the alignment *scope* to include social, cultural, technical and economic parts requires a *holistic* paradigm (*holism* being a typical property of a system, as defined in section 3.2.1). According to the *holistic* paradigm, the emergent properties and behaviour of the enterprise cannot be attributed to the parts alone.

Section 4.3.2.1 re-visits the different schools of thought of Lapalme and provides a motivation for developing a Business-IT Alignment Model (BIAM) in accordance with the motto of the first school of thought (EIT). The next section presents the ISO/IEC/IEEE 42010 standard to provide common grounds for representing different facets of the enterprise. The purpose is to apply existing theory on *architecture description* (embedded in the ISO/IEC/IEEE 42010 standard) during the construction of BIAM.

3.2.4 The ISO/IEC/IEEE 42010 standard

The ISO/IEC JTC 1/SC 7 committee (2011) produced an *architecture description* standard (for systems and software engineering) to create common grounds (a conceptual model) for architecture description. Dictionary.com (n.d.) defines a *metamodel* as "the components of a conceptual model, process, or system". The architecture description could thus also be classified as a *metamodel,* i.e. *components of the conceptual model of an enterprise architecture description.* Figure 20 portrays the *metamodel*, using conventions for class diagrams defined in [ISO/IEC 19501] (see Appendix D for class diagram notation standards). Table 9 provides definitions for the elements in Figure 20.

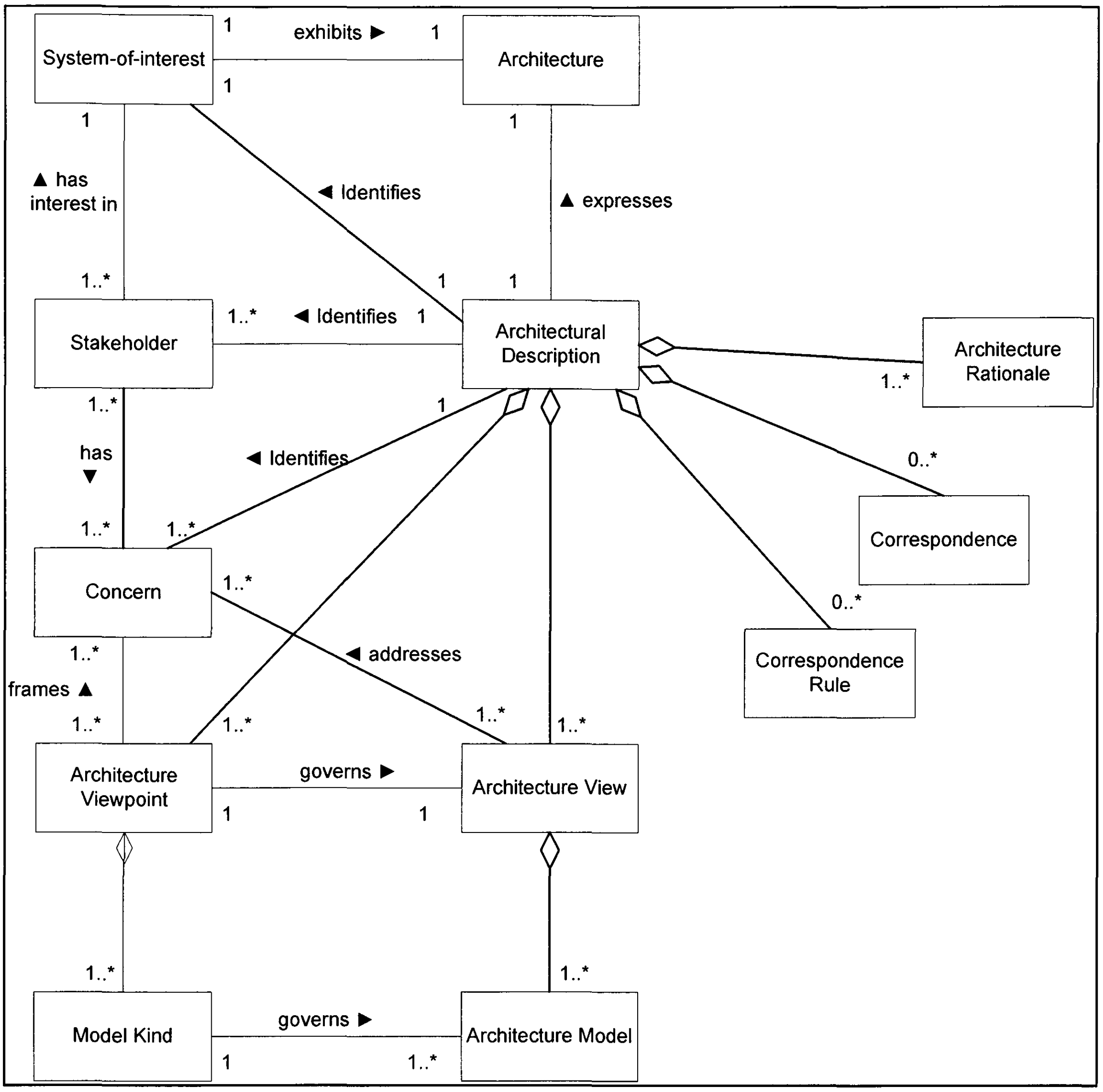


Figure 20: Metamodel of an architecture description, based on ISO/IEC JTC 1/SC 7 committee (2011, p. 5)

Table 9: Definitions of architecture description, based on ISO/IEC/IEEE 42010 standard, based on ISO/IEC JTC 1/SC 7 committee (2011)

Metamodel components	**Description and Use**
Architecture	The fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution. The term *architecture* conveys the essence or fundamentals of the system.
Architecture description	A *work product* used to express an architecture. Example: an *architecture description* is developed for enterprise ABC.
Architecture model	An *architecture model* is a *work product*; its subject is determined by its *model*

Metamodel components	Description and Use
	kind. Example: if an architecture is developed for the enterprise ABC and the *model kind* 'class diagram' is used, then the *architecture model* is a class diagram depicting knowledge of enterprise ABC.
Architecture view and viewpoint	*Viewpoint* refers to the conventions for expressing an *architecture* with respect to a set of *concerns*. A *viewpoint* is a way of looking at systems; a *view* is the result of applying a viewpoint to a particular system-of-interest. Each architecture *view* needs to represent the whole system from the perspective of the system *concerns* framed by its governing *viewpoint*. Example: ArchiMate (a modelling language) defines eighteen viewpoints, which results from using a matrix of six layers of concerns and 3 aspects of concerns.
Concern	Any topic of interest pertaining to the system. The *stakeholders* of a system hold these *concerns*. A concern pertains to any influence on a system in its environment including: developmental, technological, business, operational, organisational, political, economic, legal, regulatory, ecological and social influences.
Correspondence and correspondence rule	*Correspondences* are used to express relations between architecture description elements. They can for instance be used to express consistency, traceability, composition, refinement and model transformation. A correspondence rule expresses a constraint to be enforced on a correspondence. Example: Consider two viewpoints, *hardware* and *software* components. A correspondence rule relating the two is: R1: Every *software* element, *ei*, as defined by software components needs to execute on one or more platforms, *pj*, as defined by *hardware*.
Model kind	Conventions for a type of modelling. Examples: data flow diagrams, class diagrams, organisation charts.
Stakeholder	Individual, team, organisation, or classes thereof, having an interest in a system.
System and system-of-interest	Entities whose architectures are of interest. The entities encompass, but are not limited to, entities within the domains of: • *systems* (as described in [ISO/IEC 15288]) that are "man-made and may be configured with one or more of the following: hardware, software, data, humans, processes (e.g., processes for providing service to users), procedures (e.g. operator instructions), facilities, materials and naturally

Metamodel components	Description and Use
	occurring entities"; • *software products and services* (as described in [ISO/IEC 12207]; • *software-intensive systems* (as described in [IEEE Std 1471^{TM}:2000]) as "any system where software contributes essential influences to the design, construction, deployment, and evolution of the system as a whole" to encompass "individual applications, systems in the traditional sense, subsystems, systems of systems, product lines, product families, while enterprises, and other aggregations of interest".
Work product (not on Figure 20)	A *work product* is understood as an "artefact associated with the execution of a process" [ISO/IEC 15504-1:2004, 3.55].

Based on the *architecture description*, the ISO/IEC/IEEE 42010 also incorporates an *architecture framework* and *architecture description language*. Since both the *architecture framework* and *architecture description language* are used later in section 4.3.2.3, both concepts are defined according to the ISO/IEC/IEEE 42010 definition.

The ISO/IEC/IEEE 42010 standard (ISO/IEC JTC 1/SC 7 committee, 2011, p. 26) defines an *architecture framework* as a "means of defining existing and future architecture frameworks in a uniform manner to promote sharing of information about systems, architectures and techniques for architecture description" (see Figure 21). The ISO/IEC/IEEE 42010 standard states that although the current standard does not define all framework elements (e.g. prescriptions and relationships, process requirements, life cycle connections and documentation formats), the potential for standardisation exists.

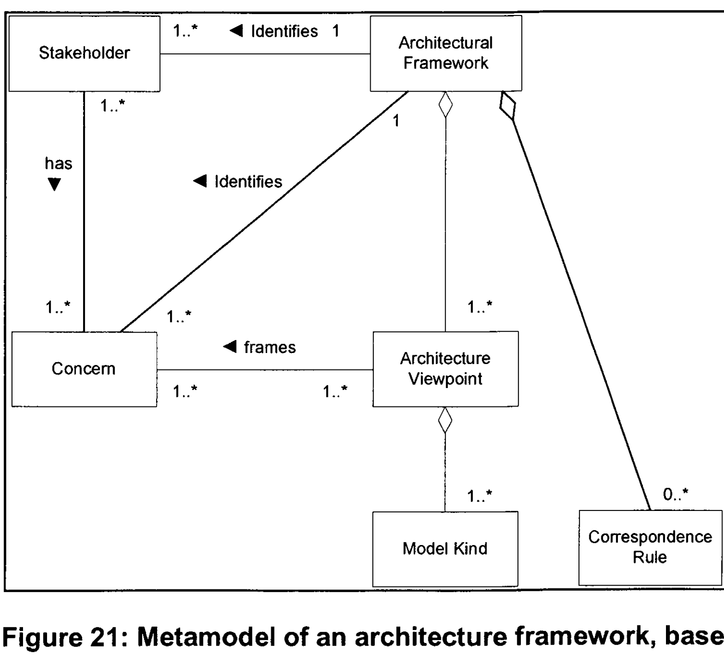


Figure 21: Metamodel of an architecture framework, based on ISO/IEC JTC 1/SC 7 committee (2011, p. 10)

The ISO/IEC/IEEE 42010 standard (ISO/IEC JTC 1/SC 7 committee, 2011, p. 26) defines an *architecture description language* (ADL) as "any language for use in an architecture description. An ADL can be used by one or more viewpoints to frame identified system concerns within an architecture description".

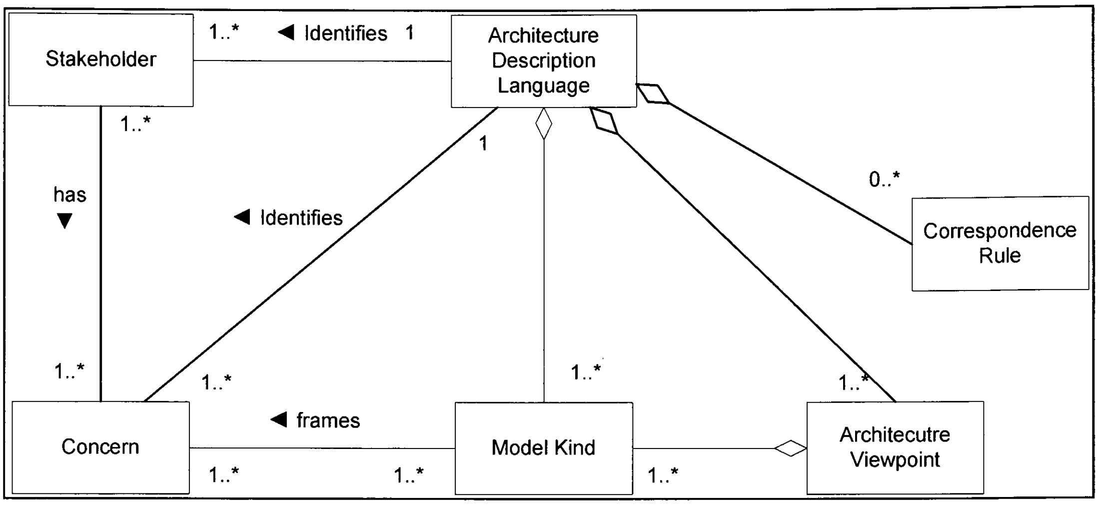


Figure 22: Metamodel of an architecture description language, based on ISO/IEC JTC 1/SC 7 committee (2011, p. 11)

This section introduced the standard for *architecture description* developed by the ISO/IEC JTC 1/SC 7 committee (2011), also using elements of the complete *architecture description* to define *architecture frameworks* and *architecture description languages.* Later, section 4.3.2.3 applies the standards provided on *architecture description*, *architecture frameworks* and *architecture description languages* during the construction of a component (*alignment mechanisms and practices*) of the Business-IT Alignment Model (BIAM).

3.3 ALIGNMENT APPROACHES

This section provides a rationale for introducing six alignment approaches that are relevant to this study. Later, the Business-IT Alignment Model (BIAM) is used as a common reference model for contextualising four of the six alignment approaches in terms of business-IT alignment.

Although a large number of theoretical EA frameworks exist, each with an aim to induce business-IT alignment at an enterprise, Sessions (2007) states that many EA frameworks/methodologies have appeared and disappeared. According to Sessions (2007), 90% of the field however, uses one of four frameworks/methodologies: the Zachman Framework, the Open Group Architecture Framework (TOGAF), the Federal Enterprise Architecture (FEA) and the Gartner Methodology. Figure 23 depicts historic events in the development of the prominent EA frameworks/methodologies. Although TOGAF is increasingly considered to be the de facto standard way of working for the development and deployment of modern IT systems in enterprises (Dietz & Hoogervorst, 2011), several other alignment approaches emerged, each providing a different perspective on alignment value-creation. A recent study performed by OVUM (Blowers, 2012), for instance indicated that the Pragmatic EA Framework and Essential Project also increased in popularity.

This thesis acknowledges the *four prominent* alignment approaches listed by Sessions (2007) and their contribution towards to the construction of the BIAM (later in section 4.2). In addition, two less prominent alignment approaches are introduced (the *foundation for execution* approach and the *essence of operation* approach) since both are used during the construction of the PRIF (Process Reuse Identification Framework) in Part C.

The purpose of section 3.3 is merely to *introduce* the six alignment approaches to the reader. Further contextualisation and comparison between the approaches will only be possible, once a common Business-IT Alignment Model (BIAM) is used. In Chapter 5, two of the six alignment approaches are re-visited (the Zachman approach and the Open Group approach) in demonstrating business-IT contextualisation using BIAM. In Chapters 7 and 8, another two of the six alignment approaches are re-visited (the *foundation for execution* approach and *essence of operation* approach) to further demonstrate business-IT contextualisation using BIAM.

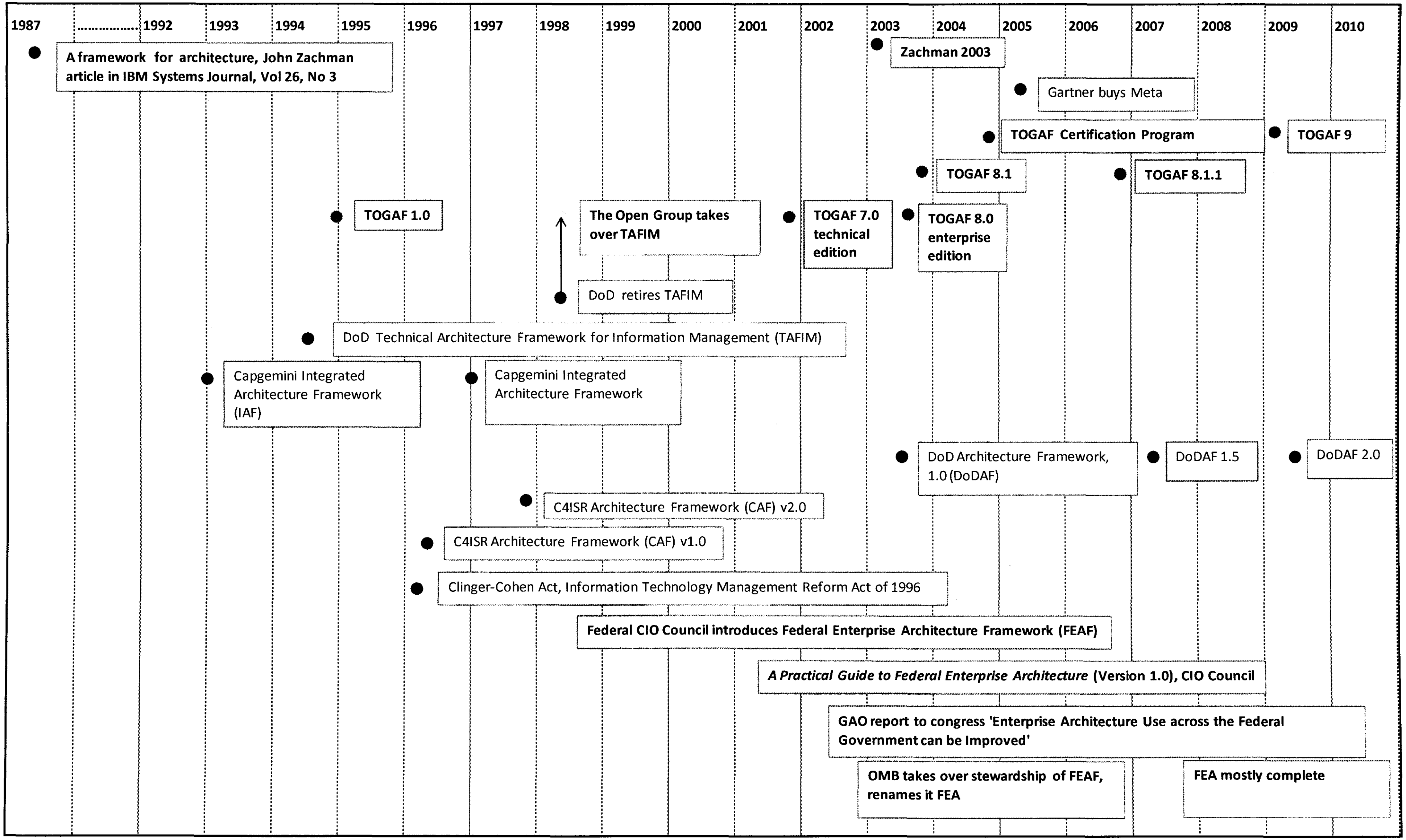


Figure 23: Timeline of enterprise architectures, based on Bespoke Systems (2012)

3.3.1 The Zachman approach

Zachman (1996), often called the farther of enterprise architecture, developed the *Zachman Framework for Enterprise Architecture* (six by six matrix presented in Figure 24) that provides a logical structure for classifying and organising the descriptive representations that are significant to the management of the enterprise and the development of enterprise systems. The *Zachman Framework for Enterprise Architecture* is an *enterprise ontology*; ontology being "a theory of the existence of a structured set of essential components of an object for which explicit expression is necessary (or even mandatory) for designing, operating and changing the object" (Zachman, 2009a, p. 15).

According to Zachman (2012) the six by six matrix depicts six communication interrogatives (what, how, when, who, where and why) as *columns* and six reification transformations (scope contexts, business concepts, system logic, technology physics, tool components, and operations instances) as *rows*. The reification process is similar to the *design process* of systems engineering, which gradually transforms system requirements to implementations (see section 3.2.2. on the *design process*).

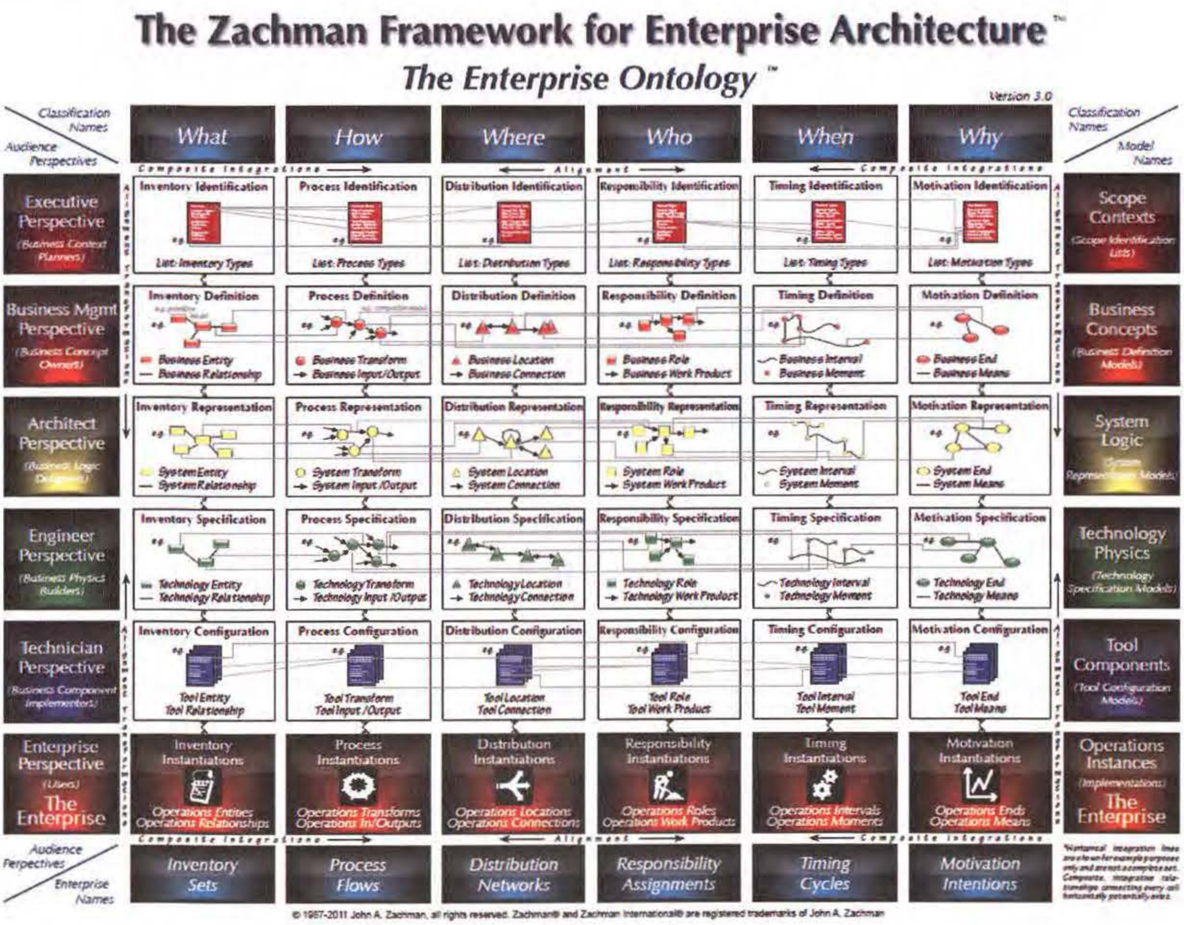


Figure 24: The Zachman Enterprise Framework, Version 3.0, a direct copy (Zachman, 2012)

The six communication interrogatives that appear as column names in Figure 24 are translated into *enterprise names* (column descriptions at the bottom of the Zachman Framework). Each communication interrogative can thus be *translated* into enterprise terminology as follows:

- What: Inventory Sets
- How: Process Flows
- Where: Distribution Networks
- Who: Responsibility Assignments
- When: Timing Cycles
- Why: Motivation Intentions

The six reification transformations that appear as rows and named by the right-hand side of Figure 24, are associated with *model names* (given in brackets next to the reification descriptions). The reification transformations concern enterprise-related *audience perspectives* (depicted as row names on the left-hand side of Figure 24). Each reification transformation thus *relate to* an audience perspective as follows:

- Scope Contexts (Scope Identification Lists): Executive Perspective (Business Context Planners)
- Business Concepts (Business Definition Models): Business Management Perspective (Business Concept Owners)
- System Logic (System Representation Models): Architect Perspective (Business Logic Designers)
- Technology Physics (Technology Specification Models): Engineer Perspective (Business Physics Builders)
- Tool Components (Tool Configuration Models): Technician Perspective (Business Component Implementers)
- Operations Instances (Implementations): Enterprise Perspective (Users)

The Zachman Framework differentiates between *abstractions* (general qualities or characteristics, apart from concrete realities, specific objects, or actual instances (Locke, 2009a)) and concrete *instantiations*. The top five rows represent *abstractions*, whereas the sixth row represents concrete *instantiations*. The intersections of the six columns with six rows produce thirty-six (36) cells, each described by its own *model*. The thirty-six models are also called *primitive models*, as each model represents the intersection of only one column with one row.

Concerning the *primitive models*, Zachman (2009a) maintains that enterprise designers should start with the explication of *primitive models* as the essential building blocks of the enterprise, to ensure re-usability of the building blocks in future enterprise designs. Once primitive building blocks have been defined via primitive models, a systematic transformation and integration of the primitive models are required. A systematic transformation of primitive models within a *single column* is called *vertical integration*, whereas the systematic integration between primitive models within a *single row* is called *horizontal integration* (Locke, 2009a). The following two examples further demonstrate the difference between *vertical integration* and *horizontal integration*:

Figure 25 represents an example of *vertical integration* and how models (abstractions), based on entity relationship modelling notation standards (see Appendix D), within the first column (*What: inventory sets*) are gradually transformed via the reification process to transform *entities* into implemented *tables* on a database. *Vertical integration* ensures that no discontinuity exists between the various rows, i.e. ensuring consistency with requirements.

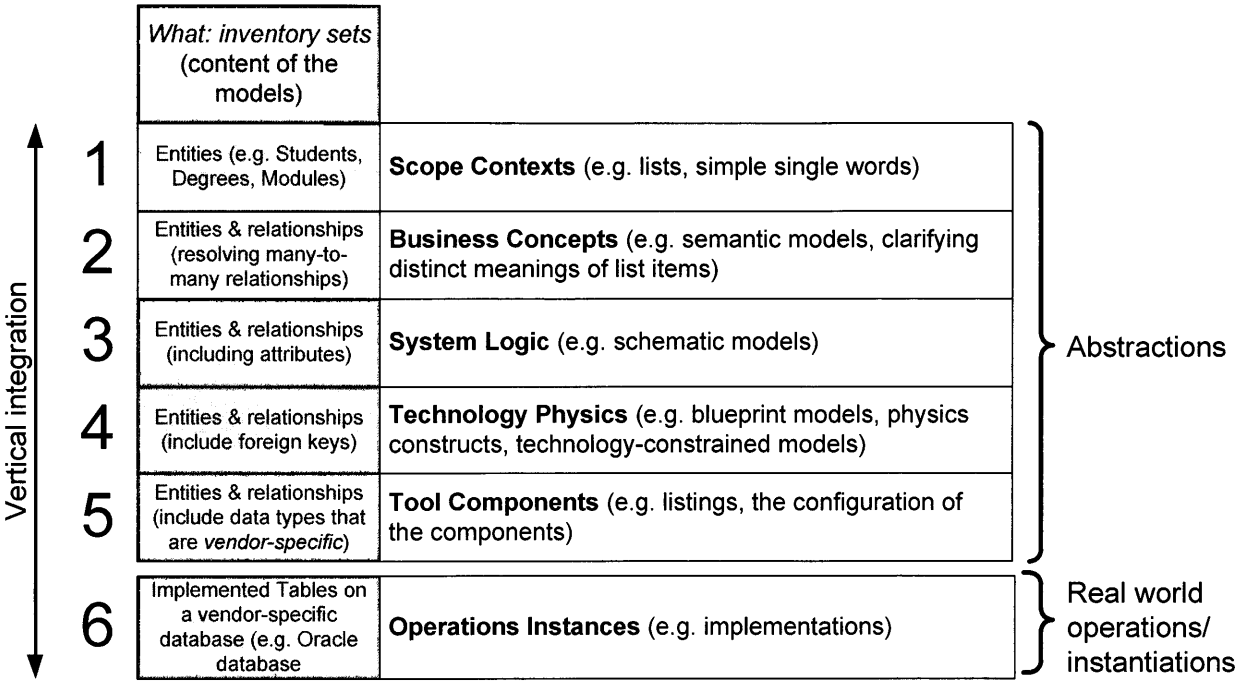


Figure 25: Example of vertical integration, based on Locke (2009a)

Figure 26 represents examples of *horizontal integration,* i.e. integrating models from different columns, but within a single row. When *primitive models* (models within separate cells) are combined, *composite models* are created, e.g. a CRUD (create, read, update, delete) matrix maps *business entities* to *business transformations*/processes, i.e. combining the first two columns (*what* and *how*) into a single model. Another example is the RACI (responsible, accountable, concerned, informed) matrix that maps *business transformations*/processes to *business roles,* i.e. combining the second and fourth columns (*how* and *who*) into a single model. *Horizontal integration* ensures that no discontinuity exists between different kinds of models from one column to the next.

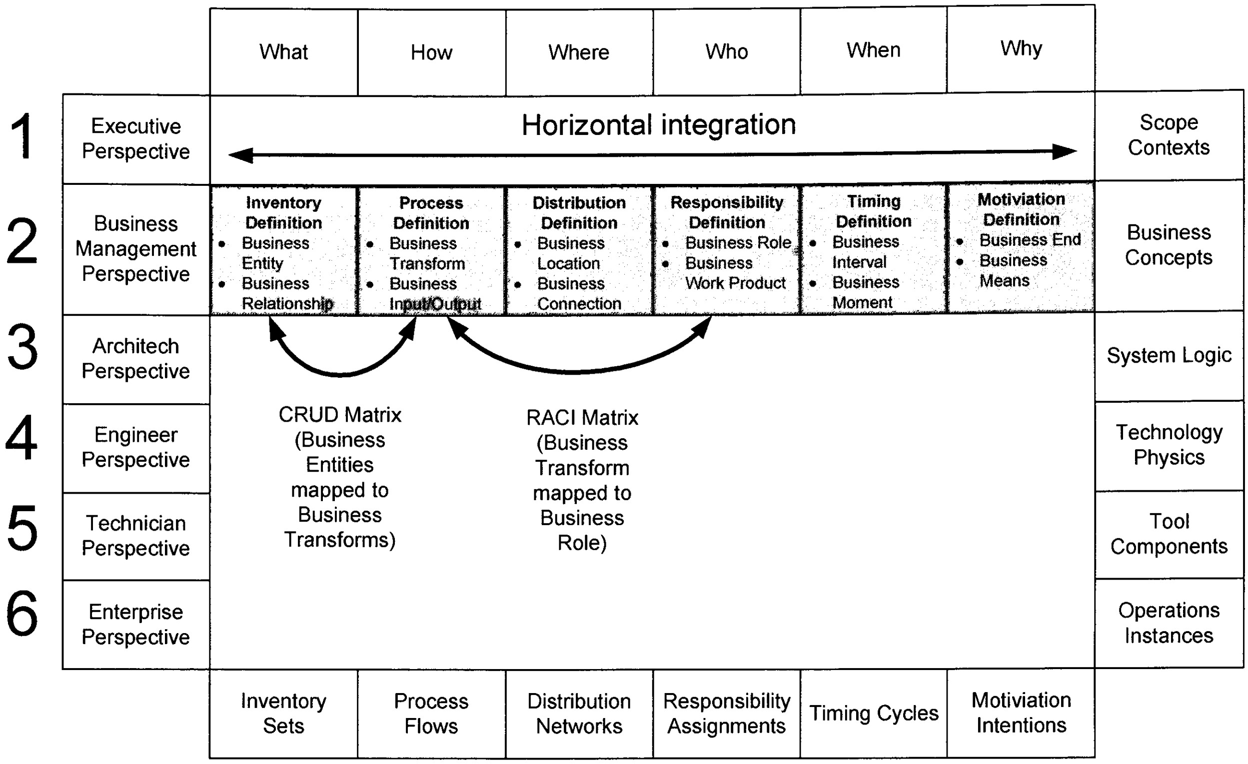


Figure 26: Example of horizontal integration, based on Locke (2009a)

Numerous developers of EA models were inspired by Zachman and applied one or more enterprise representation dimensions to describe the enterprise as a complex object. Examples include the Extended Enterprise Architecture Framework (E2AF) (Schekkerman, 2004), Integrated Architecture Famework (IAF) (Capgemini, 2007), the Federal Enterprise Architecture (FEA) (OMB, 2007b), the Gartner Enterprise Architecture Framework (GEAF) (Gartner, 2008a, 2008b) and the EA3 Cube (Bernard, 2005).

The Zachman approach is primarily concerned with creating *consistency and alignment* across the individual rows and columns on the Zachman Framework. Although the Zachman approach was only introduced in this section, section 5.2 re-visits the Zachman approach, but within the context of the Business-IT Alignment Model (BIAM), which will be defined in section 4.3.

3.3.2 The Open Group approach

TOGAF (The Open Group Architecture Framework), owned by the Open Group, became best known for its Architecture Development Method (ADM), which is an architectural process/methodology, rather than an architectural framework (Giachetti, 2010). The ADM consists of ten phases (see Figure 27), including:

1. *Preliminary.* This phase defines the *capabilities for doing architecture work*, i.e. defining the "where, what, why, who and how we do architecture". Main aspects include: defining the scope of the enterprise concerned with architecture work; key drivers and elements in the enterprise context; requirements for architecture work; architecture principles, frameworks to be used; the relationships between management frameworks; and an evaluation of enterprise architecture maturity.

2. *Phase A. Architecture vision.* This phase defines the *scope of the architecture* effort and the constraints that must be dealt with. Main aspects include: gaining recognition, endorsement and commitment from management; identification of relevant stakeholders, their concerns and objectives; definition of key business requirements and constraints that must be addressed; formulation of the value proposition/offering that demonstrates a response to the requirements and constraints; articulation of a comprehensive plan for doing architecture work; securing formal approval; and understanding the impact on other enterprise architecture development projects.
3. *Phase B. Business architecture.* This phase *defines the baseline and target business architectures*, which is a prerequisite for architecture work in any other domain (data, application and technology). Main aspects include: developing the baseline and target business architectures; analysing the gaps between the baseline and target architectures; developing architecture viewpoints for specific stakeholders to demonstrate that stakeholder concerns are addressed; selecting and using relevant tools and techniques for constructing the required viewpoints.
4. *Phase C. Information systems architecture.* This phase defines the *target data and/or application architectures* that would support the target business architecture. Main aspects include: developing baseline and target data and/or application architectures; and analysing gaps between the baseline and target architectures.
5. *Phase D. Technology architecture.* This phase maps the data and/or application components (defined in Phase C) to a set of technology components, representing required software and hardware components.
6. *Phase E. Opportunities and solutions.* This phase provides a logical grouping of IT activities into *project work packages* within the IT portfolio and other portfolios that are dependent upon IT. Main aspects include: assessing the feasibility to implement changes at the enterprise; deriving transition architectures that deliver continuous and incremental business value; and gaining consensus on an implementation/migration strategy.
7. *Phase F. Migration planning.* This phase creates a *viable implementation/migration plan* in co-operation with the portfolio and project managers. Main aspects include: assessing dependencies, costs and benefits of the various migration projects and their prioritisation; negotiating contracts for implementation projects; and monitoring the detailed implementation/migration projects in accordance with the transition architectures defined in Phase E.
8. *Phase G. Implementation governance.* This phase *governs and manages the contract* for implementing and deploying the solution(s). Main aspects include: performing appropriate governance functions while the solution is implemented and deployed; ensuring conformance to pre-defined architecture; ensuring conformance of the deployed solution with the target architecture; and mobilising supporting operations to underpin the future working lifetime of the deployed solution.
9. *Phase H. Architecture change management.* This phase *manages changes to the architecture* in a consistent way. Main aspects include: establishing an architecture

change management process for the new enterprise architecture baseline; supporting the implemented enterprise architecture as a dynamic architecture; and assessing the performance of the new architecture and make recommendations for change.

10. *Requirements management*. This phase interacts with phases A to H and denotes the dynamic process of identifying, storing and *managing the supply of enterprise architecture change requirements* (The Open Group, 2009).

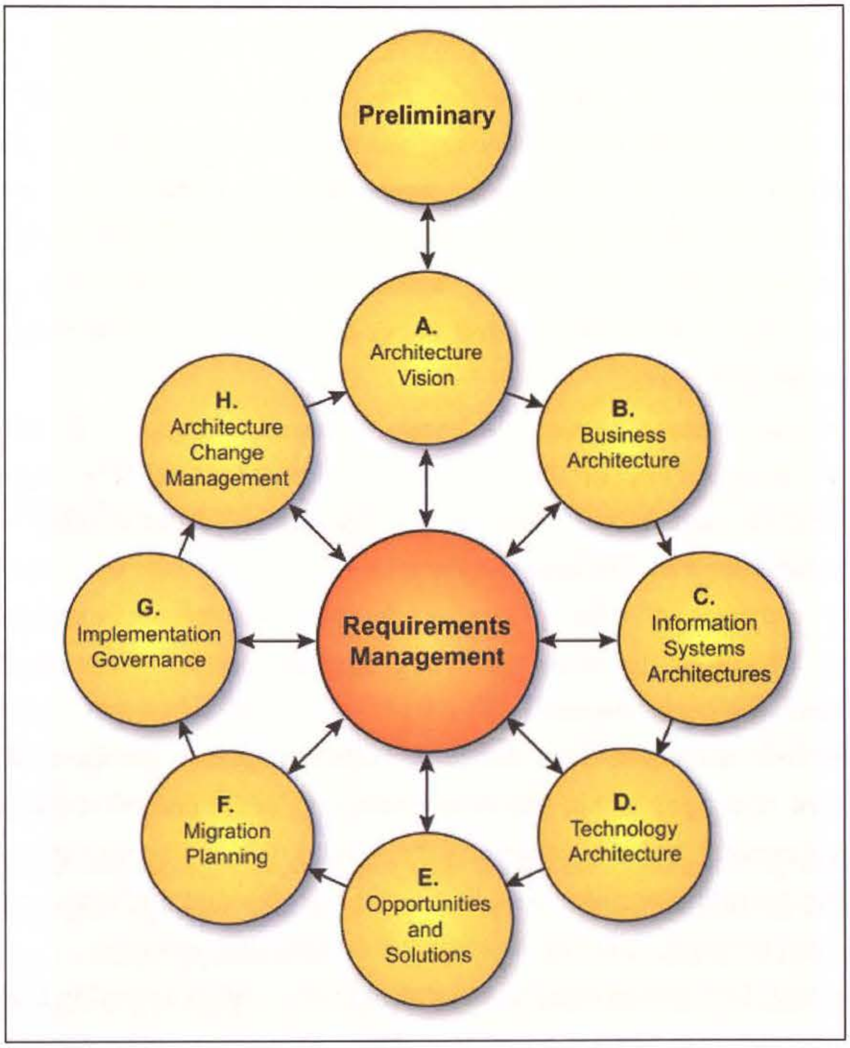


Figure 27: TOGAF ADM Cycle, a direct copy (The Open Group, 2009, p. 54)

Published in February 2009, TOGAF 9.0 incorporated major document structural changes compared to TOGAF 8.1.1. The new structure highlight seven main parts and their relationships (see Figure 28):

- *Part I: Introduction* (not shown on Figure 28). High-level introduction to key concepts, definitions of terms, release notes, and the TOGAF approach in general.
- *Part II: Architecture development method (ADM).* The step-by-step approach to develop an enterprise architecture.
- *Part III: ADM guidelines and techniques.* The set of guidelines and techniques that are available for use when using TOGAF and the TOGAF ADM.

- *Part IV: Architecture content framework.* A description of the TOGAF content framework, which includes a structured model for architectural artefacts. The part also include re-usable architecture building blocks and an overview of typical architecture deliverables.
- *Part V: Enterprise continuum & tools.* Appropriate taxonomies and tools for categorising the outputs of architecture activity within an enterprise.
- *Part VI: TOGAF reference models.* A selection of reference models, including the TOGAF foundation architecture, and the integrated information infrastructure reference model (III-RM).
- *Part VII: Architecture capability framework.* Content about the organisation, processes, skills, roles and responsibilities required for establishing and operating an architecture function within an enterprise.

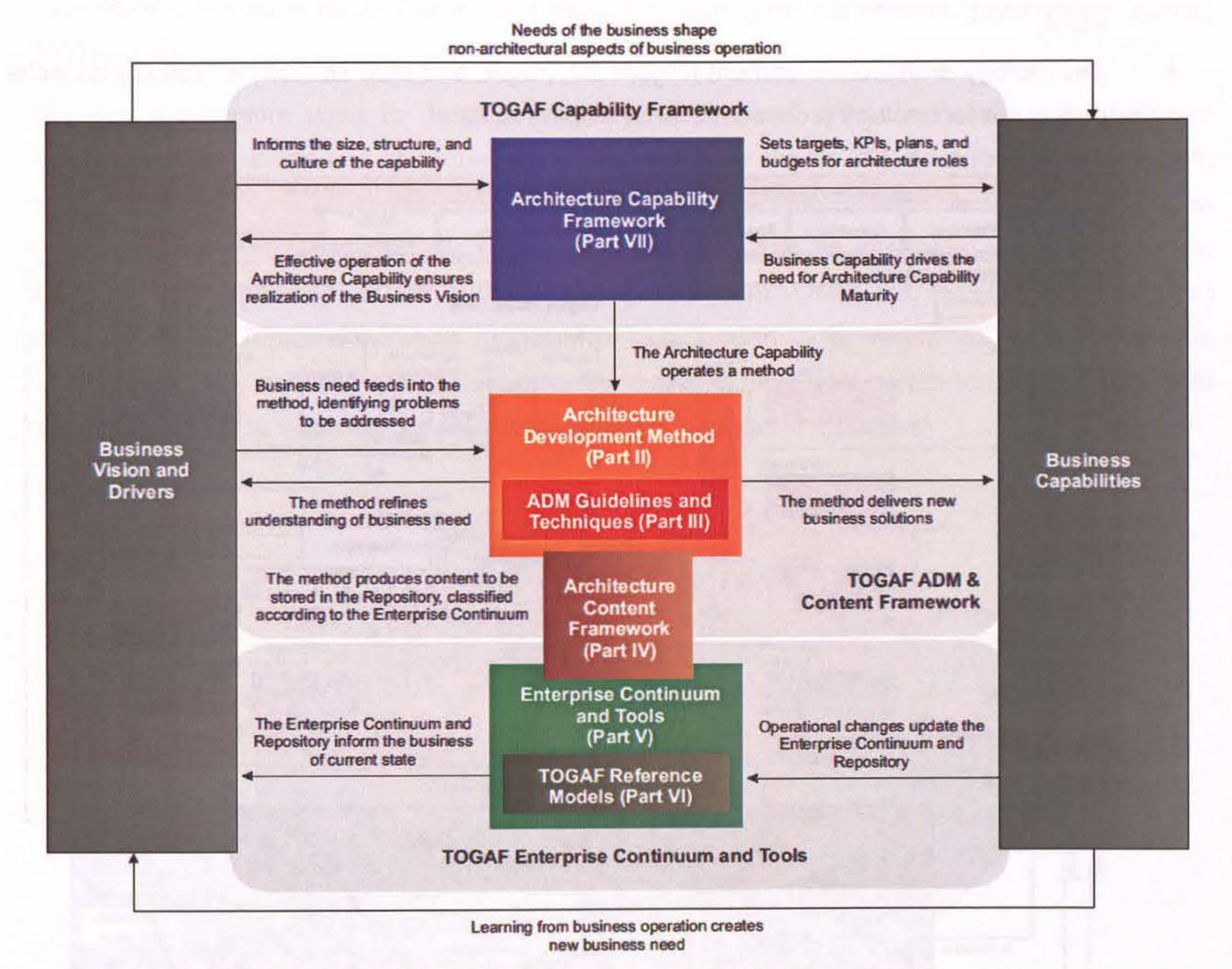


Figure 28: Structure of the TOGAF document, a direct copy (The Open Group, 2009, p. 4)

The *architecture development method* (ADM) (Figure 28, Part II) is used in combination with *ADM guidelines and techniques* (Figure 28, Part III) and the *architecture content framework* (Figure 28, Part IV) in delivering new business solutions. The *architecture content framework* "provides a structural model for architectural content" and may also be substituted with other frameworks, such as the Zachman Framework (The Open Group, 2009, p. 361). Contrary to the intention of the Zachman Framework to create an enterprise ontology, the *architecture content* *framework* defines a set of entities to enable consistent, complete and traceable *capturing of architectural concepts*. In fostering its use, in combination with the ADM, the *architecture content framework* is structured to highlight correlation with the ADM phases. A detailed representation of the architecture content framework, called the *content metamodel* (see Figure 29) demonstrates the correlation between content and ADM phases:

- *Architecture principles, vision, requirements, and roadmap* content (Figure 29, pink section) is typically collected in the preliminary and architecture vision phases of the ADM.
- *Business architecture* content (Figure 29, yellow section) is typically collected during the business architecture phase of the ADM.
- *Data architecture* and *application architecture* content (Figure 29, purple and light-green sections) is typically collected during the information systems architecture phase of the ADM.
- *Technology architecture* content (Figure 29, purple and blue section) is typically collected during the technology architecture phase of the ADM.

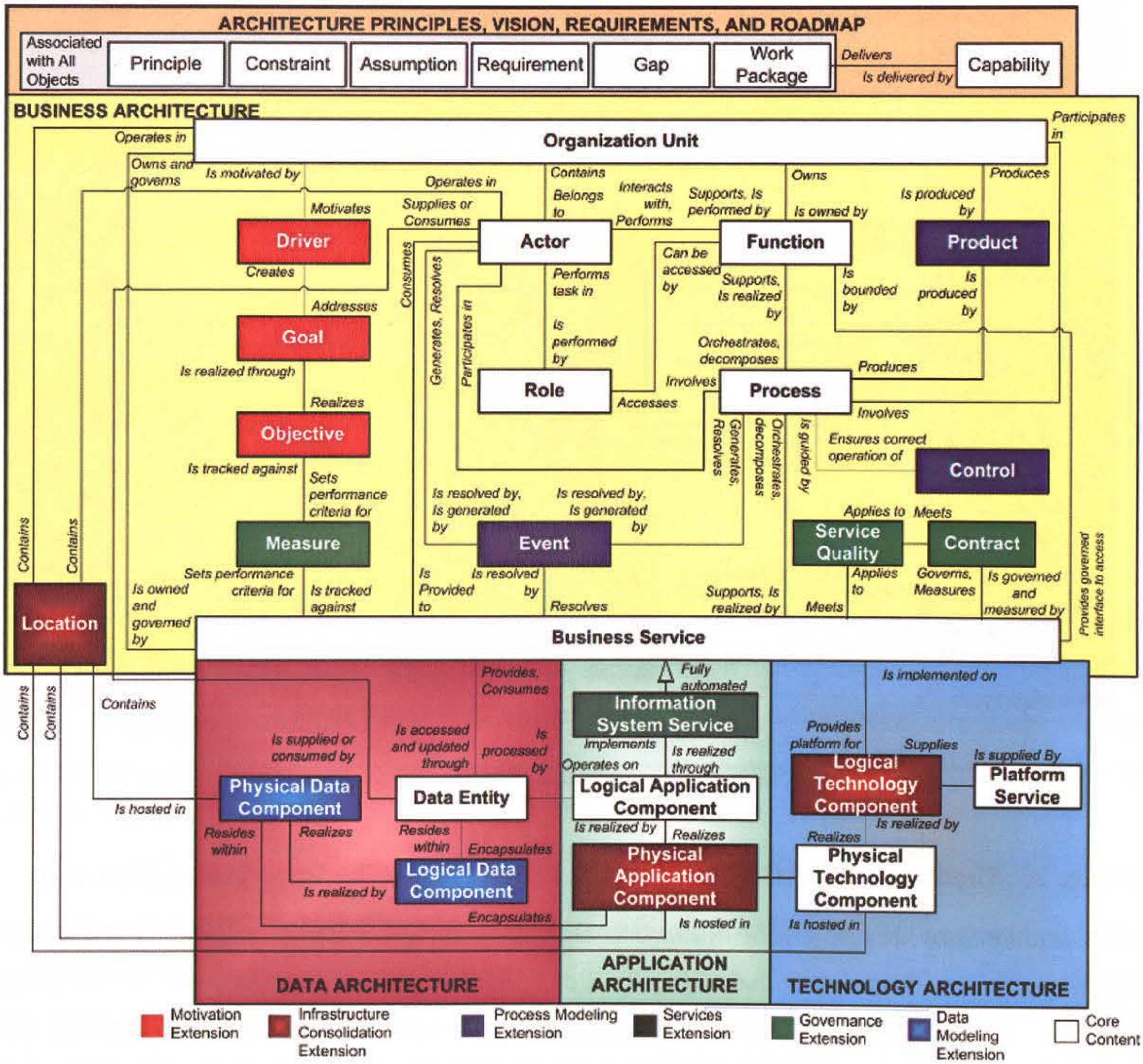


Figure 29: Relationships between entities in the content metamodel, a direct copy (The Open Group, 2009, p. 379)

The Open Group approach as presented in TOGAF is primarily concerned with creating an *alignment methodology* for designing/changing the enterprise. In this section, the Open Group approach was introduced to the reader, but will be re-visited in section 5.3, after defining the Business-IT Alignment Model (BIAM) in section 4.3.

3.3.3 The OMB approach

The Federal Enterprise Architecture (FEA) evolved from the Federal Enterprise Architecture Framework (FEAF) as the latest attempt made by the U.S. government to unite their agencies and functions under a common EA (OMB, 2007b). The FEA Program Management Office (FEAPMO) maintains that FEA provides the Office of Management and Budget (OMB) and federal agencies with "a common language and framework to describe and analyse IT investments, enhance collaboration and ultimately transform the federal government" (OMB, 2007b, p. 4).

The key mechanism used to describe the architecture and enhance collaboration between federal agencies, is the use of segment architectures (see Figure 30). An agency contains both core and mission area segments and business service segments. Enterprise services are cross-cutting services that span multiple segments. Segments can be leveraged within an agency, across several agencies, or the entire federal government (OMB, 2007b). The OMB (2007a) also provides common reference models for (e.g. performance reference model, business reference model, service component reference model, technical reference model and data reference model) to enhance collaboration between the federal agencies.

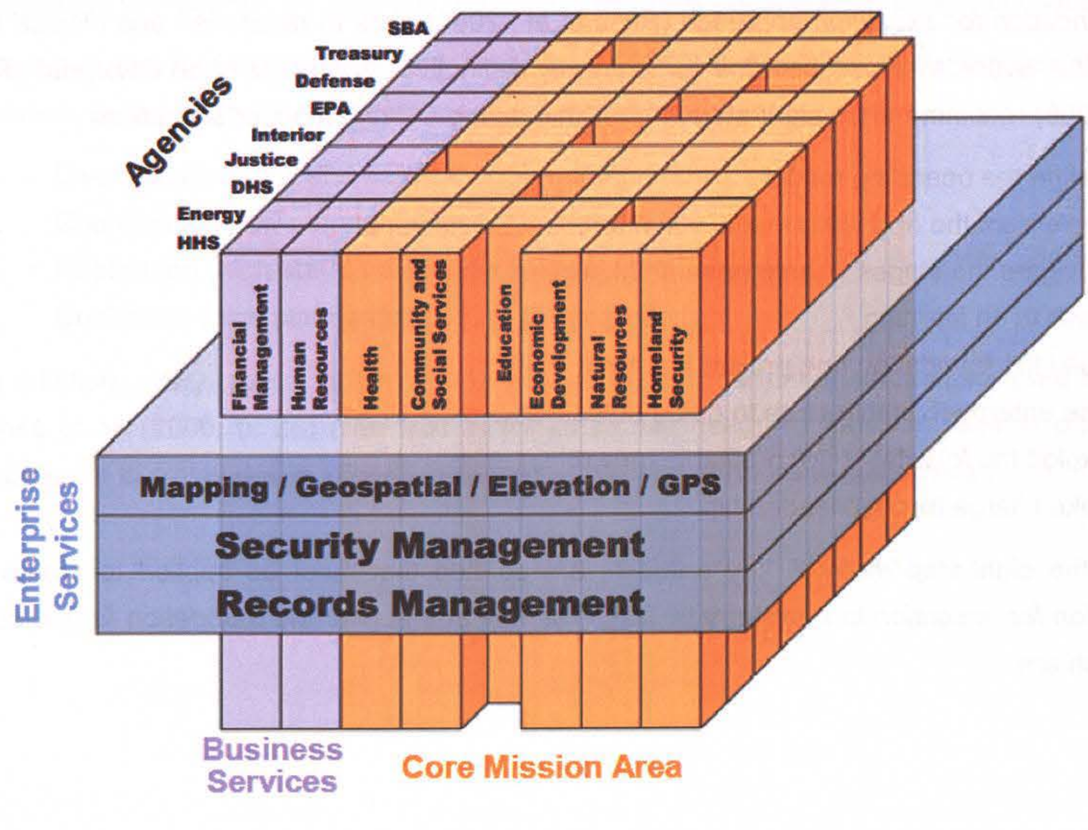


Figure 30: Segments and services, a direct copy (OMB, 2007b, p. 3)

The OMB approach is primarily concerned with *alignment/collaboration* between different federal agencies. Due to its restricted use by US government only (Sessions, 2007), this thesis does *not* provide an extensive business-IT alignment contextualisation of the OMB approach. However, the OMB approach contributed towards the development of the *alignment mechanisms and practices* of the BIAM, as discussed in section 4.3.

3.3.4 The Gartner approach

Gartner, an IT research and consulting enterprise, developed a Gartner Enterprise Architecture Method (GEAM) that consists of a Gartner EA process model and a Gartner EA framework. The Gartner EA process model represents key characteristics and a synthesis of best practices for developing and maintaining an EA, while the Gartner EA framework articulates the relationships between enterprise business architecture (EBA), enterprise information architecture (EIA), enterprise technical architecture (ETA), and their synthesis with enterprise solutions architecture (ESA) (Bittler & Kreizman, 2005).

The Gartner approach is primarily concerned with creating an *alignment methodology* for designing/changing the enterprise. Due to the restricted access to Gartner publications and copyright on Gartner materials, this thesis does *not* provide an extensive business-IT alignment contextualisation of the Gartner approach later in this thesis. Still, the Gartner approach contributed towards the development of the *alignment mechanisms and practices* of the BIAM, as discussed in section 4.3.

3.3.5 The foundation for execution approach

The *foundation for execution* approach (Ross et al., 2006) aims to rationalise and digitise both the routine, everyday processes and competitively distinctive capabilities of an enterprise. Ross et al. (2006) recommend an eight-step *method* in creating a *foundation for execution*:

1. Define the operating model
2. Implement the operating model via enterprise architecture
3. Navigate the stages of enterprise architecture maturity
4. Cash in on learning
5. Build the foundation one project at a time
6. Use enterprise architecture to guide outsourcing
7. Exploit the foundation for profitable growth
8. Take charge through leadership

During the eight-step *method*, key artefacts are defined that must be applied to create the *foundation for execution* in a systematic way. The key artefacts of the *foundation for execution* approach are:

1. The operating model
2. The core diagram
3. Four stages of architecture maturity
4. The IT-engagement model

The key artefacts are discussed subsequently.

3.3.5.1 The operating model

The *operating model* (OM) is used to establish the "necessary level of business process integration and standardisation for delivering goods and services to customers" (Ross et al., 2006, p. 44) and has two main dimensions: (1) business process standardisation, and (2) business process integration. The two dimensions require separate decisions, due to different *end results.*

Standardisation of business processes means defining how a process will be executed regardless of who or where it is executed. The *end result* of process standardisation, is a reduction in variability and therefore dramatic increases in throughput and efficiency. However, process standardisation has a cost, since standardisation limits local innovation and may require expensive rip-and-replace efforts to replace legacy systems with the new standard.

Integration of business processes, links business units via shared data. The *end result* of process integration is an increase in efficiency, coordination, transparency and agility. Integration speeds up the flow of information and transactions throughout an enterprise. Yet, integration may be difficult and time-consuming, since enterprises need to develop standard definitions and formats for data that will be shared across business units and functions.

Based on the two main dimensions, Ross et al. (2006) defined four general types of operating models, based on the levels of standardisation and integration:

1. Diversification (low standardisation, low integration)
2. Coordination (low standardisation, high integration)
3. Replication (high standardisation, low integration)
4. Unification (high standardisation, high integration)

In addition, every type of operating model also exhibits certain characteristics (see Figure 31). Ross et al. (2006, p. 28) aver that every enterprise needs to "position itself in one of these quadrants to clarify how it *intends* to deliver goods and services to customers".

Business process integration		
High	**Coordination** • Shared customers, products, or suppliers • Impact on other business unit transactions • Operationally unique business units or functions • Autonomous business management • Business unit control over business process design • Shared customer/supplier/product data • Consensus processes for designing IT infrastructure services; IT application decisions made in business unit	**Unification** • Customers and suppliers may be local or global • Globally integrated business processes often with support of enterprise systems • Business units with similar or over-lapping operations • Centralised management often applying functional/process/business unit matrices • High-level process owners design standardised processes • Centrally mandated databases • IT decisions made centrally
Low	**Diversification** • Few, if any, shared customers or suppliers • Independent transactions • Operationally unique business units • Autonomous business management • Business unit control over business process design • Few data standards across business units • Most IT decisions made within business units	**Replication** • Few, if any, shared customers • Independent transactions aggregated at a high level • Operationally similar business units • Autonomous business unit leaders with limited discretion over processes • Centralised (or federal) control over business process design • Standardised data definitions but data locally owned with some aggregation at corporate • Centrally mandated IT services
	Low	High

Business process standardisation

Figure 31: Characteristics of four operating models, based on Ross et al. (2006, p. 29)

Not only does an OM decision represent a general vision of a how an enterprise will enable strategies, but each operating model presents different *opportunities and challenges for growth*. For example, *process standardisation*, evident in the replication OM (see Figure 32, *Replication*), enables *organic* growth by expanding into new markets, replicating standard practices and innovations in new markets. However, growth via *acquisition* requires rip-and-replace of infrastructure to leverage the existing foundation.

Business process integration		
High	**Coordination** • **Organic:** stream of product innovations easily made available to existing customers using existing integrated channels. • **Acquisition:** can acquire new customers for existing products but must integrate data.	**Unification** • **Organic:** leverage economies of scale by introducing existing products/services in new markets; grow product line incrementally. • **Acquisition:** can acquire competitors to leverage existing foundation; must rip and replace infrastructure.
Low	**Diversification** • **Organic:** small business units may feed core business; company grows through business unit growth. • **Acquisition:** unlimited opportunities; must ensure shareholder value.	**Replication** • **Organic:** replicate best practices in new markets; innovations extended globally. • **Acquisition:** can acquire competitors to expand market reach; must rip and replace.
	Low	High

Business process standardisation

Figure 32: Different operating models position enterprises for different types of growth, based on Ross et al. (2006, p. 39)

Another key artefact that is derived from the OM, is called the core diagram, which will be discussed next.

3.3.5.2 The core diagram

The *core diagram* translates OM decisions into a visual representation of the processes, data and technologies that need to be shared across the enterprise. Ross et al. (2006) define four common elements in a core diagram:

- *Core business processes.* The stable set of enterprise processes required to execute its operating model and respond to market opportunities.
- *Shared data driving the core processes.* Customer data shared across product lines or business units of an enterprise.
- *Key linking and automation technologies.* Technologies that enable integration of applications (middleware) to shared data, major software packages such as ERP systems, portals providing standardised access to systems and data, and electronic interfaces to key stakeholder groups.
- *Key customers.* Major customer groups served by the *foundation for execution*.

The elements highlighted in a core diagram depend on the type of OM. Each OM consequently requires a different process and template for its design. As an example, the unification OM requires a *process* (see Figure 33, top half) to identify key customers to be served, key processes to be standardised and integrated, and shared data to integrate processes and serve customers. Finally, key technologies may also be added (optionally) to automate or link processes. The *template* for a unification OM (see Figure 33, bottom half) reflects the highly standardised and integrated processes and shared data that make products and services available to customers. Linking and automating technologies are only shown if they are signification in terms of management vision (Ross et al., 2006).

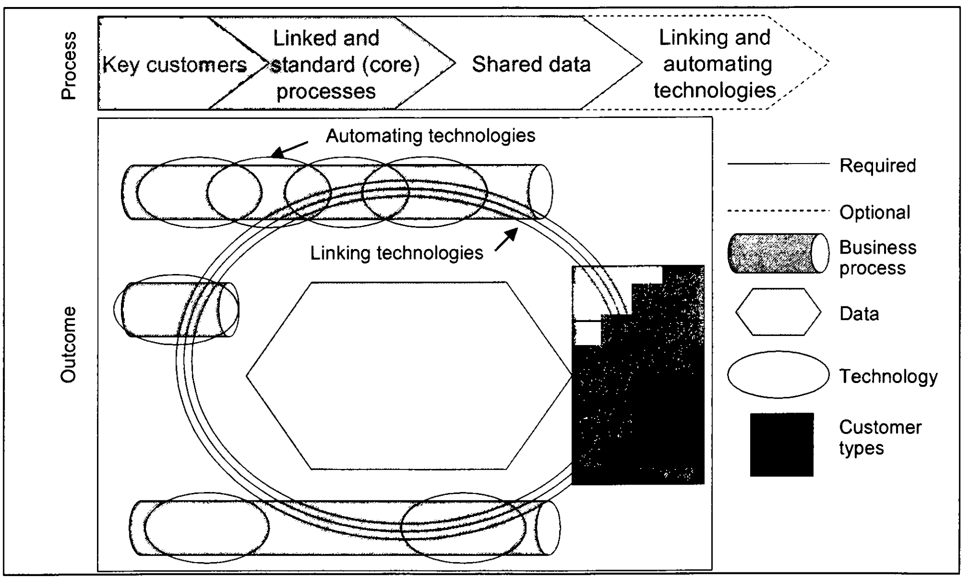


Figure 33: Core diagram process and template for a unification OM, based on Ross et al. (2006, p. 54)

The core diagram provides a graphical representation of enterprise vision in terms of standardisation requirements. In pursuit of this vision, enterprises gradually advance through four stages of architecture maturity. The four stages of architecture maturity are discussed next.

3.3.5.3 Four stages of architecture maturity

The *four stages of architecture maturity* refer to the consistent pattern used by enterprises for building their *foundation for execution*. When enterprises advance through the stages of architecture maturity, they realise benefits ranging from reduced IT operating costs to greater strategic agility (Ross et al., 2006).The four stages are:

1. *Business silos architecture*, where enterprises maximise individual business unit needs or functional needs.
2. *Standardised technology architecture*, i.e. gaining IT efficiencies through technology standardisation and increased centralisation of technology management.
3. *Optimised core architecture*, i.e. providing enterprise-wide data and process standardisation, appropriate for the OM.
4. *Business modularity architecture*, where enterprises manage and reuse loosely coupled IT-enabled business process components to preserve global standards while enabling local differences.

Since each stage requires enterprise changes, enterprises need to acquire learning in several areas (e.g. business objectives, funding priorities, and management responsibilities), whereas learning objectives within the areas differ from one stage to the next.

When an enterprise advances through different stages of architecture maturity, governance mechanisms assist with the process of transformation. The IT engagement model portrays a set of required governance mechanisms and will be discussed next.

3.3.5.4 The IT engagement model

An *IT engagement model* (see Figure 34) is used to portray the set of governance mechanisms that will be required by an enterprise to transform itself into a future design. The *IT engagement model* contains three main ingredients:

1. Company-wide IT governance, defined as the "decision rights and accountability framework to encourage desirable behaviour in using IT" (Ross et al., 2006, p. 119).
2. Project management, which requires a formalised project methodology with clear deliverables and checkpoints.
3. Linking mechanisms, which incorporates processes and decision-making bodies that need to align incentives and connect the project-level activities to the companywide IT governance.

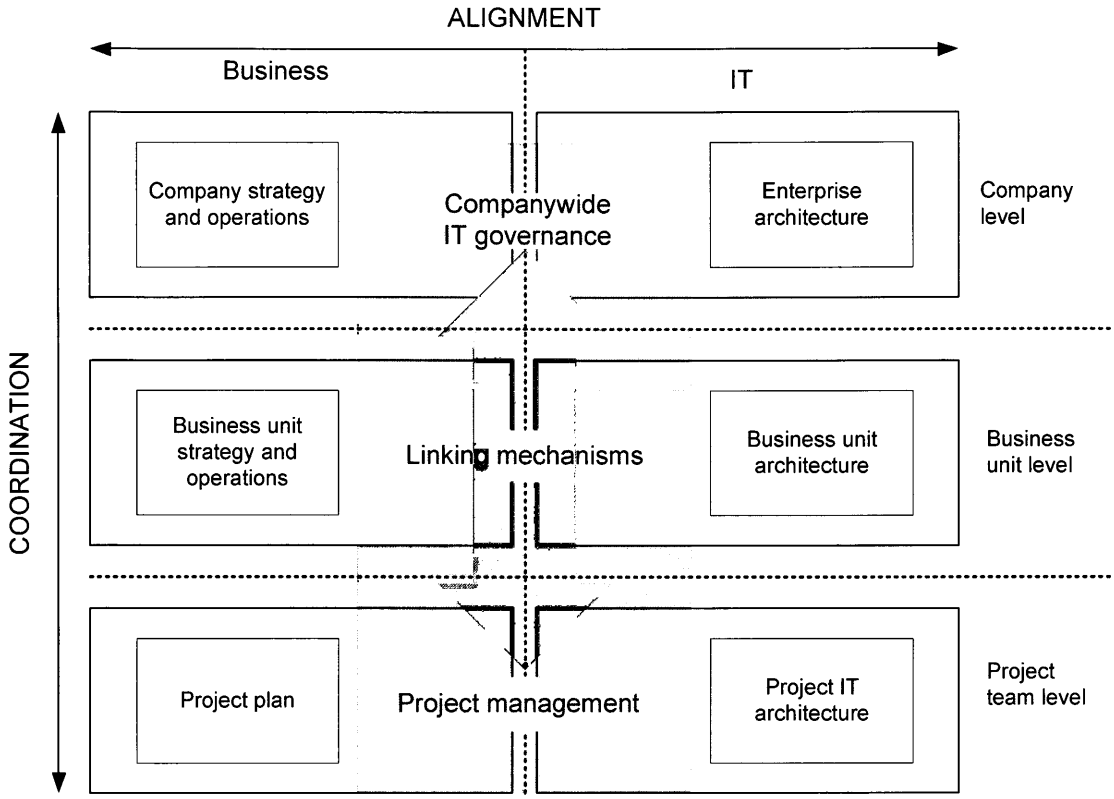


Figure 34: The IT engagement model, based on Ross et al. (2006, p. 120)

Figure 34 presents the three main ingredients of the IT engagement model, as well as the *coordination* and *alignment* between different stakeholder groups. Whereas *coordination* is required between different enterprise levels (company, business unit, and project team levels), *alignment* is required between two perspectives, i.e. business and IT.

The *foundation for execution* approach is primarily concerned with creating an *alignment* vision embedded in the required operating model. Although this section introduced the *foundation for execution* approach to the reader, one can only compare the *foundation for execution* approach to other alignment approaches if a common business-IT alignment model exists. Section 7.2 therefore re-visits the *foundation for execution* approach after defining a Business-IT Alignment Model (BIAM) in section 4.3.

3.3.6 The essence of operation approach

Similar to Zachman (see section 3.3.1), Dietz (2006) in his *essence of operation approach*, also applies the generic *system design process* to demonstrate alignment between requirements and implementations. Similar to Zachman (see section 3.3.1), his objective is to create an enterprise ontology, but ontology in this case defined as the "*essence of construction and operation*" of an enterprise (Dietz, 2006, p. 8). Since Dietz maintains that the organisation of an enterprise is a *social system*, and the active elements of a social system are human beings who operate on and communicate about things in the object world, the *essence of construction and operation* need to contain the communicative aspects of the enterprise. The *essence of operation approach* thus draws on the theory of communicative action of Habermas (1981) to provide an explanation of how communication works, and how communication is used to perform coordination acts and production acts in an enterprise.

This section first differentiates between *coordination acts and production acts* and the distinct human abilities required to communicate. The distinct human abilities are then used to discuss the *organisation of the enterprise* as layered system. With reference to three different layers, the section concludes with an introduction to the *ontological aspect models* that are required to represent the ontological aspect system of the enterprise, and a *methodology* to develop the ontological aspect models.

3.3.6.1 Coordination acts vs. production acts

Humans perform two kinds of acts within their position of authority and responsibility*: production acts* and *coordination acts*. *Production acts* render goods and/or services that are delivered to the environment of the enterprise, and may be either material (e.g. manufacture product) or immaterial (e.g. decision to grant an insurance claim). *Coordination acts* however, ensure that humans enter into and comply with commitments towards each other regarding the performance of a production act. In performing coordination acts and production acts, humans apply three kinds of communicative acts that correspond with their human abilities (Figure 35):

- The *forma* ability (meaning 'form') concerns the form aspects of communication and information, and requires *coordination acts* (e.g. uttering information or perceiving information) to perform *production acts* (e.g. transmitting or storing data).
- The *informa* ability ('what is in the form') concerns the content aspects of communication and information, and requires *coordination acts* (e.g. expressing thought or educing thought) to perform *production acts* (e.g. deducing or reasoning).
- The *performa* ability ('through the form') concerns creation/design of new, original things linked to communication, and requires *coordination acts* (e.g. exposing or evoking commitment) to perform *production acts* (e.g. deciding or judging (Dietz, 2006)).

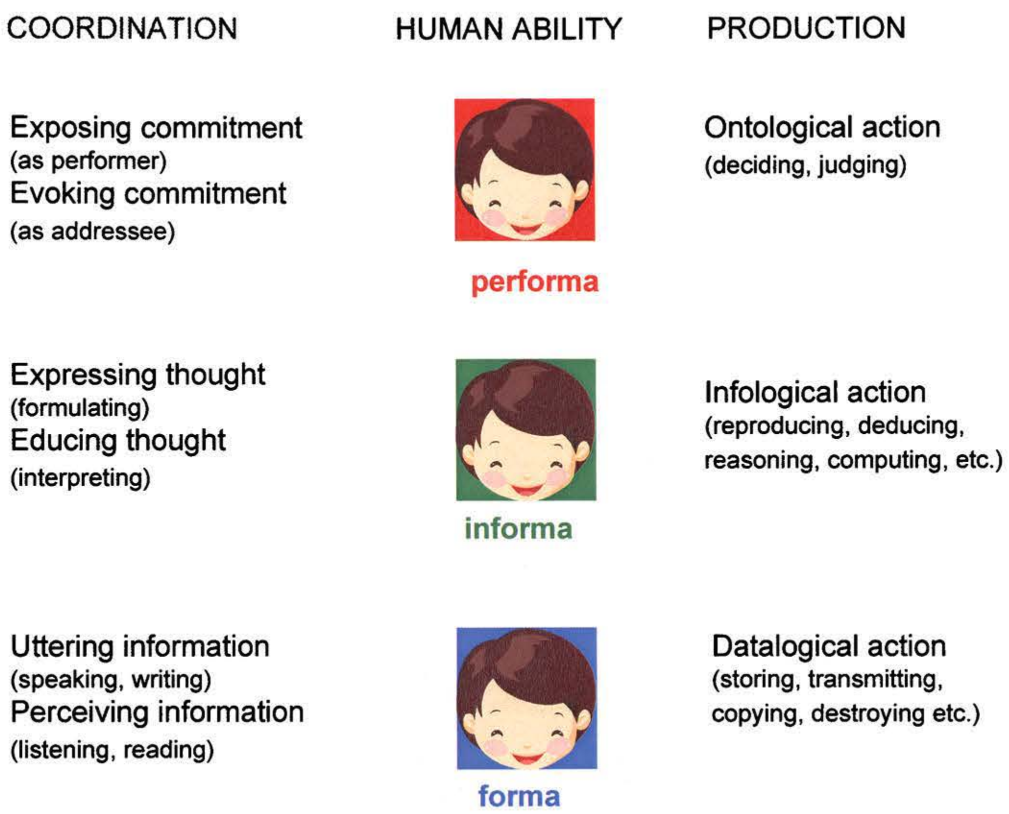


Figure 35: Three kinds of communicative acts, based on Dietz (2006)

The distinct human abilities (Figure 35, *Performa, Informa* and *Forma* abilities) provide the opportunity to create three abstraction layers in representing the *organisation* of the enterprise, which is discussed in the next section.

3.3.6.2 The organisation of the enterprise

The previous section indicated that the *performa* abilities are associated with ontological production acts (Figure 35, *Ontological action*), whereas *informa* abilities are associated with infological production acts (Figure 35, *Infological action*), and *forma* abilities are associated with datalogical production acts (Figure 35, *Datalogical action*).

Using the three distinct human abilities, Dietz (2006) thus represents the *organisation* of the enterprise as a heterogeneous *social* system that consists of a layered integration of three homogeneous social systems: the ontological, infological and datalogical aspect systems (see Figure 36). The three aspect systems are of the same category, i.e. *social* systems, but differ in terms of their *kind of production*: the ontological aspect system produces ontological acts, such as decisions and judgements; the infological aspect system produces infological acts, such as reproducing, deducing, reasoning and computing; whereas the datalogical aspect system produces datalogical acts, such as storing, transmitting, copying and destroying.

The distinction between different aspect systems enables one to focus on the essential/ontological aspect system in describing the essential operation of an *organisation*, irrespective of its realisation (i.e. integration with the other two aspect systems) or implementations (using technology to make the organisation operational). The three aspect systems thus only represent the *organisation* of the enterprise system and *exclude* the implementation (incorporating technology) of the enterprise system.

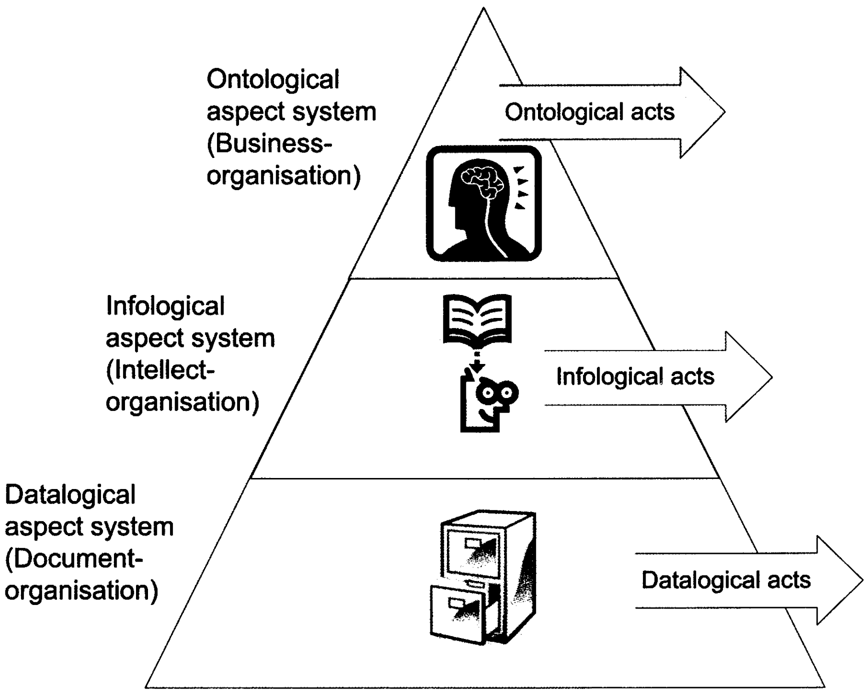


Figure 36: The three aspect systems, based on Dietz (2006)

Dietz (2006) focuses on the essential/ontological aspect system (Figure 36, *Ontological aspect system*) using ontological aspect models (OAMs) to represent the ontological knowledge of an enterprise. The next section introduces the OAMs.

3.3.6.3 The ontological aspect models

The main contribution of the *essence of operation approach* is the ontological aspect models (OAMs) that convey the ontological knowledge of *enterprise construction*. Figure 37 illustrates the three aspect systems and the set of OAMs to represent the ontological knowledge of an enterprise. The OAMs are *white box* models that provide a *constructional notion* of the *ontological aspect* system (see section 3.2.1.1), rather than *black box* models that convey the function or behaviour of a system. Dietz (2006, p. 82) equates the set of OAMs to the skeleton of the enterprise, which provides the "rigorous basis for effective and elegant movements but does not determine the external beauty of the 'body'". Many other human abilities are thus required to achieve an optimal-performing enterprise.

3.3.6.4 A methodology for developing the ontological aspect models

In assisting the practitioner to develop the OAMs (Figure 37) in the right way, Dietz developed a *methodology,* called DEMO (Design and Engineering Methodology for Organisations) and suggests that the OAMs are developed in the following sequence:

1. Develop the interaction model (re-visited in section 8.2.3) to represent the actors and transaction types that are involved during an enterprise operation.

2. Derive the process model from the interaction model to demonstrate the transaction patterns for each transaction type.
3. Detail the action model based on the individual steps of the process model to serve as guidelines for actors in dealing with their agenda.
4. Derive the state model from the action model to specify the state space of the production world.
5. Convert the interaction model to an interstriction model by adding the passive influences (facts that were created) as detailed in the state model (Dietz, 2006).

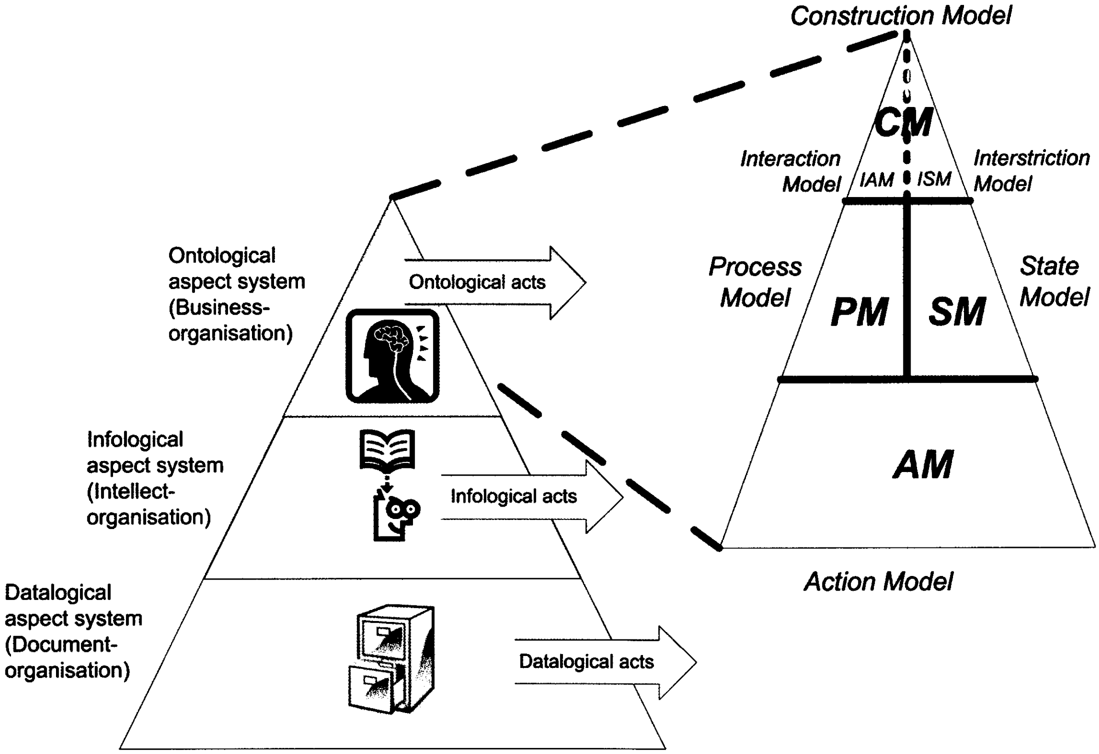


Figure 37: The ontological aspect models, based on Dietz (2006, p. 140)

The *essence of operation* approach is primarily concerned with creating the essential constructional view of the *organisation* of the enterprise system (called the enterprise ontology), as a starting point for *alignment* with the ICT system. Hoogervorst (2009) already acknowledged the value of enterprise ontology as defined by Dietz (2006) by using *enterprise ontology* and *architecture guidance* as two pillars in his *enterprise engineering* approach (see section 3.4.7). Although this section provided an introduction of the *essence of operation* approach, section 8.2 re-visits the *essence of operation* approach using the Business-IT Alignment Model (BIAM) as discussed in section 4.3.

This section introduced the six alignment approaches that were primarily used and referenced for the purpose of this thesis. The next section introduces eight *other alignment approaches*, applied as a secondary data source to provide additional motivation and explanation for the BIAM components (as discussed in Chapter 4).

3.4 OTHER ALIGNMENT APPROACHES

The previous section (section 3.3), introduced six alignment approaches, which were used as the primary data source for analysing alignment approaches to construct the BIAM. This section introduces eight *other alignment approaches* that were also referenced in this thesis as secondary data sources. Table 10 presents the eight *other alignment approaches*, their key mechanisms and referenced publications.

Table 10: Other alignment approaches

Alignment approach	Key mechanism(s)	Referenced publications
GERAM approach	Generalised Enterprise Reference Architecture and Methodology (GERAM) framework	(GERAM, 1999)
Schekkerman approach	E2AF (Extended Enterprise Architecture Framework)	(Schekkerman, 2004)
The dynamic architecture approach	DYA (Dynamic Architecture)	(Wagter, van den Berg, Luijpers, & van Steenbergen, 2005)
Bernard approach	EA3 Cube Framework	(Bernard, 2005)
Gharajedaghi approach	Interactive Management Model	(Gharajedaghi, 2006)
Capgemini approach	IAF (Integrated Architecture Framework)	(Capgemini, 2007)
Hoogervorst approach	Enterprise governance and design concepts	(Hoogervorst, 2009)
The Giachetti approach	EDM (Enterprise Design Methodology)	(Giachetti, 2010)

The following sections introduces each of the eight *other alignment approaches* in terms of their *main benefits* and *key mechanisms.*

3.4.1 The GERAM approach

The *GERAM approach* addresses the challenges that enterprises face in a rapidly changing environment and the need to adapt dynamically (GERAM, 1999). Acknowledging the value of existing reference architectures, the IFIP/IFAC task force evaluated existing enterprise integration reference architectures (CIMOSA, GIM and PERA) and consolidated the existing reference architectures into a consolidated, generalised architecture. The proposed reference architecture was entitled GERAM (Generalised Enterprise Reference Architecture and Methodology). GERAM incorporates a set of method, models and tools, which are needed to *build and maintain* the integrated enterprise (GERAM, 1999).

The *key mechanism* of the *GERAM approach* is the GERAM framework, which consists of several components (see Figure 38). The most important component, is the GERA (Generalised Enterprise Reference Architecture), which includes basic concepts for enterprise engineering and integration (e.g. specifying enterprise entities, life cycles and life histories of enterprise entities). Other components include methodologies for enterprise engineering (EEMs), enterprise modelling languages (EMLs), which are used to produce enterprise models (EMs). The models guide the implementation of the operational system of the enterprise (EOS), which may also be supported by specific enterprise modules (EMOs). The methodology and languages are supported by enterprise engineering tools (EETs) (GERAM, 1999).

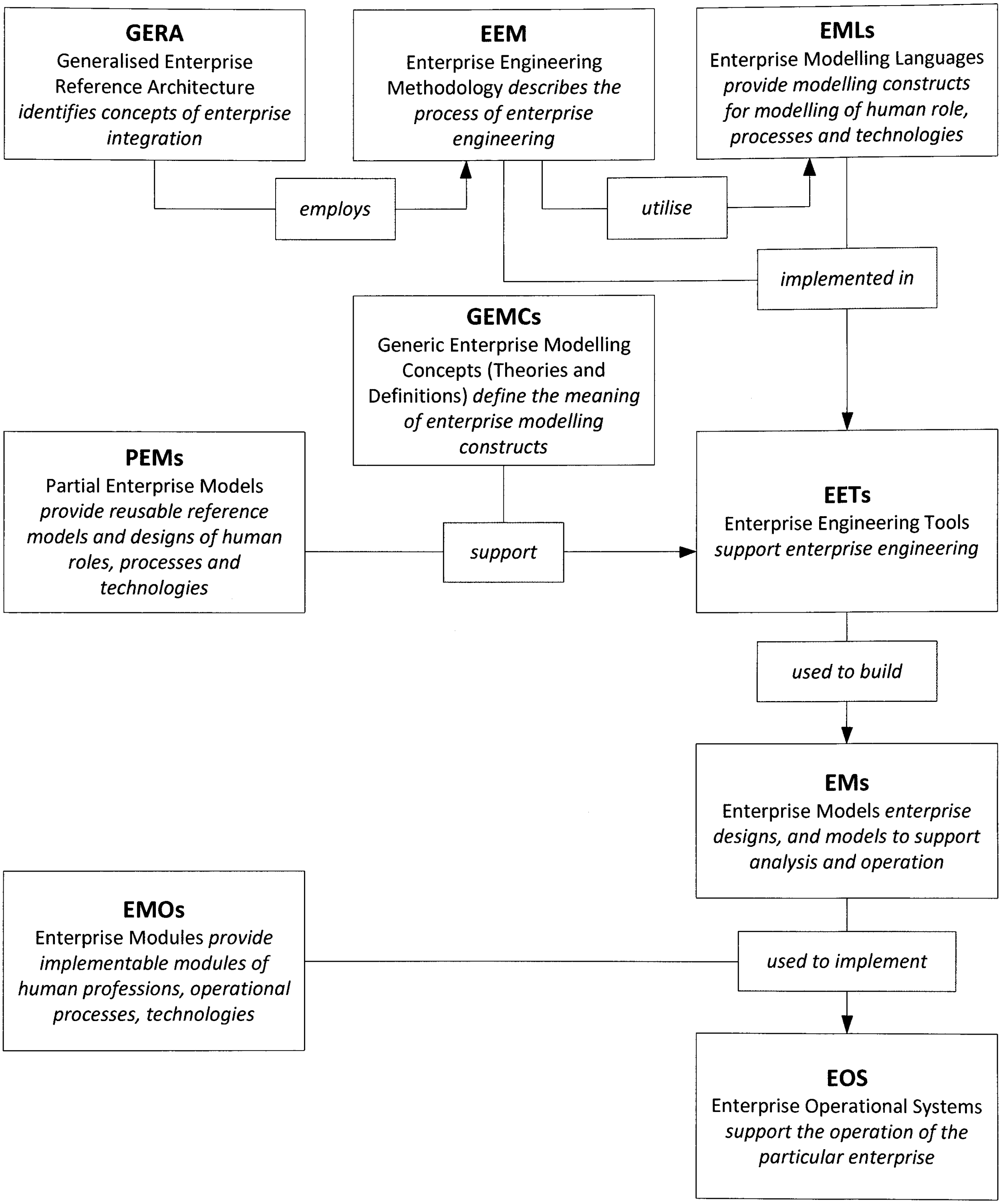


Figure 38: GERAM (Generalised Enterprise Reference Architecture and Methodology) framework components, based on GERAM (1999)

3.4.2 The Schekkerman approach

The *Schekkerman approach* addresses the need of enterprises to collaborate and communicate with all the extended stakeholders of the enterprise (Schekkerman, 2004).

The *key mechanism* of the *Schekkerman approach* is the Extended Enterprise Architecture Framework (E2AF). The E2AF was developed by the Institute for Enterprise Architecture

Developments in 2002, primarily influenced by the Zachman Framework, EAP (Enterprise Architecture Planning) and IAF (Integrated Architecture Framework). The E2AF resembles a matrix of six columns and four rows to distinguish between different levels of concerns and different aspects of the enterprise (Schekkerman, 2004).

The six levels of *concern* include:

1. *Contextual level:* Describing the motivations of the enterprise.
2. *Environmental level*: Representing the business and technology relationships within the extended enterprise.
3. *Conceptual level:* Referring to the requirements of enterprise entities involved in various aspect areas of the enterprise.
4. *Logical level:* Representing the ideal logical solutions for each aspect area.
5. *Physical level:* Describing the physical solutions of products and techniques in each aspect area.
6. *Transformational level:* Describing the impact for the enterprise in terms of the proposed solutions (Schekkerman, 2004).

The four *aspect areas* include:

1. *Business or organisation:* Expressing the business elements and structures.
2. *Information:* Representing the information needs, flows and relations.
3. *Information – systems:* Referring to the automated support of specific functions.
4. *Technology – infrastructure:* Representing the supporting technology environment for the information systems (Schekkerman, 2004).

3.4.3 The dynamic architecture approach

The *dynamic architecture* approach addresses the challenge that enterprises face in finding the correct balance between *coherence* and *agility. Coherence* is required to ensure that the enterprise functions as a uniform entity, whereas *agility* requires dynamic enterprise changes to keep up with changes in products and markets (Wagter et al., 2005).

The *key mechanism* of the *dynamic architecture* approach is the Dynamic Architecture (DYA) model. The DYA model suggests information system development conforming to architecture standards, but also provide for information system development *without conformance* to architecture standards. Most of the development projects should be anticipative in nature, conforming to architecture standards. Development *without conformance* needs to be the exception, requires motivation and still happens in a controlled way. Thus an enterprise may need to develop an ad hoc, short-term solution (*without conformance*) when the enterprise is taken by surprise or if the enterprise needs to seize a once-off competitive advantage (Wagter et al., 2005).

3.4.4 The Bernard approach

The *Bernard approach* intends to *improve enterprise performance* by perceiving the enterprise in a holistic and integrated way, developing both current and future representations/artefacts of the enterprise (Bernard, 2005).

The *key mechanism* of the *Bernard approach* is the EA3 Cube Framework (Figure 39). The EA3 Cube (Figure 39) contains:

1. *Horizontal slices*: Sub-architectures for distinct functional areas.
2. *Vertical segments*: Segments of distinct activity, called *lines of business.*
3. *Common threads*: Threads of common activity that are present in all levels of the framework, e.g. security, standards and workforce.

Artefacts (Figure 39, *Artefacts*) are documentation about the horizontal slices and vertical segments, describing the current or future architecture of the enterprise.

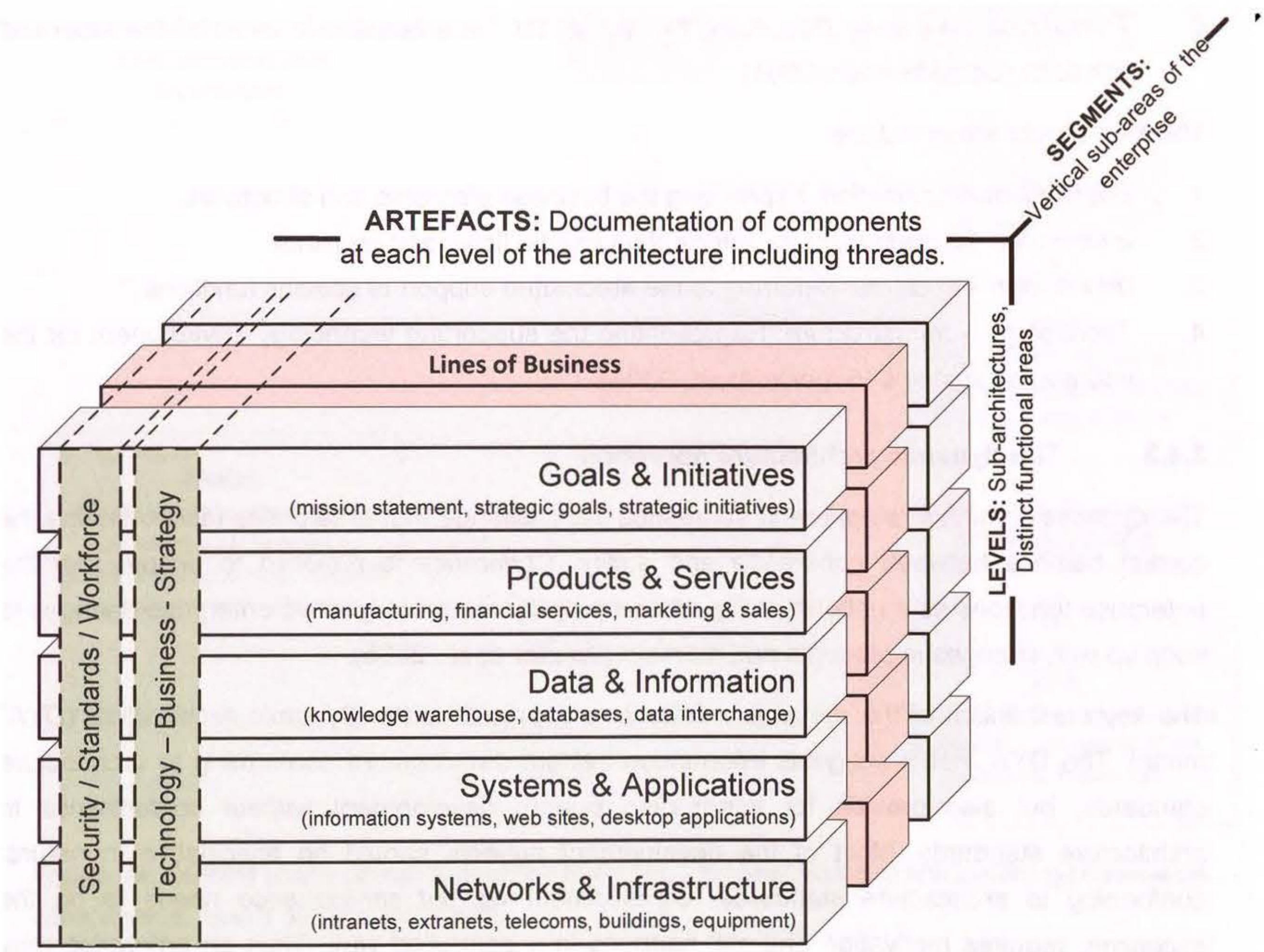


Figure 39: The EA3 Cube Framework, based on Bernard (2005, p. 38)

3.4.5 The Gharajedaghi approach

The *Gharajedaghi approach* addresses the challenges that enterprises face due to continuous "change of the game". Garajedaghi (2006) states that a dual paradigm shift is necessary to understand the enterprise, which would contribute towards effective enterprise redesign and management. The dual paradigm shift requires (1) a shift in the *method of inquiry* (shifting from an analytical approach towards a systems approach), and (2) a shift in the *conception of the enterprise* (shifting from a mindless system towards a multiminded sociocultural system).

The *key mechanism* of the *Gharajedaghi approach* is the Interactive Management Model (see Figure 40). The Interactive Management Model suggests contextual knowledge within three areas, prior to the problem-definition and design within an enterprise:

- *Basic assumptions*: Making assumptions about the evolving game in which enterprises participate, drivers for change and basis for competition.
- *Systems principles*: Understanding systems principles, such as openness, purposefulness, emergent properties, multi-dimensionality and counter-intuitiveness.
- *System dimensions*: Understanding and describing an enterprise in terms of five dimensions, i.e. power, beauty, wealth, knowledge and values.

Knowledge of the environmental context, systems principles and systems dimensions is necessary to define problems and opportunities, using various techniques (system analysis, obstruction analysis and system dynamics). Based on the analyses, enterprise designers design a solution/idealised design. The idealised design could lead to several levels of output (redesigning the enterprise, its operations or products).

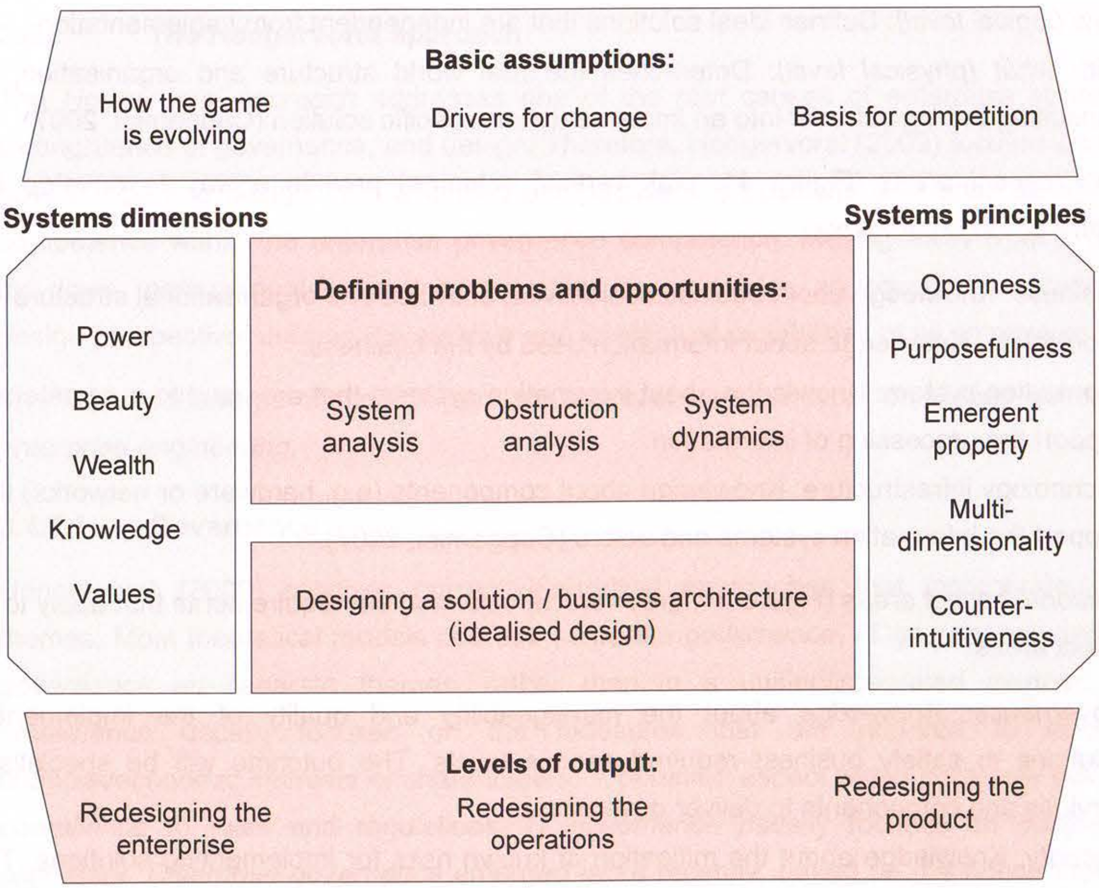


Figure 40: Interactive Management Model, based on Gharajedaghi (2006, p. 23)

3.4.6 The Capgemini approach

The *Capgemini approach* addresses the challenges of uncontrolled growth of information systems and technology in the late 1990s. Uncontrolled growth resulted in complex and costly information system landscapes. The *Capgemini approach* provides a solution to create better alignment between business and IT, deliver more flexibility for business and IT, and manage complexity better (Capgemini, 2007).

The *key mechanism* of the *Capgemini approach* is the Integrated Architecture Framework (IAF) (see Figure 41). Capgemini (2007, p. 4) views architecture as "providing a comprehensive and coherent view across business, information , systems and technology". The IAF is used to structure and define architecture content in terms of two dimensions: (1) abstraction levels, and (2) aspect areas.

The abstraction levels (Figure 41, horizontal bars) allows for a consistent definition within each aspect area:

- *Why (contextual level)*: Provides the scope and objectives for the new architecture and its content.
- *What (conceptual level)*: Elaborates and analyses the objectives, re-stated as requirements.
- *How (logical level)*: Defines ideal solutions that are independent from implementation.
- *With what (physical level):* Determines the real world structure and organisation, by translating the *logical level* into an implementation-specific solution (Capgemini, 2007).

Four *core aspect areas* (Figure 41, pink vertical columns) provide a way to develop the architecture of the enterprise:

- Business: Knowledge about business objectives, activities and organisational structure.
- Information: Knowledge about information used by the business.
- Information system: Knowledge about information systems that are used to automate and support the processing of information.
- Technology infrastructure: Knowledge about components (e.g. hardware or networks) that support the information systems and actors (Capgemini, 2007).

Two *additional aspect areas* (Figure 41, grey vertical columns) set requirements that apply to all core aspect areas:

- *Governance:* Knowledge about the manageability and quality of the implemented solutions to satisfy business-required service levels. The outcome will be specialised services and components to deliver governance.
- *Security:* Knowledge about the mitigation of known risks for implementing solutions. The outcome will be specialised services and components to deliver the required security (Capgemini, 2007).

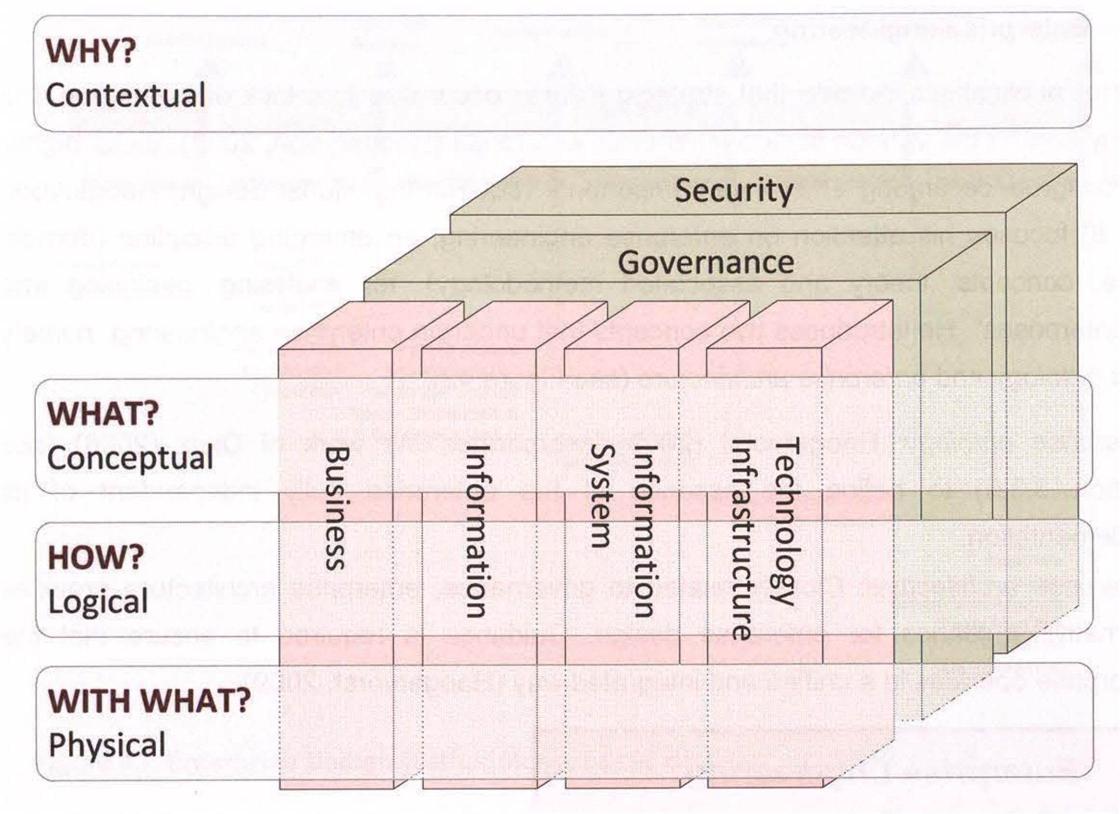


Figure 41: The Integrated Architecture Framework, based on Capgemini (2007, p. 13)

3.4.7 The Hoogervorst approach

The *Hoogervorst approach* addresses one of the root causes of enterprise strategic failure, incongruence of governance, and design. Therefore, Hoogervorst (2009) focuses on addressing governance and design from a unified perspective. He positions enterprise design as a core competence within the enterprise governance competence. Moving away from a mechanistic top-down management-focused perspective, he advocates an organismic governance and design perspective, utilising the creative and intellectual capabilities of all employees.

The *key mechanisms* of the *Hoogervorst approach* are concepts on unified *governance* and *enterprise engineering*.

3.4.7.1 Governance

Hoogervorst (2009) criticizes current theoretical approaches that incorporate governance themes. Most theoretical models address *corporate governance*, *IT governance* and *enterprise governance* as separate themes, rather than in a unified/integrated manner. *Corporate governance* usually focuses on the measures that are required to safeguard the financial/economic interests of shareholders. A pertinent aspect within corporate governance, is *compliance* to rules and regulations. *IT governance* usually focuses on *business and IT alignment*. *Enterprise governance* emerged more recently, based on the notion that enterprise *performance* (rather than compliance) safeguards shareholder interests. Hoogervorst (2009) unites corporate governance and IT governance under the umbrella-term, *enterprise governance*.

3.4.7.2 Enterprise engineering

A number of publications indicate that strategic failures occur due to a lack of coherence and consistency among the various components of an enterprise (Hoogervorst, 2009). Since higher levels of congruence among enterprise components requires intentional design, Hoogervorst (2009, p. 8) focuses his attention on enterprise engineering, an emerging discipline (domain knowledge, concepts, theory and associated methodology) "for analysing, designing and creating enterprises". He introduces two concepts that underpin enterprise engineering, namely *enterprise ontology* and *enterprise architecture* (see Figure 42):

- *Enterprise ontology*: Hoogervorst (2009) incorporates the work of Dietz (2006) (see section 3.3.6) to define the essence of the enterprise, fully independent of its implementation.
- *Enterprise architecture*: Closely related to governance, enterprise architecture provides normative guidance for enterprise design. Guidance is required to ensure that the enterprise operates in a unified and integrated way (Hoogervorst, 2009)

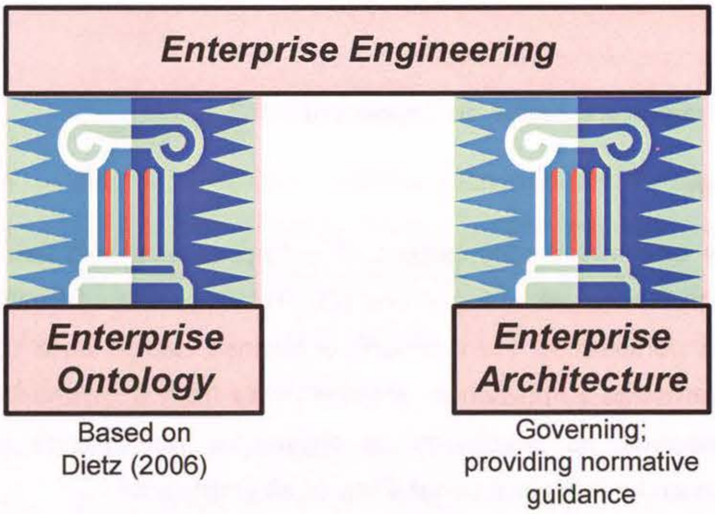


Figure 42: Pillars of enterprise engineering, based on Hoogervorst (2009)

3.4.8 The Giachetti approach

The *Giachetti approach* addresses the integration challenges of enterprise design. Knowledge for enterprise design is often fragmented and contained within different disciplines, preventing enterprises from achieving optimally (Giachetti, 2010). Giachetti (2010) states that enterprises require a system-wide perspective on the enterprise to integrate the specialised knowledge of separate enterprise aspects. As a solution, he provides an enterprise engineering methodology.

The *key mechanism* of the *Giachetti approach* is the Enterprise Design Methodology (EDM), which consists seven life-cycle phases (see Figure 43). Each phase contains several activities. Certain milestones mark the end of one phase and the beginning of the next, e.g. Kick-off meeting marks the end of *project initiation* and the start of *project planning*. The EDM forms the backbone to present several principles, models, methods and tools needed to design the enterprise (Giachetti, 2010).

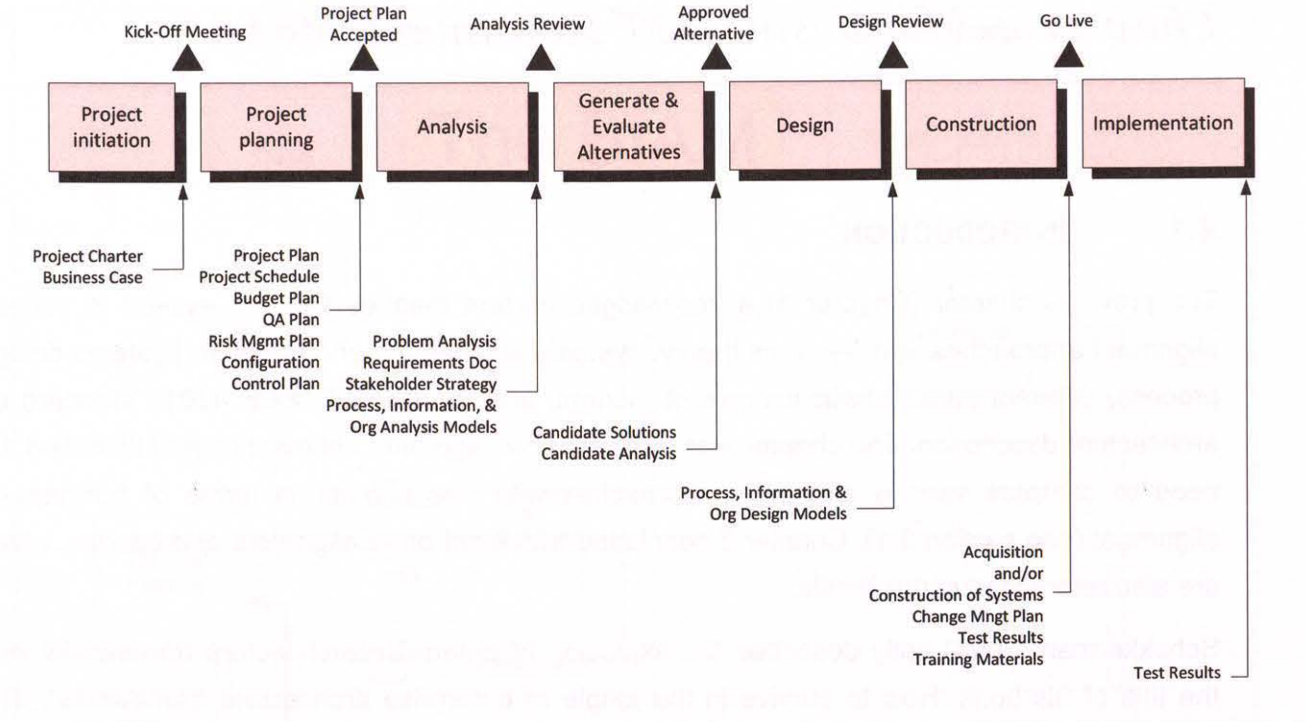


Figure 43: Enterprise Design Methodology, based on Giachetti (2010, p. 120)

3.5 CONCLUSION

Chapter 3 introduced the concept of business-IT alignment within a broader enterprise alignment context. Acknowledging the different approaches towards alignment, common theoretical foundations do exist. The theoretical foundations for business-IT alignment were delineated in section 3.2, and include systems theory, systems engineering and the basic systems design process, different paradigmatic schools of thought, and the ISO/IEC/IEEE 42010 standard on architecture description. Without providing a critical analysis in section 3.3, six alignment approaches are discussed, of which four approaches are prominent in literature (Zachman approach, Open Group approach, OMB approach and Gartner approach) and two less popular alignment approaches (the *foundation for execution* approach and the *essence of operation* approach). These six alignment approaches were used as the *main data source* during an inductive development of the BIAM (as discussed in Chapter 4).

Four of the six alignment approaches (the Zachman approach, Open Group approach, the *foundation for execution* approach and the *essence of operation* approach) will be used later in this thesis to verify the use of BIAM in providing a business-IT contextualisation.

Finally, this thesis referred to eight *other alignment approaches* as a *secondary data source*. The *other alignment approaches* (referenced in Chapter 4), provide additional motivation and explanation for the BIAM components.

4.1 INTRODUCTION

The previous chapter (Chapter 3) acknowledged current theories that are evident in various alignment approaches, e.g. systems theory, systems engineering and the basic systems design process, different paradigmatic schools of thought, and the ISO/IEC/IEEE 42010 standard on architecture description. The chapter also described six alignment approaches and identified the need to compare various alignment approaches with one another in terms of business-IT alignment (see section 3.1). Chapter 3 concluded with eight *other alignment approaches,* which are also referenced in this thesis.

Schekkerman (2004) aptly describes the explosion of enterprise architecture frameworks with the title of his book 'How to survive in the jungle of enterprise architecture frameworks'. The number of relevant EA frameworks emphasises the need to provide a common reference model in order to discuss and compare various alignment approaches with one another. The purpose of this chapter is to recognize the knowledge embedded in current alignment approaches by inductively creating a model that will highlight prominent themes/patterns evident in each of these alignment approaches. This chapter answers the second research question, namely:

What model is required to contextualise different business-IT alignment approaches?

This chapter applies the theory of Chapter 3 through an inductive development process to develop the BIAM (Business-IT Alignment Model)[1]. The chapter starts with the inductive development process that was followed, emphasising the contributions of the six alignment approaches previously discussed in section 3.3, since each approach differs in business-IT alignment intent, scope and alignment means. Section 4.2 repeats and extends the research design (exploratory design, previously discussed in section 2.6.3), whereas section 4.3 details the components of the proposed BIAM.

4.2 THE BIAM CONSTRUCTION PROCESS

This study used inductive reasoning (see Figure 44), discussed previously in section 2.6.3, to derive a Business-IT Alignment Model (BIAM).

[1] The content of Chapter 4 is based on: De Vries, M. (2010). A framework for understanding and comparing enterprise architecture models. *Management Dynamics, 19*(2), 17-29.

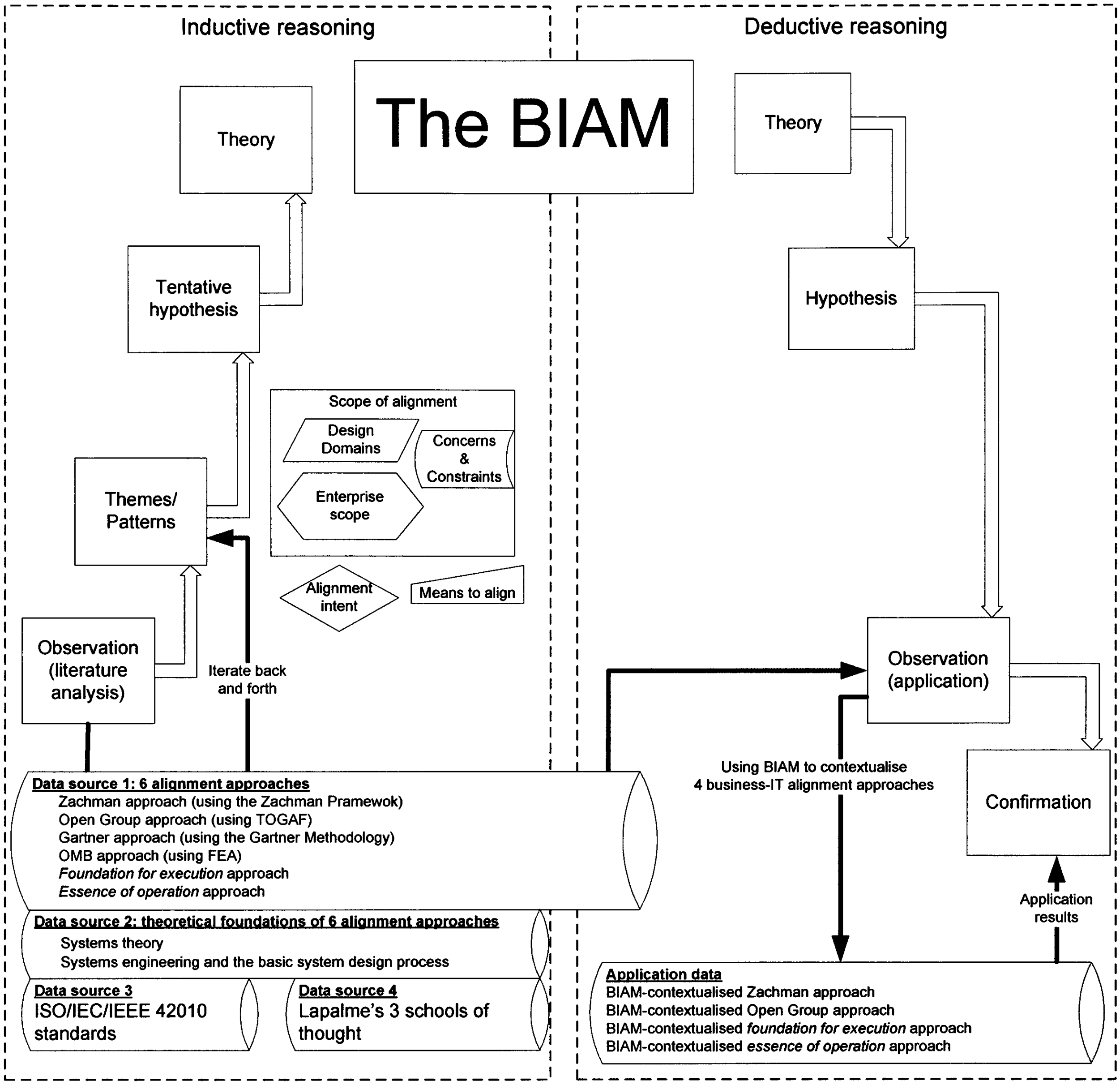


Figure 44: Exploratory design for building and applying the BIAM (duplicate of Figure 16)

As stated in section 2.6.3, an exploratory research design was used as a supplementary component of a mixed methods design, to develop the BIAM. Furthermore, a literature review was used as the data-gathering method, *inductively* formulating the main components of the BIAM. Subsequently the conceptual BIAM is applied (in Chapter 5) in a *deductive* way to demonstrate the interpretation and use of the model in terms of four theoretical alignment models.

As mentioned in section 2.6.3, this study used four *main data sources* in constructing the BIAM:

1. Six current alignment approaches (discussed in section 3.3).
2. Theoretical foundations of the six alignment approaches, which include systems theory (discussed in section 3.2.1), systems engineering and the basic system design process (discussed in section 3.2.2).
3. The ISO/IEC/IEEE 42010 standards (discussed in section 3.2.4).
4. Lapalme's three schools of thought (discussed in section 3.2.3).

A *secondary data source* (eight *other alignment approaches*, discussed in section 3.4) was used to provide additional motivation and explanation for the BIAM components.

In this thesis, the initial development of BIAM (called BIAF (De Vries, 2010)), was extended to acknowledge the three different schools of thought on alignment approaches, as defined by Lapalme (2011), and the differences in design and alignment scope. The alignment approaches included in the main data source primarily gravitate towards the first school of thought (enterprise IT architecting) and the business-IT alignment scope. Due to its representation in terms of business-IT alignment scope, the contextualisation model is classified as a Business-IT Alignment Model (BIAM).

4.3 THE PROPOSED BUSINESS-IT ALIGNMENT MODEL (BIAM)

The purpose of this section is to relate the components of the BIAM to its theoretical foundations, followed by an in-depth discussion of every BIAM component. The section starts with a definition of the main BIAM components upfront to demonstrate the theoretical foundations of each component in section 4.3.1, followed by a detailed description of each component in section 4.3.2.

The results of the literature review indicated that business-IT alignment approaches provide answers to one or more of the following *three questions*:

- Question 1: '*Why* should the enterprise use the proposed approach to align?'
- Question 2: '*What* should the enterprise align?'
- Question 3: '*How* should the enterprise align?'

In answering the three questions through a conceptual mechanism, the BIAM subsequently consists of *four main components*:

- Component 1: An *alignment belief/paradigm of creating value* (Figure 45, foundation ellipse) (answering Question 1).
- Component 2: Three alignment *dimensions* (Figure 45, three panes of the block) to define the scope of alignment (answering Question 2).
- Component 3: Supporting *alignment mechanisms and practices* (Figure 45, bottom triangle) to ensure alignment across the alignment dimensions (partially answering Question 3).
- Component 4: *Alignment approach classifiers* that influences the selection of appropriate *alignment mechanisms and practices* (partially answering Question 3) (De Vries, 2010).

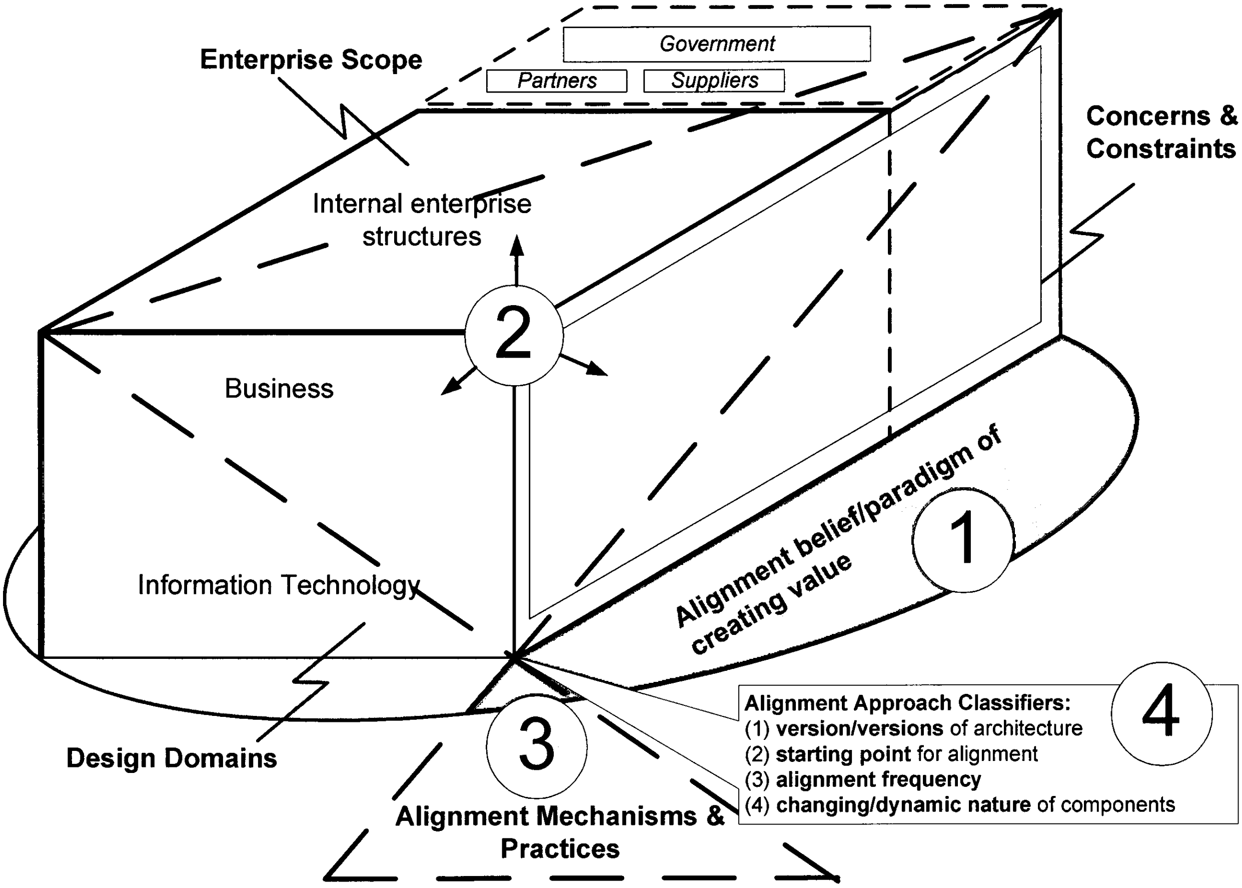


Figure 45: The BIAM (adapted from De Vries, 2010)

The core of the BIAM, is the *alignment mechanisms and practices* (Figure 45, Component 3 / bottom triangle), since they create the business-IT alignment *capability* that contributes to business-IT alignment. The alignment *mechanisms and practices* ensure alignment across Component 2, i.e. *design domains*, stakeholder *concerns*, and the *enterprise scope* (e.g. business units, programmes, and projects). Slicing across the three dimensions, the *alignment mechanisms and practices* thus form the core/heart of the BIAM, enacting alignment for the intended scope.

In support of the *alignment belief/value-creation paradigm* (Component 1) and three alignment *dimensions* (Component 2), the collective set of *mechanisms and practices* (Component 3) may be further characterised using *alignment approach classifiers* (Figure 45, Component 4 / callout). The classifiers relate to:

1. Version or versions of alignment (current state / future state)
2. Starting point for doing architecture work (top-down, bottom-up or middle in)
3. Alignment frequency (periodic vs continuous)
4. Different ways of addressing the changing/dynamic nature of the alignment components

The following sections relate the components of the BIAM to its theoretical foundations and delineate each component of the BIAM in terms of content and supportive literature sources.

4.3.1 Theoretical foundations supporting the BIAM

This section first provides an indication of how the current knowledge base was applied in constructing the BIAM (see Figure 46). A more detailed mapping is provided against the knowledge base during the discussion of every BIAM component in the subsequent sections.

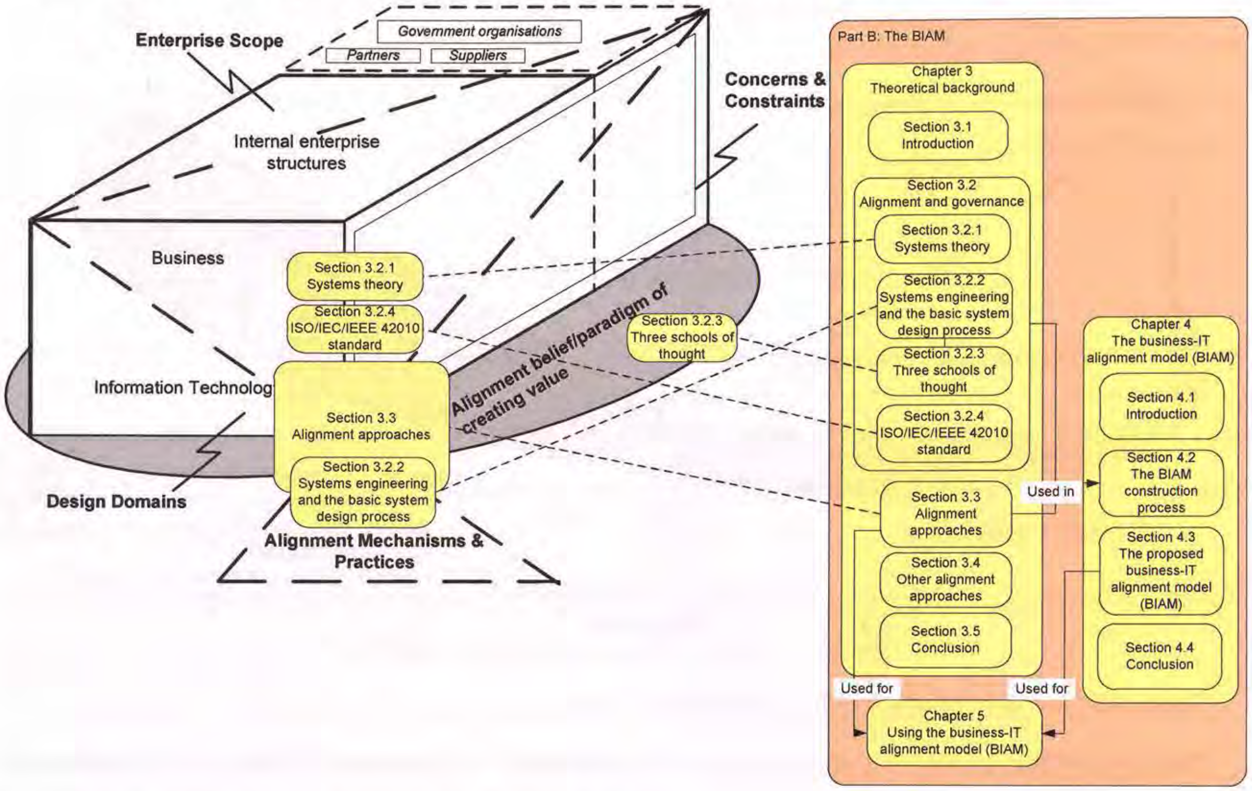


Figure 46: The theoretical foundations of the BIAM

Figure 46 illustrates that the foundation component of the BIAM (*Alignment belief/paradigm of creating value*) relates to the three different schools of thought and intends to accommodate different beliefs and paradigms, such as the three different schools of thought previously discussed in section 3.2.3.

Two of the three alignment *dimensions* (Figure 46, front and side panes, *Design Domains* and *Concerns & Constraints*) of the BIAM, represent the descriptive elements of the enterprise. Systems theory (covered in section 3.2.1) refers to different notions of a system and its representation using *white-box models* and *black-box models*, whereas the ISO/IEC/IEEE 42010 standard provides a standard for *architecture description* (covered in section 3.2.4).

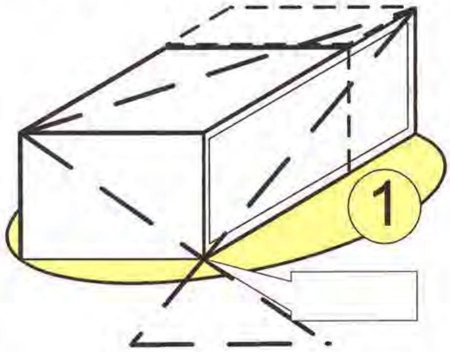
The *alignment mechanisms and practices* (Figure 46, *Alignment Mechanisms and Practices*) of the BIAM refer to the various means of alignment. Systems engineering and the basic system design process (covered in section 3.2.2) provides a systematic process to align different systems (e.g. the *organisation* of the enterprise system with ICT).

Finally, Figure 46 demonstrates that alignment approaches (covered in section 3.3) address one or more of the BIAM alignment components. As an example, the Open Group approach provides an *alignment belief/paradigm of creating value* (foundation component of the BIAM), delineates the scope of alignment in terms of three *alignment dimensions* (three panes of the BIAM block), and provides a rich set of *alignment mechanisms and practices* (bottom triangle of the BIAM).

4.3.2 The BIAM components

This section describes the various components of the BIAM according to Figure 45.

4.3.2.1 Component 1: Alignment belief/paradigm of creating value



The paradigm of value creation relates to the philosophical dimension of a paradigm, providing the *why* of the alignment approach and the grounds for the type of activities included in the alignment *mechanisms and practices*. Alignment approaches thus found their proposed approach on defendable value propositions/offerings. The value propositions are based on certain belief systems about value-creation in an enterprise and the capability of marketing the propositions to the owners/funding parties of the enterprise. Value is in the eye of the beholder (Hitchins, 2003), therefore alignment approaches differ in their value propositions. The value-proposition of an alignment approach is represented by the foundation component of the BIAM (Figure 45, Component 1).

Alignment approach author(s) provide a rationale for using a proposed alignment approach to address current miss-alignment problems in organisations. The authors, often influenced by their own worldview/epistemological beliefs, usually promise to deliver an alignment solution that will address the systemic miss-alignment causes in an enterprise. Similar to the different belief systems identified by Lapalme (2011) in terms of enterprise architecture, the three schools of thought could also be applicable to enterprise alignment:

1. Enterprise IT architecting
2. Enterprise integrating
3. Enterprise ecological adaption (see Table 8)

Although BIAM does not include or prescribe a taxonomy for classifying different schools of thought, BIAM acknowledges that a deeper paradigmatic analysis of alignment approaches would be useful as an extension of the BIAM, as discussed later in Chapter 12.

Enterprise Architecture (EA) is a discipline that could provide several means. The following themes emerge from various EA definitions in terms of its purpose/means:

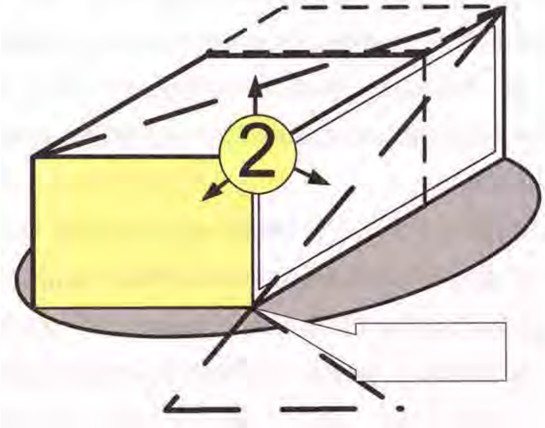
- Some reason that EA needs to provide an *aggregate view* or a blueprint for directing the enterprise in terms of required high-level processes and IT capabilities (Boar, 1999; Ross et al., 2006; Winter & Fischer, 2007). Others (DeBoever, Paras, & Westbrock, 2010) also emphasise the intention of directing the enterprise on a strategic level; EA is described as a *strategic management discipline* that creates a *holistic view* of the business processes, systems, information, and technology. The *strategic management* focus will lead to more intelligent investment decisions, extending the life of assets and decrease the number of short term, high-cost implementations.
- According to ISO/IEC/IEEE 42010, architecture needs to create a *systems view*, i.e. 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" (ISO/IEC JTC 1/SC 7 committee, 2011). The components, their interaction and interrelationships, should be described in a consistent way to ensure holistic solutions in terms of the solution components (EA Research Forum, 2009; Handler, 2004; Lapkin, 2008; The Open Group, 2009; Theuerkorn, 2005; Winter & Fischer, 2007). A *systems view* should focus on reducing complexity of IT and business processes across the breadth of the enterprise, making a company more agile (DeBoever et al., 2010).
- Gartner (Willis, 2009, p. 7) reasons that EA is about the *continuous process of transformation* from a current architecture to a future architecture, i.e. "translating business vision and strategy into effective enterprise change" (Bernard, 2005; GAO, 2006; Lapkin, 2008; Schekkerman, 2004).
- Another prominent theme is *governance*, i.e. key principles that are required to govern the design and evolution of information systems, which impact various management areas such as maintenance, compliance, and risk management (Lapkin, 2008; The Open Group, 2009; Theuerkorn, 2005; Wagter et al., 2005; Willis, 2009; Winter & Fischer, 2007).
- A less prominent definition is that EA needs to provide an integrated and transparent *representation of all interests* and their current state of alignment. As interests of stakeholders constantly evolve, the representation of interests should also be constantly updated and reconciled. EA is thus an ongoing process (Sidorova & Kappelman, 2010).

Although the above-mentioned definitions reveal some of the value-creation means, practitioners still need to demonstrate value to the business in terms of bottom-line results. Alignment approaches thus need to demonstrate how the alignment approach will increase both efficiency and effectiveness (Buchanan & Soley, 2002; Rosser, 2004).

4.3.2.2 Component 2: Dimensions

BIAM depicts three *dimensions* (Figure 45, Component 2), depicted by the three panes of the block: design domains, concerns & constraints, and enterprise scope.

Design Domains (Figure 45, Component 2, front pane*)*



The first dimension provides the means for creating logical separation between different domains that require design.

Literature reveals many different conceptualisations for design domains. Hoogervorst (2009, p. 134) maintains that the demarcation/delineation of domains reveal "functional or constructional *system facets* for which *design activities* are required"; demarcation is *not simple* and requires specific system knowledge. Design domains may also be classified as *sub-systems* (for which *design activities* are required) if the sub-system parts interact with one another (Dietz, 2006). Defining the *boundary* of the sub-system is however contextual and depends on the intentions of the observer/analyst (Giachetti, 2010).

As an example of design domains, Winter and Fischer (2007) identified five domains: business, process, integration (e.g. enterprise services), software (e.g. software services and data structures), and technology/infrastructure. The Open Group (2009) defines slightly different design domains as part of TOGAF (The Open Group Architecture Framework): business, information system (which includes application and data), and technology. Hoogervorst (2009), focusing on enterprise alignment rather than business-IT alignment, defines four domains: business (the environmental system, customers requiring products/services), organisation (processes and employees), information and technology.

Taking the Zachman Framework as a second example, one may debate whether the Zachman Framework contains *design domains* or not. If one used the definition provided by Hoogervorst (2009, p. 134), one may reason that the six columns of the Zachman Framework (see Figure 24) are *system facets* for which *design activities* are required (i.e. inventory sets, process flows, distribution networks, responsibility assignment, timing cycles and motivation intentions).

Although different categorisation strategies exist for defining design domains, two broad categories of design domains emerge from our inductive research: *business* and *information technology*, which encapsulate more detailed design domains.

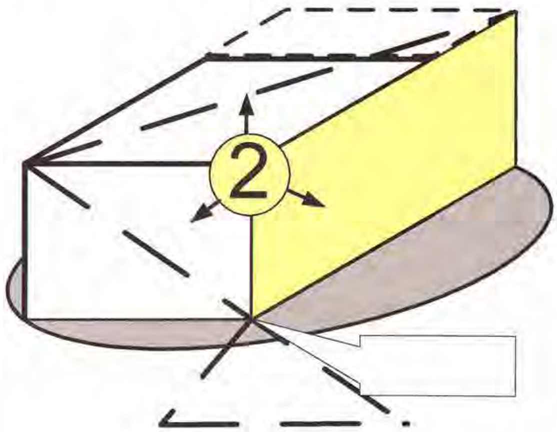
In understanding the *business* domain the following definitions on *business architecture* is used to describe the scope of the *business* domain:

- "Business architecture is a *general description of a system*. It identifies its purpose, vital functions, active elements, and critical processes and defines the nature of the interaction among them" (Gharajedaghi, 2006, p. 152).
- "It is a definition of what the *enterprise must produce* to satisfy its customers, compete in a market, deal with its suppliers, sustain operations, and care for its employees. It is composed of models of architectures, workflows, and events" (Whittle & Myrick, 2007, p. 31).
- "...business architecture is fitting the major elements of a business together"..."a set of *interrelated views of how a business works*" (McWhorter, 2008, p. 11). Supporting the latter, business architecture is "a *formal blueprint* of governance structures, business semantics, and value streams across the extended enterprise" (OMG's BAWG in Ulrich, 2008: 38).

In contrast, the *information technology* domain may consist of several layers that differ substantially amongst different frameworks. As an example, one could partition this domain into three sub-domains:

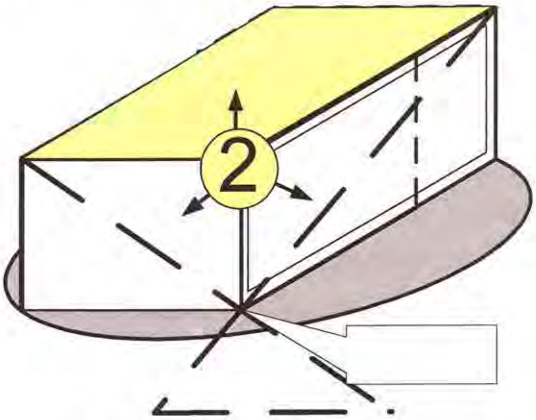
1. application (conveying the structure of specific applications, how they are designed, and how they interact with one another);
2. data (describing the logical and physical data stores in the enterprise); and
3. technical (describing the hardware and software infrastructure that supports applications and their interactions) (The Open Group, 2009).

Concerns and Constraints (Figure 45, Component 2, side pane*)*



The second dimension refers to *concerns and constraints* that should be addressed when the enterprise is designed. Different groups of stakeholders have a stake in enterprise performance, but are not necessarily in a position to influence performance (Gharajedaghi, 2006). The BIAM *concerns* (as depicted in Figure 45, *Component 2*, side pane) include those concerns that enterprise designers (e.g. enterprise managers, architects and engineers) would like to address during the design of the enterprise and its information systems. During the development of

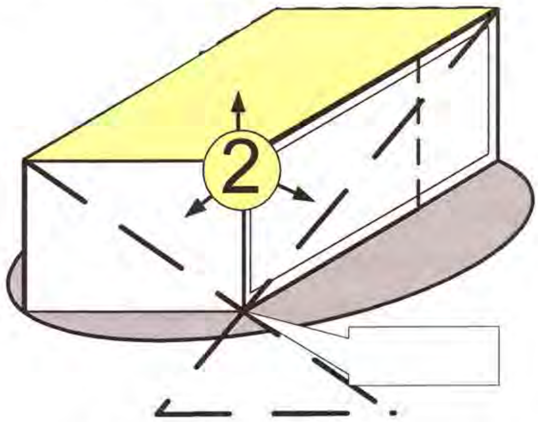
Enterprise Scope (Figure 45, Component 2, top pane*)*



The *enterprise scope* dimension of BIAM reflects the extent of alignment in terms of the *internal enterprise structures*, such as business units or lines of business, departments, programmes, and projects. Some alignment endeavours may extend the boundaries of a single enterprise to include alignment with external enterprises, e.g. government, partners and suppliers. An example of alignment across the extended enterprise is the design of a complex supply chain (Giachetti, 2010). The structural elements define the boundaries for business-IT alignment endeavours, and directly influence the required alignment responsibilities. Usually initial work, defining the intent and extent of a business-IT alignment endeavour, precedes the selection of appropriate structural elements (*internal enterprise structures* and/or external enterprises) for alignment. The TOGAF ADM (The Open Group, 2009), for instance, starts with a preliminary phase and EA vision phase to define alignment scope.

In addition to the three dimensions of Component 2 of the BIAM (i.e. Figure 45, three panes of the block), one can debate the inclusion of other dimensions. Some alignment approach authors for instance, include a dimension of generality (e.g. generic level, partial level, and particular level in Generic Enterprise Reference Architecture (GERA) (GERAM, 1999), which is similar to the Open Group Architecture Framework (TOGAF) use of an architecture continuum. The architecture continuum provides a continuum of generic to specific architectures, such as foundation architectures, common systems architectures, industry architectures, and enterprise architectures. The BIAM incorporates other dimensions as *alignment mechanisms and practices*, covered in the section 4.3.2.3.

Enterprise Scope (Figure 45, Component 2, top pane*)*



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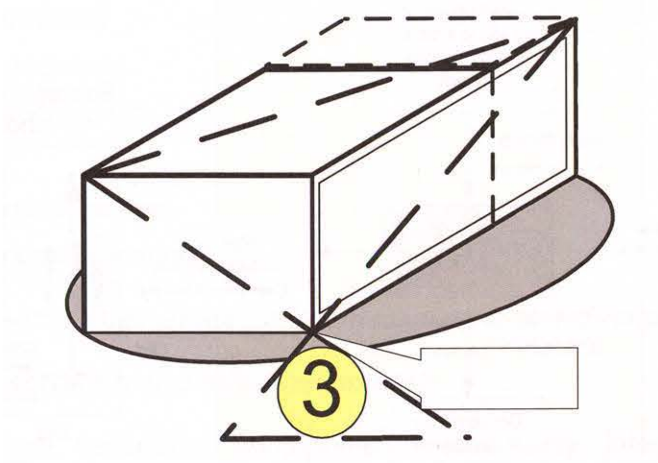
4.3.2.3 Component 3: The alignment mechanisms and practices



The set of applicable alignment *mechanisms and practices* (Figure 45, Component 3) that supports a specific alignment approach depends on the *alignment belief/paradigm of creating value* (Figure 45, Component 1) and the alignment strategy that enables alignment across the relevant alignment *dimensions* (Figure 45, Component 2).

In practice, *alignment mechanisms and practices* are usually organised as an integrated *set of alignment mechanisms and practices* as part of a methodology. TOGAF ADM (architecture development methodology) is an example of a *methodology*, which includes nine sequential and/or iterative phases and numerous mechanism and practices. Hoogervorst (2009, pp. 221, 316) also suggests an alignment *process* to enact alignment on different levels of scope.

The set of *alignment mechanisms and practices* focuses on different levels of alignment scope, depending on the object system that needs to be constructed, i.e. either the ICT system or the enterprise system. Figure 47 illustrates the different levels of alignment scope addressed by a set of *alignment mechanisms and practices*. The *enterprise system design process* starts with knowledge about the construction of the using system, i.e. the environmental system (government, regulations, industry, markets, competitors etc.), which is necessary to determine the functional requirements for the object system, i.e. the enterprise system (see Figure 47). The functional requirements specify the products/services that need to be delivered, and the customers/markets that will be served. Although functional requirements determine largely the construction of the enterprise (i.e. integrated processes, skills and technology competencies), non-functional requirements (e.g. flexibility, cost, security, cultural-impact etc.) also determines/constrains the construction of the enterprise.

The basic system design process (see Figure 47) also provides a reference to relate *strategic choices* (as defined by Hoogervorst, 2009) to functional changes and constructional changes in the enterprise.

The colours used in Figure 47 are meaningful. The light shade of yellow demonstrates alignment when designing an ICT system, which applies to BIAM during the contextualisation of current alignment approaches in Chapter 5. The bright yellow demonstrates alignment when designing the enterprise system as the object system.

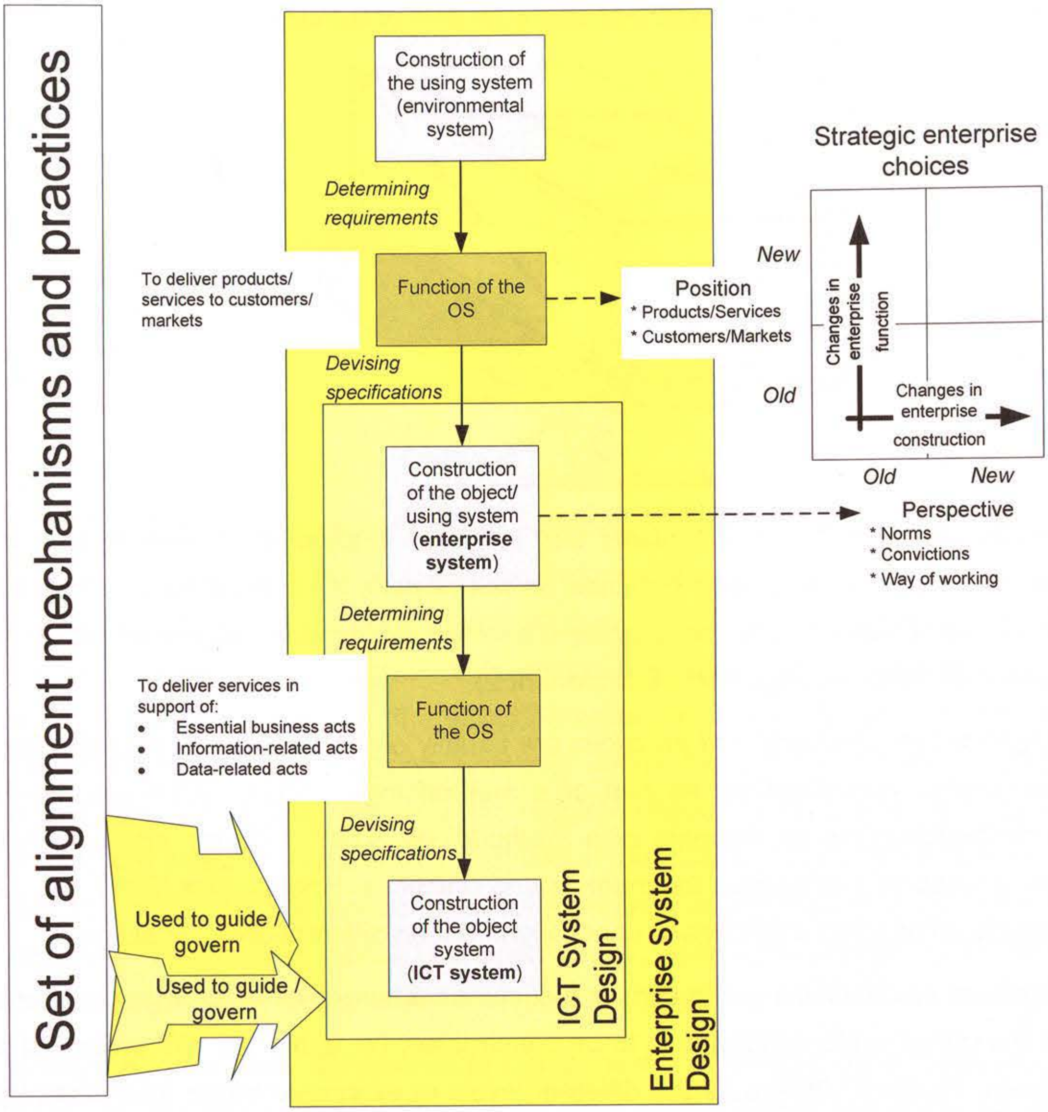


Figure 47: Relationships between a set of alignment mechanisms and practices, the system design process, and enterprise strategic choices

By applying appropriate *alignment mechanisms and practices* in an enterprise, the enterprise has the potential for creating an *enterprise alignment/governance competence,* i.e. "the organisational competence for continuously exercising guiding authority over strategy and architecture development, and the subsequent design, implementation and operation of the enterprise" (Hoogervorst, 2009, p. 265).

The following list of mechanisms and practices is neither integrated nor exhaustive, but rather an example of *alignment mechanisms and practices* found in literature. The list of mechanisms and practices all relate to the BIAM mechanisms and practices (Figure 45, Component 3) and include:

1. Architecture description and reference models
2. Alignment/design methodologies
3. Architecture principles and standards

4. Additional management mechanisms and practices
5. Governance frameworks
6. Transformation roadmaps
7. Analyses (e.g. gaps/impact)
8. Maturity models
9. Skills/learning requirements
10. Software tools and/or guidance

The remainder of this section delineates the ten *mechanisms and practices* categories.

1. Architecture description and reference models

A consistent architecture description contributes towards unity, integration and alignment. According to the ISO/IEC/IEEE 42010 standard (ISO/IEC JTC 1/SC 7 committee, 2011), an *architecture description* is a "work product used to express an architecture". An example of a work product that expresses architecture of an enterprise, is the content metamodel of TOGAF (The Open Group, 2009).

Although BIAM is not normative in terms of the elements of an *architecture description*, the terminology aligns with the descriptions provided by ISO/IEC/IEEE 42010. Table 11 relates the components of BIAM to the elements of *architecture description* provided by the ISO/IEC/IEEE 42010.

Table 11: BIAM components related to ISO/IEC/IEEE 42010 architecture description components

BIAM components / sub-components	**ISO/IEC/IEEE 42010 architecture description components**
(1) Alignment belief/paradigm of value creation.	No direct mapping.
(2) Dimensions	
Dimension 1: Design domains.	May be similar to *viewpoints* if the *viewpoints* are *facets* that require design.
Dimension 2: Concerns.	*Concerns.*
Dimension 3: Enterprise scope.	No direct mapping.
(3) Alignment mechanisms and practices	
Architecture description	*Architecture description.*
...	
Other mechanisms and practices.	No direct mapping.
(4) Alignment approach classifiers.	No direct mapping.

Architecture frameworks and *architecture description languages* use elements of the complete *architecture description* (see section 3.2.4).

Numerous EA *frameworks* exist, for example the Zachman Framework, TOGAF (the Open Group Architecture Framework), IAF (Integrated Architecture Framework), E2AF (Extended Enterprise Architecture Framework), PERA (Purdue Enterprise Reference Architecture), CIMOSA (Computer Integrated Manufacturing Open System Architecture), FEAF (Federal Enterprise Architecture Framework), JTA (Joint Technical Architecture), and DODAF (Department of Defence Architecture Framework) (Schekkerman, 2004). However, not all of these frameworks conform to the ISO/IEC/IEEE 42010 standards on defining *architecture frameworks*.

Frameworks may be associated with *languages*. Examples include BPMN (Business Process Modelling Notation), IDEF (Integrated Definition Language), UML (Unified Modelling Language), and ARIS (Architecture of Integrated Information Systems). Not all of these *languages* however conform to the ISO/IEC/IEEE 42010 standards for defining *architecture description languages*.

Generic *reference models* may be used to quick-start architecture efforts, re-use previous architectures, optimise according to best-practice reference models, and/or ensure integration across *design domains*. TOGAF (The Open Group, 2009) provides *reference models* across an enterprise continuum that ranges from a set of generic foundation architectures to enterprise-specific architectures. Various classifications can be used to partition and organise the enterprise continuum, e.g. subject matter (products, services) and viewpoint (functional breakdown or *design domain* breakdown). Other examples or *reference models* include GERA (Generalised Enterprise Reference Architecture), SCOR (Supply Chain Operations Reference model), VCOR (Value Chain Operations Reference), and e-TOM (Enhanced Telecom Operations Map) for business processes in the telecommunications industry. More examples include TRM (Technical Reference Model) and III-RM (reference model for integrated information infrastructure) developed by The Open Group. The OMB (2007a) provides reference models for every *design domain*, i.e. performance reference model, business reference model, service component reference model, technical reference model and data reference model.

2. Alignment/design methodologies

A *methodology* is a phased problem-solving approach, usually following a general problem-solving methodology:

1. scoping the problem,
2. designing the solution,
3. evaluating the solution, and
4. re-visiting the problem if the solution is unsatisfactory (Giachetti, 2010).

Alignment/design methodologies are often used to encapsulate other *alignment mechanisms and practices*. An example of a methodology is the TOGAF ADM (architecture development methodology). Hoogervorst (2009, p. 221) does not explicate a methodology to enact alignment, but also implies a *process* to create enterprise alignment.

Depending on the level of alignment (ICT developments or the development of the entire enterprise), alignment/design methodologies guides the *design process* of either the ICT system or the enterprise system (see Figure 47). Hoogervorst (2009, p. 262) emphasises that the design of the enterprise and its ICT system often occurs concurrently.

A number of *alignment/design methodologies* exist for designing the ICT system, e.g. Rapid Application Development (RAD), Architected Rapid Application Development (Architected RAD), Dynamic Systems Development Methodology (DSDM), Joint Application Development (JAD), Information Engineering (IE), Rational Unified Process (RUP) and Structured Analysis and Design (SAD) (Whitten & Bentley, 2007). Although a number of publications address the *importance of design* in enterprises (Giachetti, 2010; Hammer & Champy, 1993; Johansson, McHugh, Pendelbury, & Wheeler, 1993; Martin, 1995; D. A. Nadler & Tushman, 1997), few or over-simplified enterprise design/engineering *methodologies* exist, possibly due to the complexity of the enterprise and the multiple stakeholders involved. Also, the emphasis in literature is on *enterprise management* (the functional perspective on the enterprise), rather than on *enterprise design* (the constructional perspective of the enterprise) (Hoogervorst, 2009).

3. Architecture principles and standards

Architecture principles are general rules and guidelines that supports the way in which an enterprise intends to fulfil its mission (The Open Group, 2009, p. 265). Hoogervorst (2009, p. 127) argues that *principles and standards* ensure a unified and integrated design, addressing multiple concerns. Although TOGAF (The Open Group, 2009) provides examples of principles for every *design domain*, Hoogervorst (2009) states that some architecture principles or standards may apply to more than one *design domain* and address more than one *concern*. The practical distinction between *principles* and *concerns* is sometimes blurred, as some functional concerns may be generic to a class of systems and thus adoptable as principles, rather than concerns (Hoogervorst, 2009).

An example of a set of *standards* is the SIB (Standards Information Base) of TOGAF, which is a catalogue of technology standards and specifications that are useful in implementing the services identified in the TRM (Technical Reference Model).

4. Additional management mechanisms and practices

Several mechanisms and practices are included for management areas (e.g. architecture management, strategy management, risk management, change management, project management, and program management; on both an enterprise management level and IT management level) to ensure coherency and consistency (Hoogervorst, 2009; The Open Group, 2009). Examples of architecture management mechanisms include architecture boards/committees, architecture compliance reviews at pre-defined project milestones/checkpoints, architecture compliance review checklists and guidelines (Ross et al., 2006; Schekkerman, 2006; The Open Group, 2009; Weill & Ross, 2004).

5. *Governance frameworks*

Governance frameworks provide a collection of required areas to yield effective governance (Hoogervorst, 2009). Frameworks that are often mentioned include CobiT (Control Objectives for Information and related Technology), ITIL (IT Infrastructure Library) and ISO 17799 (Symons, 2005). According to the Open Group (2009) CobiT is a good source of information on IT governance. Hoogervorst (2009) however reasons that neither COBit, nor ITIL, nor ISO can be classified as governance frameworks. He argues that CobiT is a framework for IT *management* (containing a large number of IT management tasks, rather than governance practices that guide design), whereas ITIL is a set of best practices for *IT service management*, and ISO only directs security issues.

6. *Transformation roadmaps*

DeBoever et al. (2010) maintain that roadmaps are the primary output of enterprise architecture. The roadmaps list individual increments of change according to a timeline to show progression from the *current state* to *future state* business processes, systems, information and technology. Transformation roadmaps and practices are common to frameworks such as IAF, GERAM and TOGAF.

7. *Analyses (e.g. gaps/impact)*

The purpose of analysing architecture components and their relationships is to identify performance *gaps* or *gaps* between the current-state architecture and future state architecture. The analyses of proposed future-state architecture could also highlight the *impacts* of the future-state architecture on existing architecture components. The analyses are often used as change drivers, guiding decision-making related to the evolution of architectures (Dunshire, O'Neill, Denford, & Leaney, 2005; The Open Group, 2009).

8. *Maturity models*

Maturity models measure alignment/governance capabilities at an enterprise. Examples include the ACMM (Architecture Capability Maturity Model) developed by the US Department of Commerce (The Open Group, 2009), the Federal Enterprise Architecture Program EA Assessment Framework 2.0 (OMB, 2005), the SAM (Strategic Alignment Maturity) model of Luftman & Kempaia (2007), used to indicate IT-business alignment maturity, and the eight dimensions of EA maturity advanced by the Gartner Group (James & Burke, 2005). Distinguishing between two levels of alignment, Hoogervorst (2009) provides two maturity models, an IT governance maturity model and an enterprise governance maturity model.

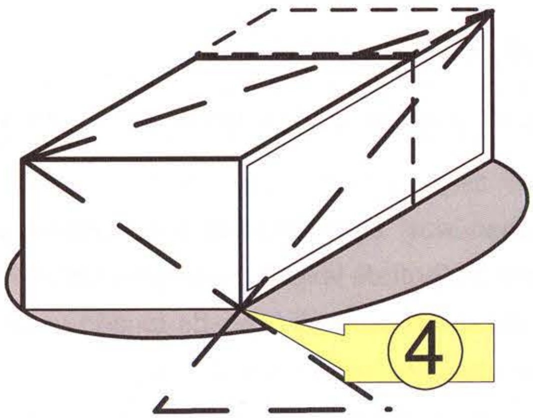
9. *Skills/learning requirements*

An alignment approach requires employees and *personal competencies* to apply suitable *alignment mechanisms and practices*. According to Hoogervorst (2009) the enterprise architect needs to master several topics within six areas (systems thinking, business and organisation, information, IT, enterprise development and change, and general topics). Ross et al. (2006) define different skill sets for CIO's (chief information officers) based on the maturity level of the enterprise. The Open Group (2009) provides an EA skills framework to define sets of generic skills, business skills and methods, enterprise architecture skills, program and project management skills, IT general knowledge skills, technical IT skills, and legal environment skills. Different skill levels (level 1 to 4) per skill, apply for different architecture roles (e.g. architecture board member, architecture sponsor, EA manager etc.).

10. Software tools and/or guidance

This mechanism includes the wide variety of tools and tool sets that are available for designing various architecture artefacts. Examples include the Systems Architect Family, ARIS Process Platform, the Metis Product Family, and ABACUS. Schekkerman (2011) provides a comparisons of enterprise architecture tools, whereas TOGAF (The Open Group, 2009) provides evaluation criteria and guidelines choosing automated tools.

4.3.2.4 Component 4: Alignment approach classifiers



BIAM provides four classifiers to differentiate between alignment approaches in 'how' they ensure alignment (Figure 45, Component 4). The BIAM foundation (*alignment belief/paradigm of creating value*) directly influences the alignment approach, which in turn influences the set of *alignment mechanisms and practices* that are required in combination with the alignment approach. The four alignment approach classifiers are:

1. Version/versions of architecture
2. Starting point for alignment
3. Addressing the dynamic nature of architecture components
4. Periodic vs. continuous alignment

The remainder of this section delineates the four *alignment approach classifiers*.

1. Version/versions of architecture

The version of alignment refers to the version of the architecture blueprints with reference to the *design domains* and *concerns*. Alignment approaches differ in their focus on creating current and/or future versions of architecture.

Some alignment approaches focus on building a complete blueprint of the current (*as-is*) architecture. These theoretical models analyse the current architectures before starting the future architectures. The Open Group (2009) in its ADM (Architecture Development Method) follows a systematic process in analysing current architectures in defining gaps (gap analyses). The rationale is that a current architecture would highlight inefficiencies, reveal opportunities for centralisation, and lead to cost-cutting efforts.

Other alignment approaches focus on the future (*to-be*) architectures, while following a pragmatic approach in building a sub-set of *as-is* architectures, depending on the purpose of the architecture exercise, e.g. providing a baseline for developing a transition strategy. Detailed modelling is only conducted in a selected and highly pragmatic way (Buchanan & Soley, 2002; DeBoever et al., 2010; Lapkin, 2008), based on the principle of *just enough architecture, just in time*.

2. Starting point for alignment

Alignment approaches either propose a top-down or bottom-up approach in developing *design domains*.

Some alignment approaches start at strategy and the business domain (top level), working towards the technical domains (bottom levels). Examples include TOGAF ADM and the Gartner EA Process model. The rationale is that EA needs to add value in terms of the strategy and business-operation of the enterprise.

As an alternative, design could also start at the technology domains (bottom levels). The rationale for starting at the bottom is that a flexible IT infrastructure would easily accommodate changes in the business domains. SOA (Service Oriented Architecture) projects are based on this paradigm (Robertson, 2005). According to The Open Group SOA Working Group (2007, p. 9), "a major benefit of SOA is that it delivers enterprise agility, by enabling rapid development and modification of the software that supports the business processes – and hence makes it easier to change the business processes themselves". Hoogervorst (2009, p. 105) uses the word *enablement* to describe the bottom-up approach. He maintains that enterprises should not only create IT-arrangements, but rather enterprise arrangements that would enable new emerging enterprise strategies. The rationale is that strategy development often does not follow a linear, analytical top-down pattern, but follows an incremental, evolutionary development process (Ciborra, 2002), derived from the complex set of business, competitive, organisational and environmental circumstances (Weill & Broadbent, 1998).

Locke (2009a, p. 79) also reports on another approach, called the middle-in approach. The middle-in approach refers to distinct *concerns* (Figure 24, six rows of the Zachman Framework) associated with the enterprise design process, e.g. scope contexts (executive perspective), business concepts (business management perspective), *system logic* (architect perspective), technology physics (engineer perspective), tool components (technician perspective), and operations instances (enterprise perspective). The rationale is that implementation of an ERP (enterprise resource planning) system, requires a middle-in approach, starting at the *system logic* level, working both 'up' and 'down' the design process to implement the system.

3. Addressing the dynamic nature of architecture components

Zachman (1996) considered the usefulness of EA when observing the architecting effort required for a Boeing 747 aircraft (Zachman, 2009b). However, the inherent design of an aircraft changes relatively slowly over time. One of the *typical system propertie*s of an enterprise is its *dynamic* nature (see 3.2.1) Enterprise design does not occur at a single point in time, as enterprises evolve over time and are constantly changing (Giachetti, 2010). *Dynamics* are at the heart of regulation in organismic systems, rather than control and feedback (Hitchins, 2003). Alignment approaches propose different means for addressing the dynamic nature of architecture components.

The Open Group (2009) maintains that the practice of open standards and boundaryless integration across departmental/divisional/enterprise boundaries address the challenges associated with dynamic changes. The rationale is that maximum flexibility through design creates the ability to change swiftly. However, alignment across the supply chain, integrating diverse databases and applications written in different languages remains a challenge. Different integration languages partially address the language challenge, e.g. DCOM (Distributed Component Object Model), CORBA (Common Object Request Broker Architecture), Enterprise JavaBeans, and XML (Extensible Markup Language). Object-orientated and service-orientated design approaches also attempt to ensure flexibility via loosely-coupled components that could easily be re-used or assembled in a make-to-requirement fashion.

Some alignment approaches acknowledge that technical architecture design practices could create flexibility, but emphasise governance practices that are required to enact change (Bittler & Kreizman, 2005; Wagter et al., 2005).

4. Periodic vs continuous alignment

Alignment approaches often reveal different paradigms regarding alignment frequency. Some models promote once-off alignment endeavours. The models are supported by the analysis of current and future architectures to identify gaps, which may lead to rip-and-replace efforts, e.g. BPR (Business Process Re-engineering) (Whitten & Bentley, 2007).

Other models address systematic alignment that is part of an ongoing, incremental enterprise design activity (Giachetti, 2010). BPM (business process management) is an example of an ongoing process of aligning business requirements with information system functionality and its supporting infrastructure (Whitten & Bentley, 2007). The rationale is that an incremental approach, i.e. creating alignment one project at a time, produce quick wins to create credibility (DeBoever et al., 2010; Ross et al., 2006).

The alignment approach classifiers of the BIAM (Figure 45, component 4) thus provide four classifiers to differentiate between alignment approaches in 'how' they ensure alignment, i.e. focusing on different versions of architecture, different starting points for alignment, addressing the dynamic nature of architecture components, and using different frequencies of alignment.

4.4 CONCLUSION

Chapter 4 recognized the knowledge embedded in current alignment approaches and used exploratory design and a literature review to inductively create a Business-IT Alignment Model (BIAM). The inductive process highlighted prominent themes/patterns evident in current alignment approaches.

The chapter delineated how BIAM answers *three* questions using *four* BIAM components. The *three* questions are:

- Question 1: '*Why* should the enterprise use the proposed approach to align?'
- Question 2: '*What* should the enterprise align?'
- Question 3: '*How* should the enterprise align?'

The *four* BIAM components are:

- Component 1: An *alignment belief/paradigm of creating value.*
- Component 2: Three alignment *dimensions* to define the scope of alignment.
- Component 3: *Alignment mechanisms and practices* to ensure alignment across the alignment dimensions.
- Component 4: *Alignment approach classifiers* that influences the selection of appropriate alignment mechanisms and practices.

The next chapter (Chapter 5) uses the BIAM to compare and contextualise two prominent alignment approaches (the Zachman approach and the Open Group approach). Later, Chapters 7 and 8 also use the BIAM to compare and contextualise two less prominent alignment approaches (the *foundation for execution* approach and the *essence of operation* approach).

5.1 INTRODUCTION

The purpose of the previous chapter was to recognize the knowledge embedded in current alignment approaches by inductively creating a Business-IT Alignment Model (BIAM) to answer the second research question, namely:

What model is required to contextualise different business-IT alignment approaches?

The purpose of this chapter is to illustrate the use of BIAM, using two diverse alignment approaches: (1) the Zachman approach, and (2) the Open Group approach. The Zachman approach and Open Group approach were selected for comparison and BIAM-contextualisation, due to their prominence in the market and their difference in emphasis related to the BIAM components. Whereas the Zachman approach emphasises delineation of the alignment *dimensions*, the Open Group approach emphasises the *process* of alignment embedded in an *alignment/design methodology*. In Chapters 7 and 8 a third and fourth alignment approach, (3) the *foundation for execution* approach, and (4) the *essence of operation* approach, are also contextualised and compared.

Sections 5.2 and 5.3 convey the contextualised alignment approaches (contextualising the Zachman Approach and Open Group approach respectively), concluding in section 5.4.

5.2 BIAM AND THE ZACHMAN APPROACH

In this section, the BIAM components delineated in section 4.3 are applied to provide a business-IT alignment contextualisation of the Zachman approach as introduced in section 3.3.1.

5.2.1 Component 1: Alignment belief/paradigm for creating value

In the Zachman approach, the main purpose/value-creating paradigm is to bridge the gap between business people and IT people in communicating effectively. By addressing different *concerns* and *design domains* (see Figure 24 in section 3.3.1, *Audience perspectives* rows and *Classification names* columns in Zachman terminology) the framework ensures that all requirements are addressed. The framework is classified as a "writing system, a planning tool, and a problem-solving tool" (O'Rourke, Fishman, & Selkow, 2003). Zachman maintains that contrary to most other models, his *enterprise ontology* provides a scientific approach in defining *design domains* and *concerns* (Zachman, 2009a, p. 20).

Sidorova & Kappelman (2010) promote the definition of a complete and comprehensive enterprise ontology, but based on a case study by Simons, Kappelman & Zachman (2010) performed at SIL (Summer Institute of Linguistics) International that developed models according to the Zachman Framework, the Zachman Framework is still just past the proof of concept and prototype stages. Section 8.2 refers to another alignment approach (the *essence of operation* approach) that also sets out to create an *enterprise ontology*.

5.2.2 Component 2: Dimensions

5.2.2.1 Design domains and, concerns & constraints

The Zachman Framework focuses on two BIAM dimensions: *design domains* and, *concerns & constraints* (see Figure 48). The *design domains* consist of six interrogatives (what, how, where, who, when, why), whereas *concerns* of six audiences/stakeholders are defined (executives, business management, architects, engineers, technicians, enterprise). Zachman (2009a) however maintains that the audiences are linked to the process of reification (which is part of the *design process*), i.e. the systematic way of transforming ideas to instantiations. The top three rows represent ideas for design and require transformation into possible technological solutions in row 4 (technology physics). Although not explicitly modelled on the Zachman Framework, row 3 may require the identification of *constraints* prior to selecting a feasible technological solution for row 4 (technology physics) (Giachetti, 2010).

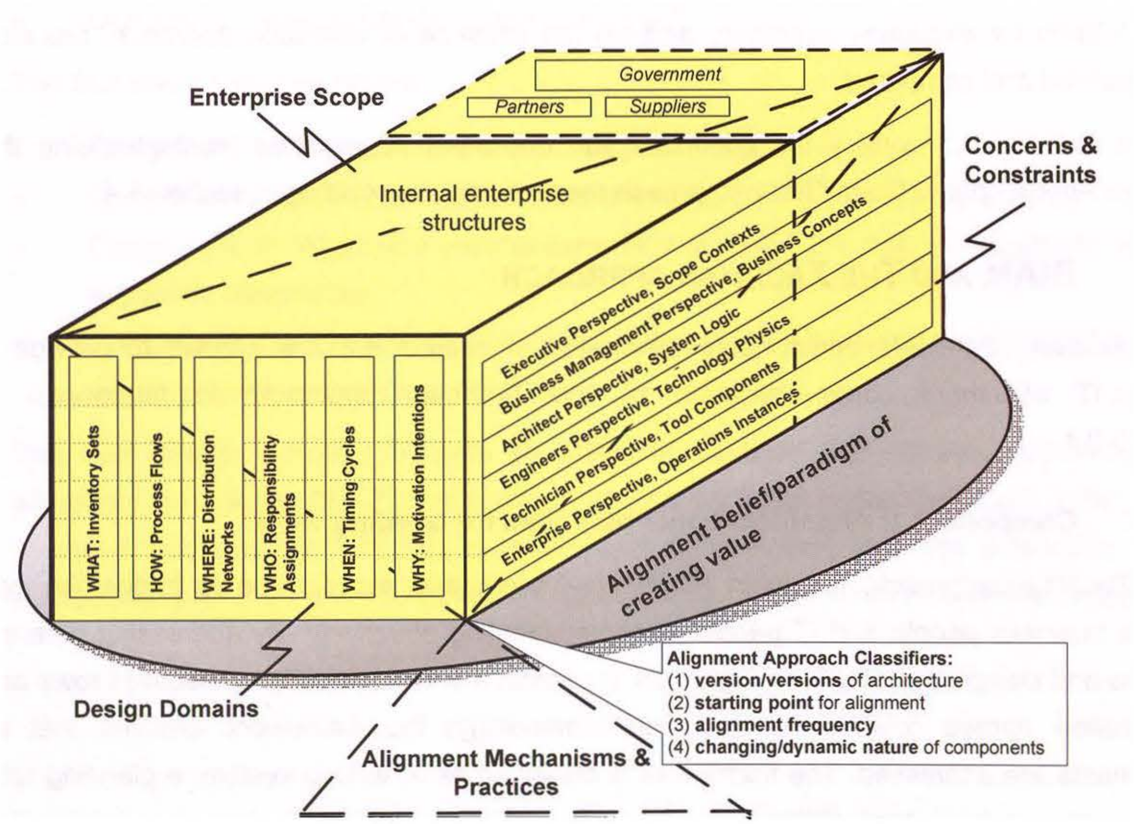


Figure 48: The BIAM contextualization of the Zachman approach

The Zachman Framework implies that the enterprise design team should be able to design each column from scope contexts to operational instantiation/implementation. The question is, could one really design each column (i.e. each Zachman column) separately starting at scope contexts and ending with operational instantiation/implementation? Although possible for the *what* column (inventory sets), design for the remaining five columns are challenging (from rows 3 to 6 (Locke, 2009b)). The columns cannot be classified as sub-systems (not every column has *interacting* parts), but do conform to the definition provided by Hoogervorst (2009), i.e. each column is a *system facet* for which *design activities* are required.

The concept of a business domain is not defined in any of the Zachman certification course notes (Locke, 2009a). Locke (the presenter of the Zachman certification course, February 2009) however mentioned that the top three rows roughly cover the concept of business, while the bottom three rows typically represent IT.

5.2.2.2 Enterprise scope

The Zachman Framework is used to do architecture work across the third dimension, *enterprise scope*. The enterprise scope dimension is thus *implied* and defined per cell (36 cells for intersections of rows and columns). Models for *each cell* could be applied enterprise-wide (or a sliver/part-of the enterprise) and on different levels of detail. The Zachman approach provides little guidance on scoping the alignment effort in terms of existing structural entities (e.g business units, departments or projects). The Zachman Framework does allow for alignment of system requirements across different enterprises (e.g. partners, suppliers and government enterprises).

Locke (2009a, p. 34) maintains that if the Zachman Framework defines the three BIAM dimensions, one should be able to define enterprise alignment as follows:

- Alignment for a *design domain* (a single column) is called *vertical integration*, ensuring that no discontinuity exists between the various rows, i.e. ensuring consistency with requirements. *Vertical integration* is a function of the column (Zachman, 2009a).
- Alignment across an area of *concern* (a single row) is called *horizontal integration*, ensuring that no discontinuity exists between different kinds of models from one column to the next. *Horizontal integration* is a function of a row (Zachman, 2009a).
- Alignment across the *enterprise scope* ensures that no discontinuity exists for any one kind of model across the scope of the enterprise. Alignment across the organising scope is a function of a cell (Zachman, 2009a).

5.2.3 Component 3: Alignment mechanisms and practices

Although the Zachman Framework provides an ontology for doing alignment work, Zachman (2009a) is not prescriptive about a required set of *alignment mechanisms and practices*. The project team should select an appropriate set of mechanisms and practices (O'Rourke et al., 2003).

The cells (intersections between rows and columns of the Zachman Framework) need to define the primitive building blocks of the enterprise, but many of the cells (especially from the third row, architect perspectives, downwards) only foster an understanding when combined, i.e. creating composite models. The Zachman Framework provides little guidance or examples on creating primitive models or transforming models from the executive perspective (row 1) to the enterprise perspective (row 6). Zachman (2009a, p. 81) suggests that one starts design efforts on the columns *what*, *where* and *why*, not providing any rationale for this approach.

Although not part of the Zachman Framework, Zachman offers a Zachman Professions Framework that specifies a *governance model* for establishing governance capabilities within an enterprise (Locke, 2009a).

5.2.4 Component 4: Alignment approach classifiers

The Zachman Framework does not enforce the development of a certain *version* (current or future state) of architecture, nor does it prescribe the *starting point* for alignment (e.g. top down or bottom-up). The Zachman Framework suggests that one should be able to address the *dynamic nature* of the socio-technical enterprise by *continuously* creating, updating and re-using primitive models as new requirements emerge.

5.2.5 Conclusion: BIAM and Zachman approach

To conclude, a BIAM-contextualisation of the Zachman approach contextualised the Zachman approach in terms of the four main components of the BIAM (Figure 45 in section 4.3.2, Components 1 to 4). The contextualisation highlights the focus of the Zachman approach in delineating the three dimensions of the BIAM (Figure 45 section 4.3.2, Component 2) and its main deficiency in stipulating appropriate *alignment mechanisms and practices* (Figure 45 section 4.3.2, Component 3).

5.3 BIAM AND THE OPEN GROUP APPROACH

This section applies the BIAM components delineated in section 4.3 to provide a business-IT alignment contextualisation of the Open Group approach as represented in TOGAF, as introduced in section 3.3.2.

5.3.1 Component 1: Alignment belief/paradigm for creating value

The Open Group (2009, p. 6) states that the purpose of enterprise architecture "is to optimise across the enterprise the often fragmented legacy of processes (both manual and automated) into an integrated environment that is responsive to change and supportive of the delivery of the business strategy".

5.3.2 Component 2: Dimensions

With regard to the BIAM *design domains*, TOGAF divides an enterprise into four *design domains* (business, application, data, and technology) (see Figure 49).

Although TOGAF does not explicitly define a separate set of BIAM *concerns*, TOGAF mentions the importance of defining different stakeholder concerns during some of the ADM (architecture development method) phases. TOGAF requires definition of both enterprise-wide *constraints* and project-specific *constraints.* Phase E (opportunities and solutions) of the ADM also determines business *constraints* for solution implementation.

TOGAF provides guidance on *scoping* EA effort during the TOGAF ADM preliminary phase. The ADM primarily focuses on alignment within the boundaries of the enterprise, rather than extending to external parties such as suppliers and partners. Figure 49 (yellow-shaded part) indicates the intended scope of alignment in using the Open Group approach.

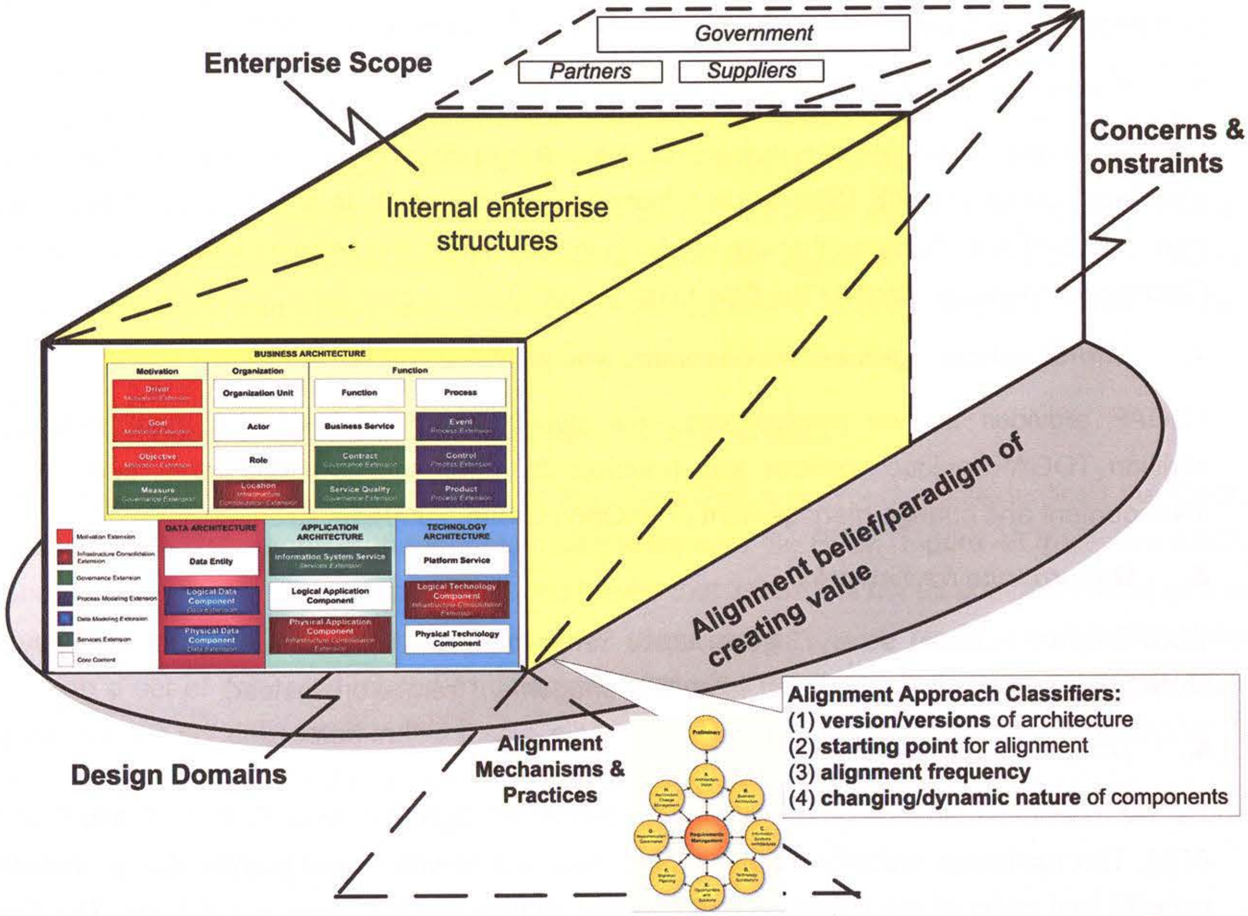


Figure 49: A BIAM contextualization of the Open Group approach

5.3.3 Component 3: Alignment mechanisms and practices

TOGAF provides numerous *alignment mechanisms and practices.*

1. Architecture description and reference models

The content metamodel of TOGAF (see Figure 29, discussed in section 3.3.2) is a work product that expresses the architecture of an enterprise. Some criticise the design domains of TOGAF as not being aligned to that of the Zachman Framework (Giachetti, 2010). Unfortunately the Zachman Framework has its own restrictions and is still in its proof-of-concept phase (Sidorova & Kappelman, 2010). Although not within the scope of the thesis, the architecture description standard ISO/IEC/IEEE 42010 (ISO/IEC JTC 1/SC 7 committee, 2011) may serve as another quality measurement tool for evaluating the content metamodel.

The TRM and III-RM (reference model for integrated information infrastructure) are *reference models* developed by The Open Group to standardise the technology infrastructure. TOGAF also refers to other reference models developed by other authors, such as e-TOM (enhanced telecom operations map) (The Open Group, 2009).

2. *Alignment/design methodologies*

TOGAF provides a nine-phased *methodology* for architecture development, called the ADM (architecture development method) (see Figure 27) (The Open Group, 2009).

3. *Principles and standards*

TOGAF provides examples of *principles* for every *design domain*. TOGAF also includes a set of *standards*, called the SIB (Standards Information Base), which is a catalogue of technology standards and specifications that are useful in implementing the services identified in the TRM (Technical Reference Model) (The Open Group, 2009).

4. *Additional management mechanisms and practices*

TOGAF provides several mechanisms and practices within architecture management. In addition TOGAF includes policies and practices for other management areas, such as risk management and change management (The Open Group, 2009).

5. *Governance frameworks*

TOGAF refers to CobiT as an IT governance framework (The Open Group, 2009). Hoogervorst (2009) however reasons that CobiT is an IT *management* framework instead.

6. *Transformation roadmaps*

TOGAF provides guidance on developing roadmaps throughout phases B, C, D, E and F of the ADM. The roadmaps typically include project lists, a time-oriented migration plan to delineate benefits and costs of the migration options, and implementation recommendations (The Open Group, 2009).

7. *Analyses (e.g. gaps/impact)*

TOGAF includes *gap analyses* for phases B, C and D of the ADM. Phase E (opportunities and solutions) consolidate the gap analyses results into a set of solutions. Although TOGAF mentions the use of impact analyses, practical guidance is limited (The Open Group, 2009).

8. *Maturity models*

TOGAF mentions several maturity models, detailing the ACMM (Architecture Capability Maturity Model) developed by the US Department of Commerce (The Open Group, 2009).

9. *Skills/learning requirements*

TOGAF provides an EA skills framework to define sets of generic skills, business skills and methods, enterprise architecture skills, program and project management skills, IT general knowledge skills, technical IT skills, and legal environment skills. Different skill levels (level 1 to

4) per skill, apply for different architecture roles (e.g. architecture board member, architecture sponsor, EA manager etc.) (The Open Group, 2009).

10. Software tools and/or guidance

TOGAF provides evaluation criteria and guidelines choosing automated tools (The Open Group, 2009).

5.3.4 Component 4: Alignment approach classifiers

In terms of *alignment approach classifiers*, the Open Group states that adherence to an iterative ADM, which includes a requirements management phase, would ensure *continuous alignment* between different architecture abstraction layers, addressing the *dynamic nature* of a socio-technical enterprise. However, the gap analysis performed could also lead to *periodic* rip-and-replace initiatives. The methodology follows a *top-down approach* in terms of architecture development and alignment, and promotes the development of both current and future state architectural models (The Open Group, 2009).

5.3.5 Conclusion: BIAM and the Open Group approach

To conclude, a BIAM-contextualisation of the Open Group approach contextualised the Open Group approach in terms of the four main components of the BIAM (Figure 45 in section 4.3.2, Components 1 to 4). The contextualisation showed that TOGAF is not as comprehensive as the Zachman approach in defining Component 1 (three panes of the block), i.e. TOGAF does provide a set of *concerns* related to different stakeholder groups. Other deficiencies may also exist, but are not delineated in this thesis, since TOGAF is not applied in Part C of this thesis. A critical evaluation of TOGAF is provided by Dietz & Hoogervorst (2010).

5.4 CONCLUSION

In this chapter, the BIAM (constructed and delineated in Chapter 4) was applied to contextualise two approaches: (1) the Zachman approach, and (2) the Open Group approach.

The contextualisation of the two approaches (Zachman approach and the Open Group approach) in terms of the BIAM provides strong evidence that the BIAM is useful in providing a common business-IT alignment contextualisation. The BIAM-contextualisation not only highlighted the differences between various alignment approaches, but also creates the opportunity to combine elements from different alignment approaches. Part C of this thesis (Chapters 7 and 8), provides another two BIAM-contextualisations for two approaches: (1) the *foundation for execution* approach, and (2) the *essence of operation* approach. The BIAM is used to highlight deficiencies inherent in using the operating model (OM), which is part of the *foundation for execution* approach and subsequently address some of the deficiencies by using the interaction model (IAM), which is part of the *essence of operation* approach.

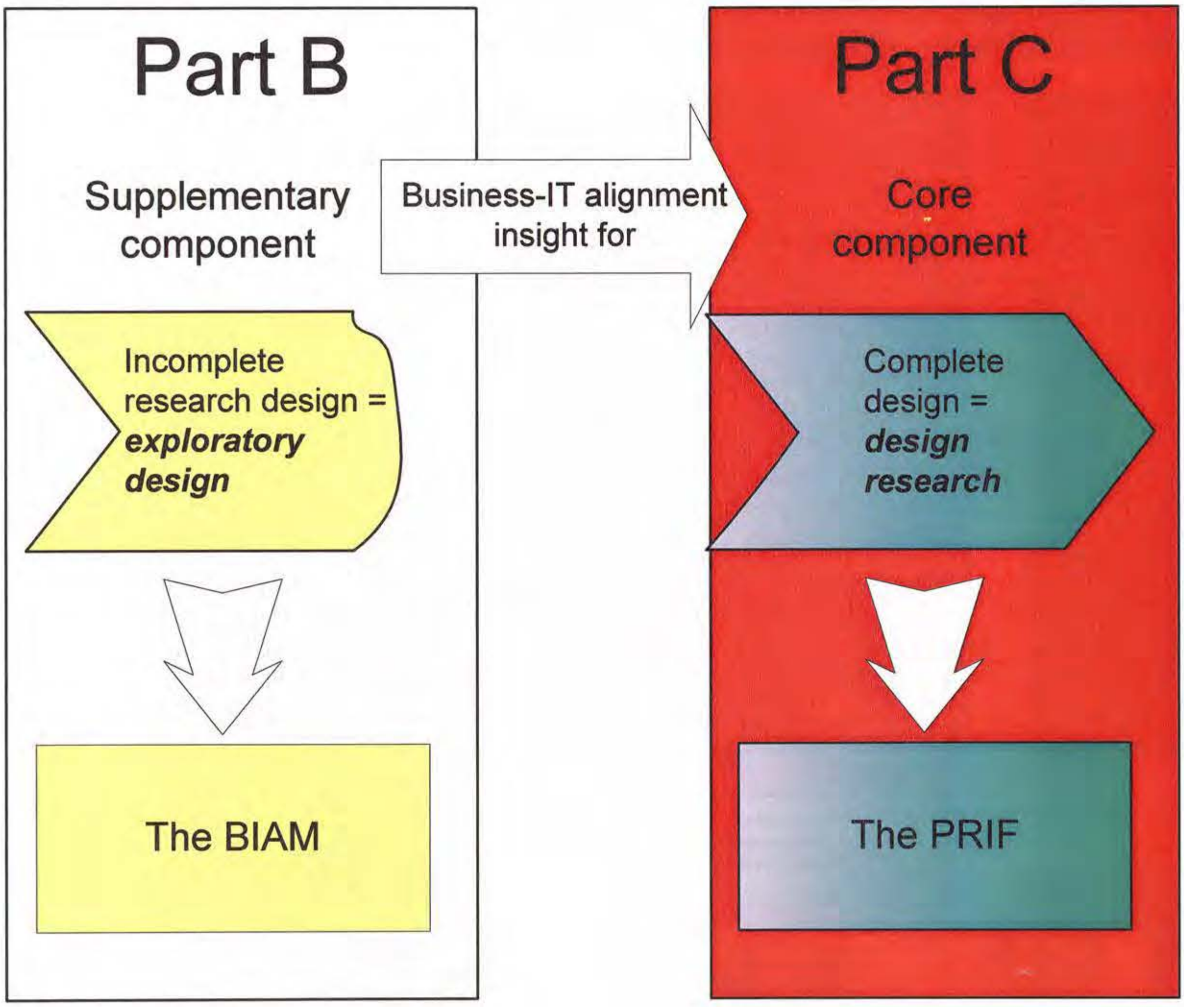
The contextualised approaches highlighted the foci of the different approaches in terms of the four BIAM components: (1) the *alignment belief/paradigm of creating value,* (2) three alignment *dimensions* to define the scope of alignment, (3) supporting *alignment mechanisms and practices* to ensure alignment across the alignment dimensions, and (4) *alignment approach classifiers* that influences the selection of appropriate alignment mechanisms and practices.

Part C of this thesis (Chapters 7 and 8), provides another two BIAM-contextualisations for two approaches: (1) the *foundation for execution* approach, and (2) the *essence of operation* approach.

PART C: THE PRIF

Insanity is doing the same thing over and over again and expecting different results. ~ Albert Einstein

As stated in Chapter 2, this thesis follows a mixed methods design, with two design components: (1) a supplementary component, and (2) a core component. Part B discussed the result of the supplementary component, the BIAM, since the BIAM provides insight for the core component in developing the PRIF (Process Reuse Identification Framework). Part C discusses the development of PRIF and the role of BIAM during the PRIF development process.

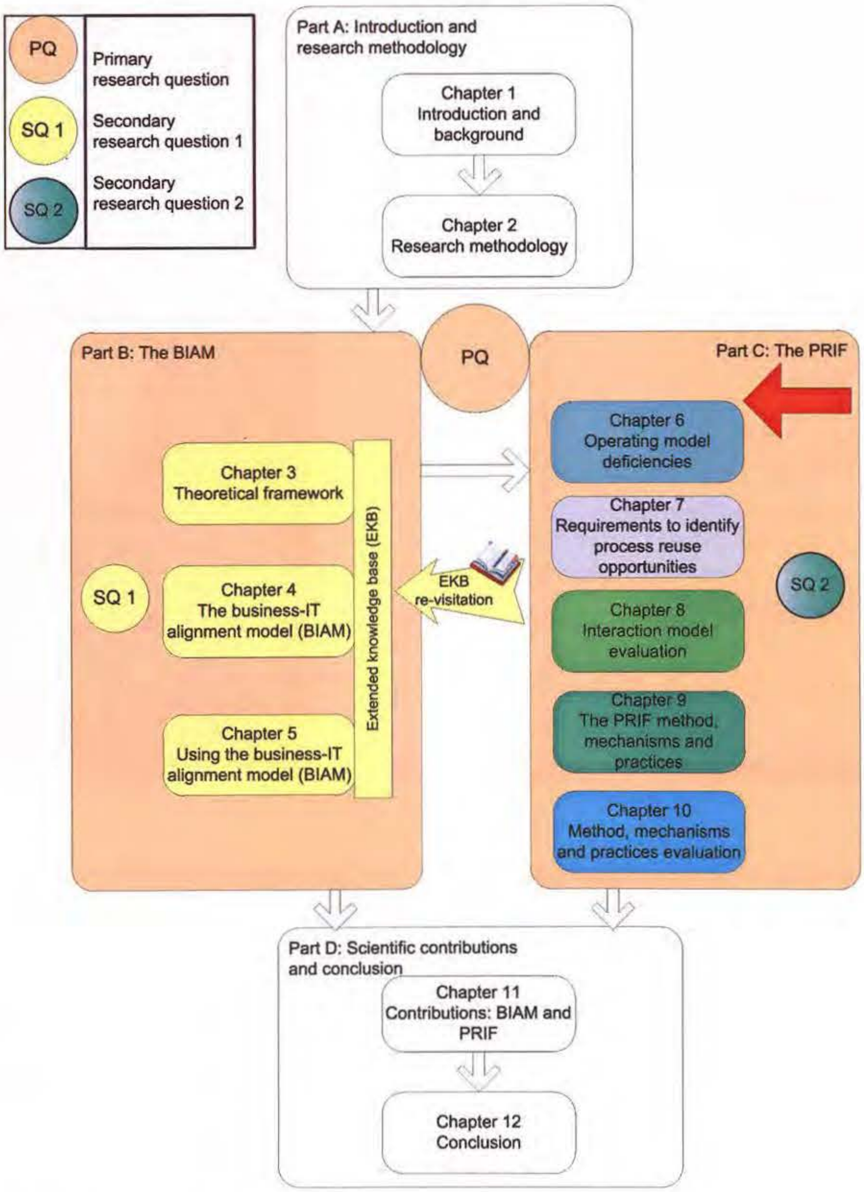


Part C answers *Research Question 2*, as defined in section 1.4, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

Part C contains Chapters 6 to 10 to develop a PRIF (Process Reuse Identification Framework), using *design research*, as described in sections 2.3.2 and 2.6.2. Figure 50 guides the reader through the different cycles of the design research process in developing a PRIF.

- Chapter 6 delineates the operating model (OM) deficiencies and the need to identify process reuse opportunities at an enterprise.
- Chapter 7 elicits requirements to identify process reuse opportunities at an enterprise.
- Chapter 8 evaluates the use of the interaction model in addressing a sub-set of requirements identified in Chapter 7.
- Chapter 9 delineates the proposed PRIF *method, mechanisms and practices*.
- Chapter 10 evaluates the proposed PRIF and its associated *method, mechanisms and practices*.



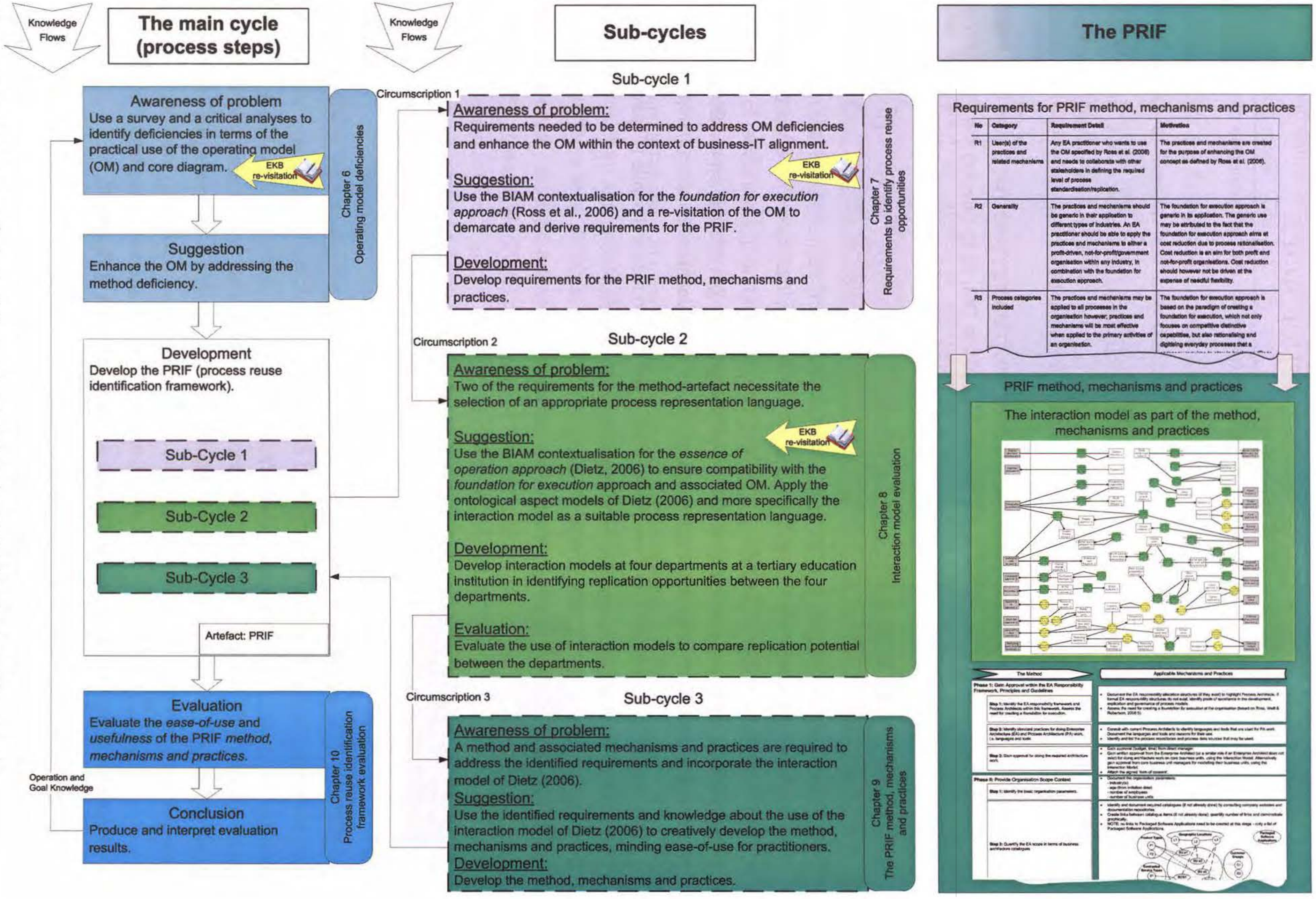


Figure 50: Design research for building and validating the PRIF (duplicate of Figure 15)

6.1 INTRODUCTION

The previous part (Part B) provided theory about various alignment approaches, also proposing a Business-IT Alignment Model (BIAM) to provide a business-IT alignment contextualisation for alignment approaches.

One of the main goals of this thesis is to enhance the operating model (OM), due to its inherent deficiencies. This chapter conveys the deficiencies of the OM, as to develop the PRIF (Process Reuse Identification Framework), to address the second research question, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

The purpose of Chapter 6 is to focus on the *foundation for execution* approach and its associated OM, to identify OM-deficiencies[2]. Re-visiting the *foundation for execution* approach (previously discussed in section 3.3.5), this chapter used a questionnaire to identify OM deficiencies. Later in section 7.2, additional deficiencies are identified when the BIAM is used to provide a business-IT alignment contextualisation for the *foundation for execution* approach.

This chapter presents the first three steps of the main design research cycle (Figure 51), namely *awareness of problem, suggestion* and *development* initiation.

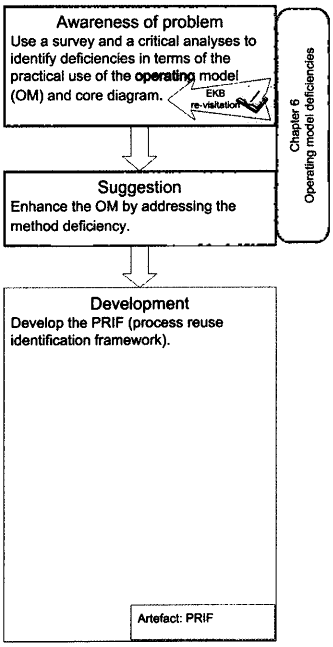


Figure 51: Design cycle context for Chapter 6 (duplicating part of Figure 50)

[2] The content of Chapter 6 is based on: De Vries, M., & Van Rensburg, A. C. (2009). Evaluating and refining the 'Enterprise Architecture as Strategy' approach and artefacts. *South African Journal of Industrial Engineering, 20*(1), 31-43.

A survey and critical analysis were used to identify deficiencies in terms of the practical use of the operating model (OM) and the core diagram that led to the *awareness of a problem* and a *suggestion* to enhance the OM within the context of business-IT alignment.

In section 6.2, the *foundation for execution approach* is revisited with the intent to evaluate the practical use of the OM and core diagram. Section 6.3 delineates the research process and survey to evaluate the OM and core diagram, followed by the results in section 6.4 and interpretation of results in section 6.5. Section 6.6 summarises the a*wareness of a problem,* a *suggestion* and initial *development* to solve the problem. The chapter concludes in section 6.7.

6.2 FOUNDATION FOR EXECUTION APPROACH RE-VISITED

The *foundation for execution* approach provides a new approach in preventing piece-meal/disjointed IT developments that react to every new strategic initiative (Ross et al., 2006). Contrary to other business-IT alignment approaches where IT supports strategy (Lapkin, 2005; Rosser, 2004), Ross *et al.* (2006) maintains that management needs to make a strategic decision on the required operating model (OM) of the enterprise, that would guide systematic development of the supporting ICT systems. A decision about a required OM would assist in creating a *foundation for execution*, i.e. rationalising and digitising the routine, everyday processes and competitively distinctive capabilities of the enterprise. If enterprises fail to decide and implement the required OM, their ICT systems would remain a bottleneck, reacting to piece-meal strategic initiatives that contribute to incoherent and inconsistent IT landscapes.

The selection of an *appropriate OM* is paramount, as it “articulates a vision of how the company will operate” (Ross et al., 2006, p. 44). The OM is also a “choice about what strategies are going to be supported”, driving the implementation of a whole set of strategic initiatives (Ross et al., 2006, p. 26). Ross et al. (2006) warn against the consequences of using an incorrect OM, as the OM constrains the type of growth opportunities available to the enterprise. The OM ultimately directs IT principles decisions (Weill & Ross, 2008; Weill & Ross, 2004) and also indicates “what type of interoperability approach will be appropriate” (The Open Group, 2009, p. 331).

Since the OM is the cornerstone of the *foundation of execution* approach, this study intended to evaluate the practicality of defining an OM and its translation, the core diagram (translating the OM into high-level enterprise architecture components). A survey was used to receive qualitative feedback on the difficulties experienced in defining the current OM and the core diagram for an enterprise / sub-division. As a frame of reference, Figure 52 depicts the four *stereotypical OMs* (discussed in section 3.3.5), whereas Figure 53 depicts the *core diagram* template for a unification OM (discussed in section 3.3.5).

Business process integration		Business process standardisation: Low	Business process standardisation: High
High		**Coordination** • Shared customers, products, or suppliers • Impact on other business unit transactions • Operationally unique business units or functions • Autonomous business management • Business unit control over business process design • Shared customer/supplier/product data • Consensus processes for designing IT infrastructure services; IT application decisions made in business unit	**Unification** • Customers and suppliers may be local or global • Globally integrated business processes often with support of enterprise systems • Business units with similar or over-lapping operations • Centralised management often applying functional/process/business unit matrices • High-level process owners design standardised processes • Centrally mandated databases • IT decisions made centrally
Low		**Diversification** • Few, if any, shared customers or suppliers • Independent transactions • Operationally unique business units • Autonomous business management • Business unit control over business process design • Few data standards across business units • Most IT decisions made within business units	**Replication** • Few, if any, shared customers • Independent transactions aggregated at a high level • Operationally similar business units • Autonomous business unit leaders with limited discretion over processes • Centralised (or federal) control over business process design • Standardised data definitions but data locally owned with some aggregation at corporate • Centrally mandated IT services

Figure 52: Characteristics of four operating models, based on Ross et al. (2006, p. 29) (duplicate of Figure 31)

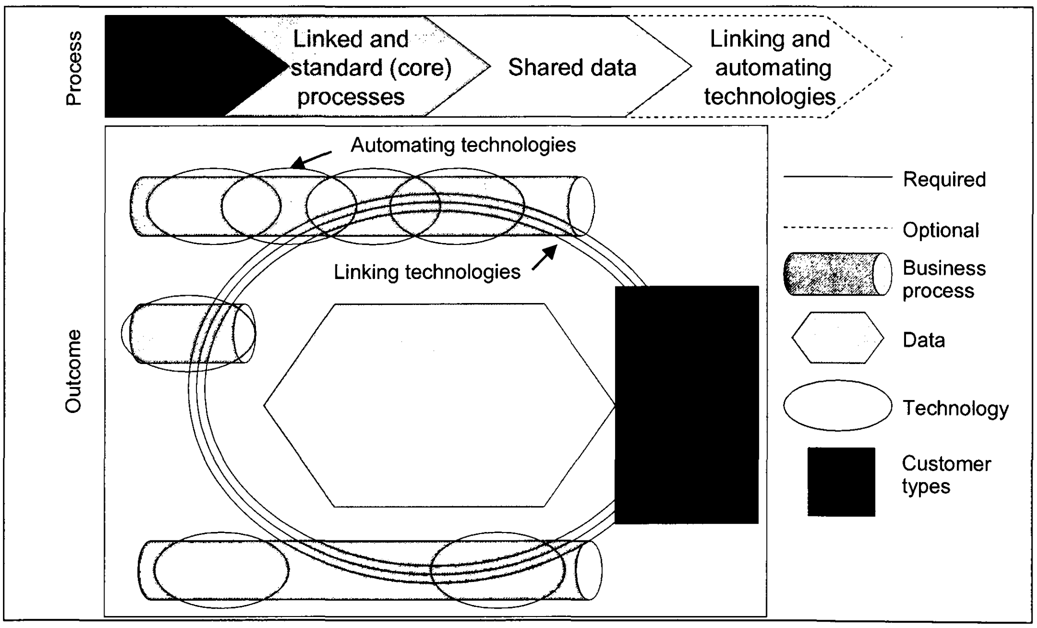


Figure 53: Core diagram process and template for a unification OM, based on Ross et al. (2006, p. 54) (duplicate of Figure 33)

Given the characteristics of four stereotypical OMs (depicted in Figure 52), every enterprise needs to "position itself in one of these quadrants to clarify how it *intends* to deliver goods and services to customers" Ross et al. (2006, p. 28). Upon selection of an appropriate OM, the enterprise should translate the selected OM into a core diagram. Ross et al. (2006) provide four core diagram templates, one for each type of OM. If, for example, management selected a unification OM as appropriate OM for the enterprise, they need to translate the OM into a core diagram according to the process and template given in Figure 53. Following the *process* part (top half) of Figure 53, they need to construct the core diagram according to the *outcome* template (bottom half) of Figure 53. The OM and core diagram should then direct the enterprise in elevating through four stages of architecture maturity:

1. *Business silos architecture*, where enterprises maximise individual business unit needs or functional needs.
2. *Standardised technology architecture*, i.e. gaining IT efficiencies through technology standardisation and increased centralisation of technology management.
3. *Optimised core architecture*, i.e. providing enterprise-wide data and process standardisation, appropriate for the OM.
4. *Business modularity architecture*, where enterprises manage and reuse loosely coupled IT-enabled business process components to preserve global standards while enabling local differences.

Given this background, the subsequent section presents a research process to answer two questions:

- How practical is it to define the current operating model (OM) for an enterprise?
- Once an appropriate OM is selected, and using the guidelines, examples and templates (e.g. Figure 53) of Ross et al. (2006), how practical is it to translate the OM into a core diagram?

6.3 THE RESEARCH PROCESS

In evaluating the practicality of defining the OM and derived core diagram, experimentation was used, collecting data via a questionnaire (discussed in section 2.6.2.1). According to Ross et al. (2006, p. 44), senior managers need to "debate their company's operating model". This study took the stance that EA practitioners will be primarily responsible (in consultation with the chief executive officer and business managers) to articulate a future OM and the derived core diagram, based on business architecture analyses. The reason is that EA practitioners are primarily responsible for business architecture analysis and are equipped to model and analyse the enterprise, using the modelling standards and tools of the enterprise. Questionnaires, based on experimentation, would thus be a suitable instrument to obtain feedback from EA practitioners on the practicality of defining the OM, based on guidelines, examples and templates provided by Ross et al. (2006).

6.3.1 The experimentation process

The experimentation process included several phases to ensure that participants were knowledgeable in the theoretical areas of concern:

1. *Training phase*: The study provided training to the research participants to ensure that they were knowledgeable on business-IT alignment, strategic decision-making, and the foundation for execution approach and associated artefacts as defined by Ross et al. (2006). Training consisted of live presentations, course notes, and literature references for further reading.
2. *Learning/formative assessment phase*: Participants had the opportunity to work individually or in pairs to select an enterprise to apply theory in practice. Participants had to submit an interim report for evaluation to assess their understanding of the theoretical content. Participants received feedback on the interim project report to provide participants with the opportunity to improve/update their final reports.
3. *Experimentation phase*: Participants submitted a complete report based on application of theory in practice. Participants received report instructions (see Appendix B) to apply theory in practice. As part of the report requirements, participants had to develop an operating model (OM) and core diagram. Based on their experience of applying theory in practice, participants completed a questionnaire.
4. *Evaluation phase*: Analysis of the qualitative feedback from the questionnaires gave new insight into the practicality of two key artefacts (OMs and core diagrams). The parameters/variables that were measured, and the questions related to the parameters, are discussed next.

6.3.2 The questionnaire

According to Rea & Parker (2005) a quantitative research requires a research hypothesis about the relationship(s) between variables/parameters. This study does not aim to defend a hypothesis about parameters and their relationships. Instead, parameters have been identified to provide sufficient context in evaluating the practicality of defining operating models and core diagrams. Figure 54 indicates that the participant profile (*Parameter 1*), enterprise profile (*Parameter 2*) and current architecture status (*Parameter 3*) could have an influence on the practicality of defining operating models and core diagrams (*Parameter 4*).

Table 12 provides a summary of the relevant questions that were derived to evaluate the four parameters. Some of the questions were copied from the on-line survey used by the Institute for Enterprise Architecture Developments (IFEAD) (Schekkerman, 2006). The Oracle Magazine subscription form (Haunert, 2008) provided a list of business activities, which were also incorporated in the questionnaire. The original questionnaire consisted of twenty-eight questions (both closed-ended and open-ended (see Appendix A), but not all questions were used for the purpose of this study.

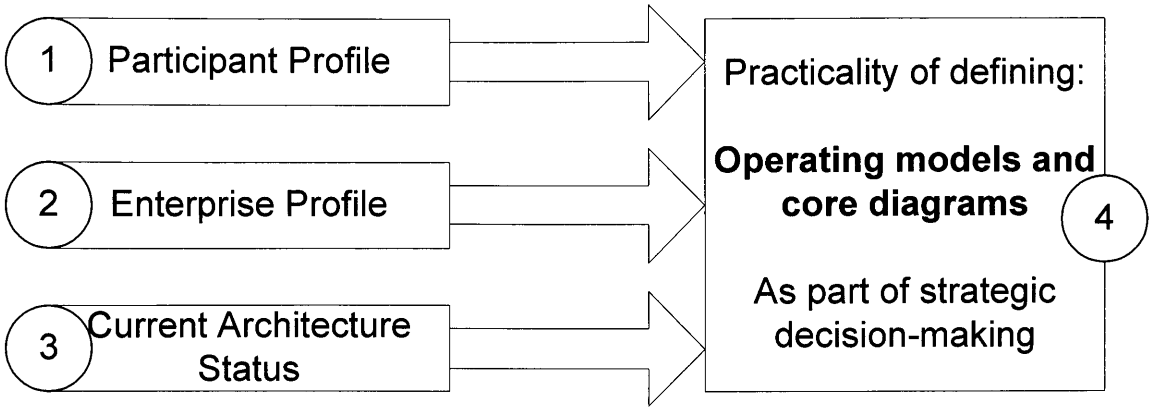


Figure 54: Parameters that influence the practicality of defining two key artefacts

Table 12: Questions related to the four parameters

Questionnaire questions related to the four parameters
Parameter 1: Participant profile
1.1. Please specify your tertiary qualification, e.g. BEng (Industrial).
1.2. What is your current position (e.g. Systems Analyst, Full-time student, etc.)?
1.3. Did you enrol for any course in Information Systems Design (or similar course) previously?
1.4. Did you have any work exposure to Information Systems (e.g. worked in the IT department as a Systems Analyst / worked on a SAP implementation project to implement new procedures, etc.)?
Parameter 2: Enterprise profile
2.1. Specify the number of employees of the entire enterprise.
2.2. What is the primary business activity(s) of your enterprise?
Parameter 3: Current architecture status
3.1. Classify the architecture maturity of your enterprise on a corporate level.
3.2. Is Enterprise Architecture, Business and / or IT Architecture, etc. established in your (corporate) enterprise? IF APPLICABLE, select the relevant options.
3.3. Have you already implemented enterprise architecture governance in your enterprise?
3.4. Define the primary drivers / reasons for implementing EA governance.
3.5. Have you implemented any architecture modelling technology that includes a repository?
Parameter 4: The perceived practicality of operating models and core diagrams
4.1. On what level did you analyse your enterprise architecture?
4.2. What is the current operating model applied to the selected level of analysis in the previous question?
4.3. What difficulties did you experience in defining the current operating model?
4.4. What difficulties did you experience in compiling a core diagram?

This section delineated the experimentation process to evaluate the practicality of defining operating models and core diagrams. As indicated, the intent of the questionnaire was to provide sufficient context in terms of three parameters (participant profile, enterprise profile and current architecture status), which could have an influence on the fourth parameter (practicality of defining operating models and core diagrams). The next section discusses the questionnaire results.

6.4 RESULTS

The study engaged thirty participants in the experimentation phase (see previous section 6.3, no 3, *Experimentation phase*). As participants had the option to work in pairs, there were *twenty-one* final projects with corresponding reports and completed questionnaires. The following sections convey the results of the questionnaire in terms of parameters, numbered from 1 to 4 in Figure 54.

Since some of the questions pertaining to Parameter 1 and Parameter 2 in this survey *were replicated* for a different sample during the evaluation of the PRIF *method, mechanisms and practices* (in Chapter 10), percentages are used for comparison purposes.

For the remaining questions, actual numbers are used, which is more informative for a small sample such as this one.

6.4.1 Parameter 1: Participant profile

The *participant profile* parameter provides an indication of the knowledge and experience of the participant. The questionnaire therefore gathered data about the participant in terms of his/her tertiary qualification, current working position, prior knowledge about information systems in terms of work exposure and previous enrolments in information-system related courses.

Figure 55 indicates that fifty-two percent (52%) of the participants had previously obtained an engineering degree, thirty-two percent (32%) a technical diploma, twelve percent (12%) a Bachelor of Science (BSc) degree, and four percent (4%) a Bachelor of Commerce (BCom) degree. Tertiary qualifications also correlated with the working positions of the participants. Most of the participants (52%) held positions that were related to *business process planning and/or improvement* (see Figure 56: Process Analyst/Engineers, Quality Assurance Engineers, Business Analysts, Industrial Engineers and Planners). Questions regarding prior knowledge about information systems indicated that sixty-seven percent (67%) of the participants had previously enrolled for information system-related courses, while thirty-eight percent (38%) indicated work-exposure in the field of information systems.

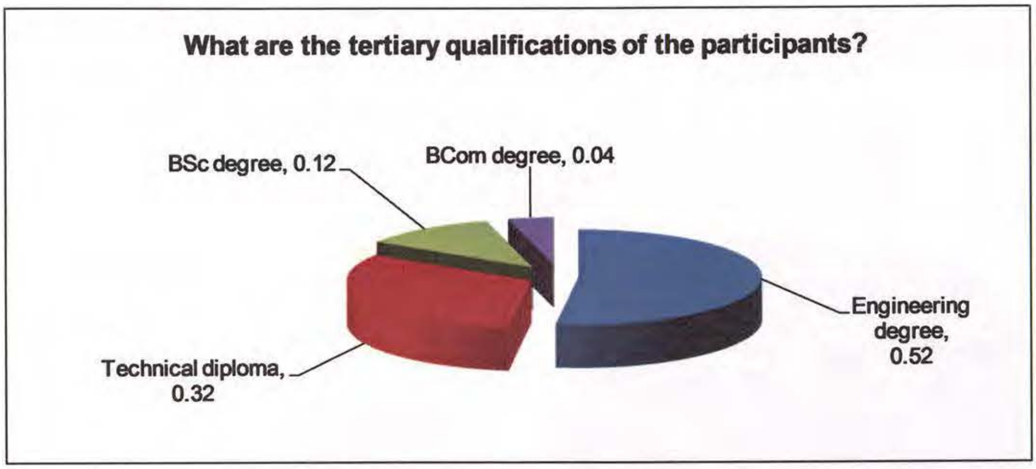


Figure 55: Tertiary qualifications of the participants

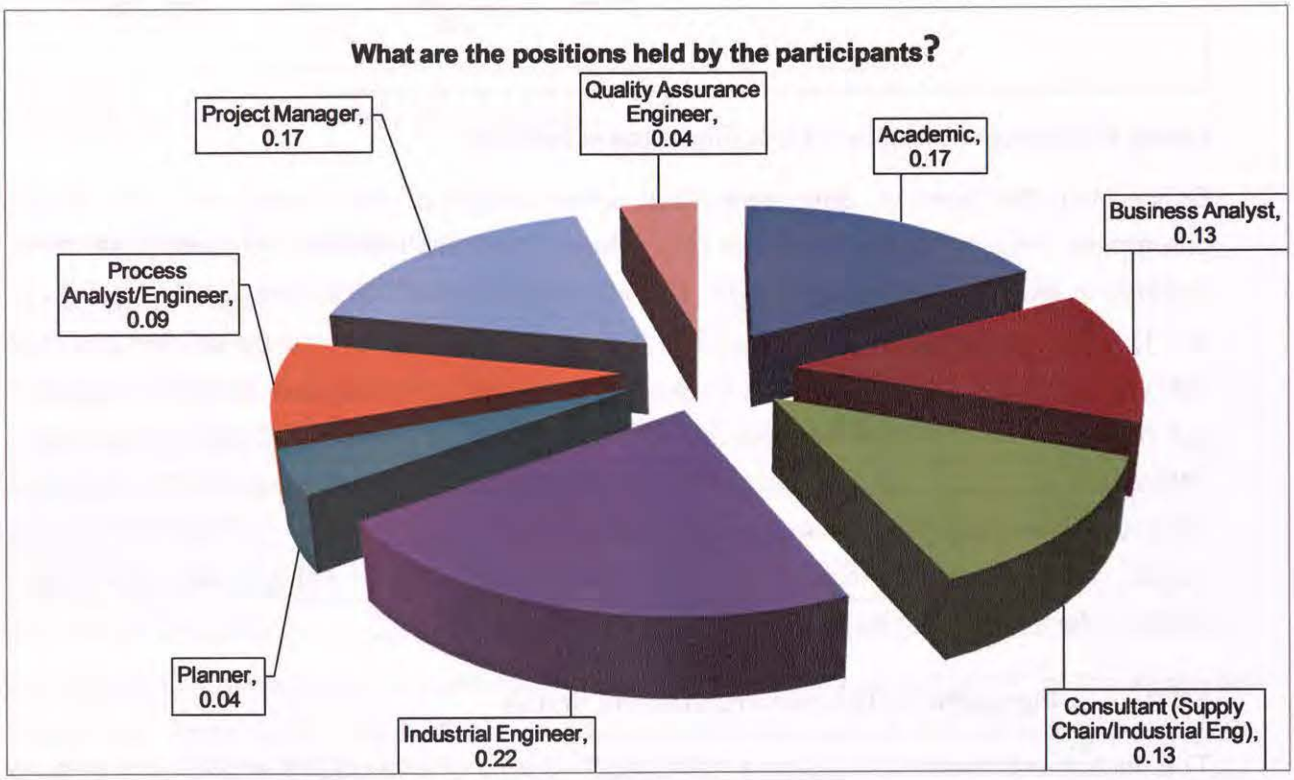


Figure 56: Positions held by the participants

6.4.2 Parameter 2: Enterprise profile

The *enterprise profile* parameter provides an indication of the size and type of enterprises that were used by the participants during the experimentation process. Since the thirty participants had the option to work in pairs, there were *twenty-one* enterprises subjected to analysis. Each participant (or participant-pair) had to develop an operating model and core diagram for his/her chosen enterprise.

In terms of enterprise size, most of the analysed enterprises employed between 100 and 10,000 employees (see Figure 57, largest sector)

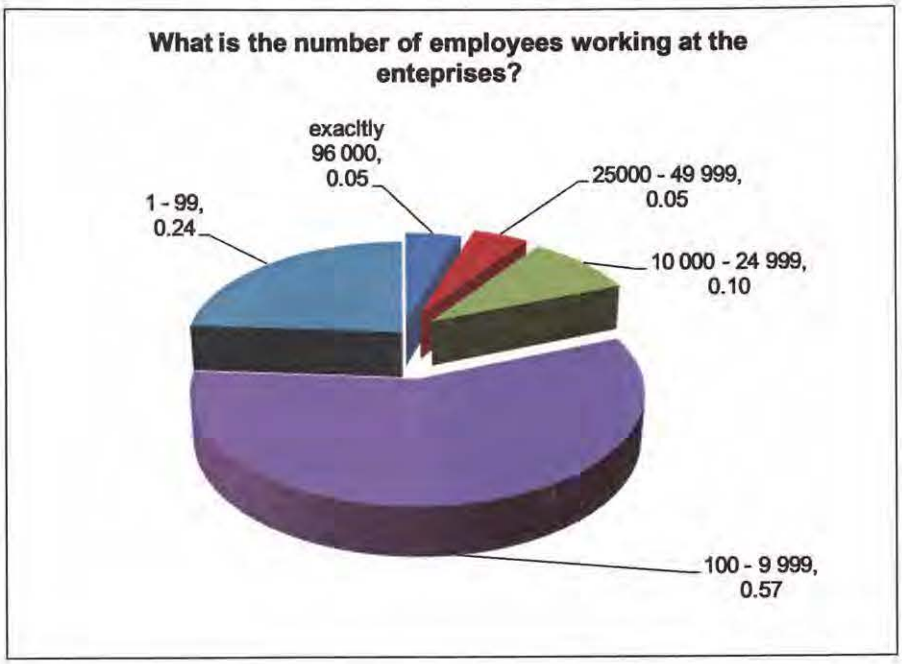


Figure 57: Number of employees working at the enterprises

Concerning the type of enterprises that were analysed, the *twenty-one* (21) analysed enterprises were involved in *nineteen* (19) different business activities - an enterprise could be involved in *multiple business activities*. The activities included automotive manufacturing (5 out of 21), the consumer sector (4 out of 21), high-technology original equipment manufacturer (3 out of 21), industrial manufacturing (3 out of 21), professional services (3 out of 21), research (3 out of 21), other business services (5 out of 21) and 12 remaining business activities (17 enterprises out of 21). Business activities that were excluded include media and entertainment, construction/engineering, financial services/insurance, health care, independent software vendor, life sciences (biotech, pharmaceuticals), oil and gas, travel and transportation, and utilities (electric, gas, sanitation, water).

6.4.3 Parameter 3: Current architecture status

The *current architecture status* parameter provides an indication of the architecture maturity of the analysed enterprises. The questionnaire therefore gathered data about the architecture maturity of the analysed enterprises, established architecture levels, implementation of EA governance, the primary drivers/reasons for implementing EA governance, and the use of architecture modelling technology.

The architecture maturity was measured according to the four architecture maturity stages defined by Ross et al. (2006): (1) business silos architecture, (2) standardised technology architecture, (3) optimised core architecture, and (4) business modularity architecture.

Figure 58 indicates that a large number of enterprises (9 out of 21) managed their divisions in silos. A significant number had progressed to the level of standardised technology (7 out of 21) and optimised core (5 out of 21). None of the enterprises operated according to a modular business design. According to Table 13, business architecture was well-established at 11 out of

21 enterprises. The perceived level of business architecture activity may also be explained by the high process inclination of the participants.

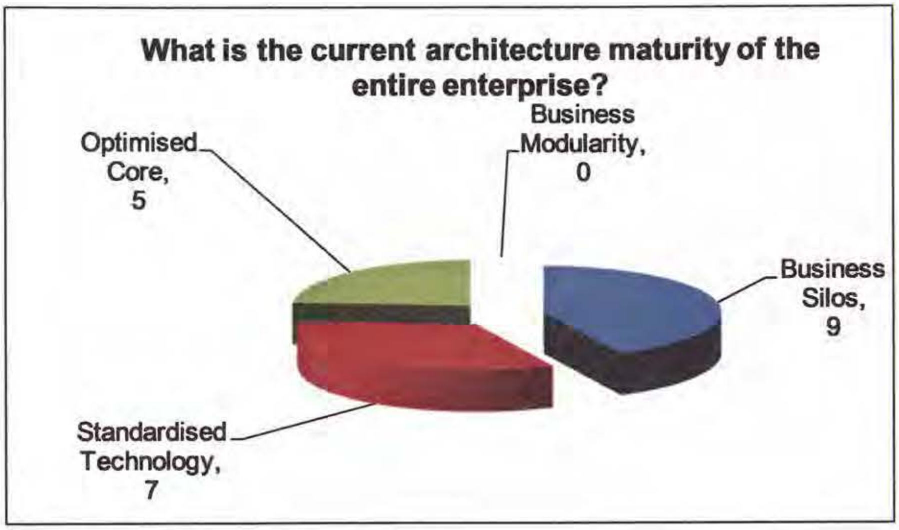


Figure 58: Architecture maturity of enterprises

Table 13: Established architecture levels

Architecture Levels	Number of enterprises
Business Architecture	11
Information-System Architecture (Applications Architecture)	7
Enterprise Architecture	6
Security Architecture	6
Information Architecture	5
Technology Infrastructure Architecture	5
Governance Architecture	3
Software Architecture	3

EA governance activities were performed at thirty-eight percent (8 out of 21) of the analysed enterprises. Participants indicated that an enterprise should invest in EA governance owing to its decision-making support (7 out of 21), system development support (6 out of 21), and delivery of insight and overview of business & IT (5 out of 21).

Only four participants indicated the use of any architecture modelling technology that includes a repository. Tools include ARIS, Casewise, and Systems Architect. According to Figure 59, thirty-eight percent (8 out of 21) did not use an EA framework.

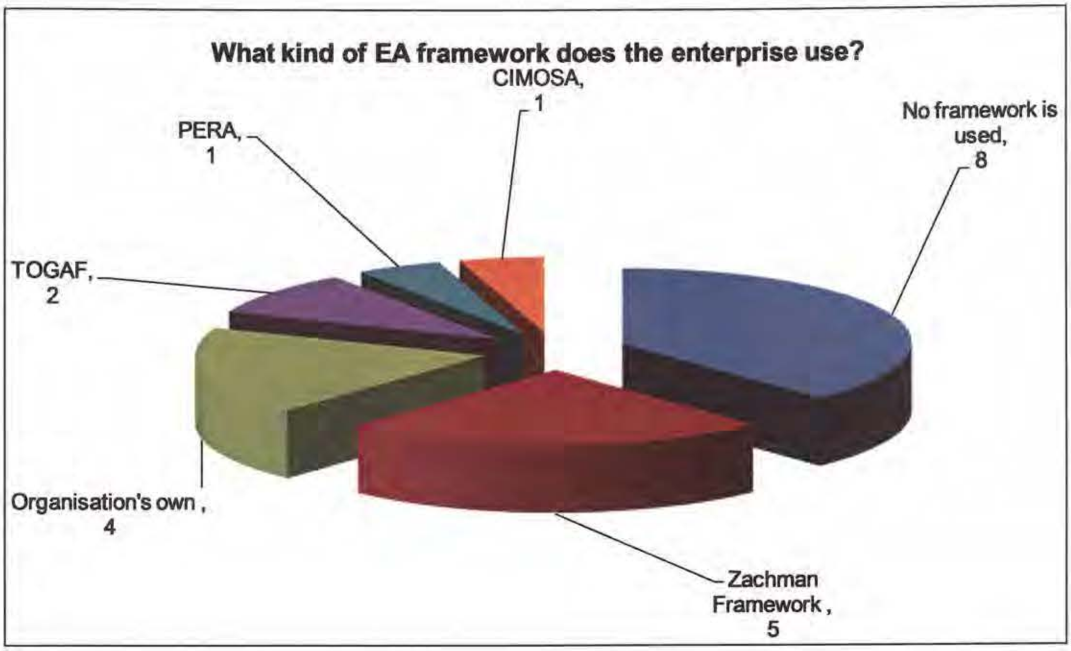


Figure 59: Enterprise architecture framework in use

6.4.4 Parameter 4: The perceived practicality of operating models and core diagrams

Two parameters that could have an effect on the perceived practicality of the OMs and core diagrams include the *level of analysis* (e.g. entire enterprise or a sub-division of the enterprise) and the *OM classification* of the analysed enterprise/sub-division itself.

In respect of the *level of analysis*, participants preferred to apply analysis on a business unit level (17 out of 21) rather than a corporate level (4 out of 21).

Regarding the *OM classification*, the four stereotypical OMs were well represented: diversification (7 out of 21), unification (6 out of 21), replication (5 out of 21), and coordination (3 out of 21). Although the EA practitioner could either define a current or future-state (appropriate) OM for an enterprise, additional consultation (with the chief executive officer and business managers) would be required to define a future OM. Consequently, this study only reports on defining the current-state OM for an enterprise/business unit.

Table 14 provides the results pertaining to the perceived practicality of OMs and core diagrams, answering the two questions identified in the previous section (section 6.2), which are:

- How practical is it to define a current *operating model* (OM) for an enterprise?
- Once an appropriate OM is selected, and using the guidelines, examples and templates of Ross et al. (2006), how practical is it to translate the OM into a *core diagram*?

According to the results in Table 14, participants experienced difficulties in *defining the current OM* for the analysed enterprise or business unit due to several reasons. The main reason being that it is diffucult to select a single operating model (one out of four stereotypical OMs) for an enterprise or business unit. Participants also experienced difficulties in *compiling a core diagram* for the analysed enterprise or business unit due to several reasons. The main reason being that it is difficult to select the main components of the core diagram.

Table 14: Perceived practicality of OMs and core diagrams

Difficulties in defining the current OM	Difficulties in compiling a core diagram
Nineteen (19 out of 21) participants had difficulty in defining the current OM. Participants indicated their difficulty in deciding on one specific operating model (14 out of 19). A few participants (4 out of 19) indicated minimal difficulty in identifying the operating model. The following themes emerged from the qualitative feedback: • Participants had trouble in *deciding on a single operating model* (8 out of 14 who had trouble). They had difficulty in establishing the degree of process standardisation / integration that would be required to classify an enterprise according to a specific model. Enterprises (especially on a corporate analysis level) exhibited behaviours of multiple OMs. • Participants (5 out of 14 who had trouble) conveyed their difficulty in *finding the correct information* to perform a classification. This was also attributed to the limited knowledge and awareness of EA in the enterprise. • Some difficulty (1 out of 14 who had trouble) occurred in defining an operating model on a *business unit level* due to fuzzy boundaries between the corporate level and business unit level.	Twenty (20 out of 21) participants had difficulty in compiling a core diagram. The following themes emerged from qualitative feedback: • Half the participants who indicated difficulties regarding core diagram construction (10 out of 20) had trouble in *selecting the main components* of the core diagram. Of these that experienced difficulty, participants had trouble in identifying the shared technologies (4 out of 10 who had trouble), shared data (3 out of 10), shared processes (3 out of 10), and the key customers (1 out of 10). The problematic identification of shared technologies may be attributed to the participant profile or limited exposure to technology infrastructure. • Participants (6 out of 20) had difficulty in *understanding the generic core diagram templates* provided by Ross et al. (2006) or relating the diagram components to their company. They also questioned the validity of their own core diagram designs. • Another concern was the *availability and/or the consolidation of available information* (4 out of 20 participants).

6.5 INTERPRETATION AND SUMMARY OF RESULTS

Based on the results of the previous section (section 6.4), this section provides a summary and interpretation of the results obtained, referring to the four parameters (Figure 54) that influence the practicality of defining the two key artefacts (the OM and core diagram).

In terms of the *participant profile (parameter 1)*, most of the participants had an engineering background and held positions related to business process planning and improvement. Participants also had sufficient knowledge of information systems.

Concerning the *enterprise profile (parameter 2)*, most of the enterprises that were analysed employed between 100 and 10,000 employees, i.e. medium to large enterprises, rather than small enterprises. The enterprises were involved in a large number of business activities, including automotive manufacturing, the consumer sector, high-technology original equipment manufacturer, industrial manufacturing, professional services, research, other business services and 12 less-represented activities. Business activities that were excluded are media and entertainment, construction/engineering, financial services/insurance, health care, independent software vendor, life sciences (biotech, pharmaceuticals), oil and gas, travel and transportation, and utilities (electric, gas, sanitation, water).

In terms of *architecture status (parameter 3)*, results indicated a relatively low level of architecture maturity; most of the analysed enterprises displayed business silo behaviour, while none of the enterprises operated according to a modular business design. Although the analysed enterprises had established business architecture as an architecture domain, architecture representation (using models) was limited.

The study could only report on the *perceived practicality of the OM and core diagram (parameter 4)* on a business unit level, since most of the participants defined operating models at a business unit level, rather than on a corporate level.

The interpretation of the various difficulties experienced follows:

- The difficulty of selecting a *single OM* relates to the difficulty of identifying the *degree of process standardisation / integration* for the analysed enterprise / business unit. Evaluation of the OM characteristics requires extensive implicit/explicit knowledge to define the degree of process standardisation / integration.
- Participants had difficulty in *finding the correct information* to perform an OM classification or select core diagram components. Identification of OM characteristics and core diagram components require knowledge about the strategic choices (markets, products/services), operating/organising logic, business processes, and main databases and technologies of the enterprise. Some baseline architectures are thus required, and this knowledge is not necessarily available or in an explicit format.
- Participants had *difficulty in selecting the main components* of the core diagram and understanding the core diagram templates. The limited set of examples provided in the textbook may also attribute to the limited understanding.

The results indicate problems in terms of practicality, when defining the *current-state OM and core diagram* for an enterprise/business unit. In the following section, the scope of analysis is narrowed, by focusing on the deficiencies of the OM that lead to practicality problems.

6.6 PROBLEM-AWARENESS AND SUGGESTION

The interpreted results of the previous section (section 6.5) highlighted several difficulties when identifying/constructing an OM and core diagram. Although the construction of both artefacts are problematic, the core diagram is dependent on the OM and translates the process standardisation / integration requirements of the OM into the core diagram components. Since the core diagram is a derivative of the OM, the remainder of the study focused on the OM alone. The following section provides the rationale for *enhancing the OM concept*.

If senior managers are to use the OM as a *key artefact* in guiding them during the strategic decision-making processes, it could be argued that the *method* used to obtain the artefact outputs should be more rigorous. Ross et al. (2006) based their book 'Enterprise Architecture as Strategy' on the insights from a series of research projects that explored more than 200 companies and another 256 companies where their focus was on IT governance (Ross et al., 2006). Although the OM alone was applied to 1500 companies during a MIT CISR study in 2008 (Weill & Ross, 2008), an inquiry was made about the *method* applied to classify a company according to a specific OM. In correspondence with one of the authors of the book 'Enterprise Architecture as Strategy', Jeanne Ross, on 21 June 2010, it was confirmed that a theoretical gap did exist in terms an *OM-classification method*. Jeanne Ross commented as follows: "We have never written an academic paper on the topic of the operating model. We intended to, but we've never gotten around to it. The model is based on 40 case studies and qualitative analysis of those cases" (Ross, 2010). Although proven qualitatively in 40 case studies, the method-knowledge to derive an OM was not explained.

Although a powerful decision-making tool in guiding ICT developments, a *method deficiency* exist, i.e. the *method used to obtain OM outputs*, has not been elucidated. The *awareness* of method deficiencies of the OM thus led to a *suggestion.* The suggestion is that the OM is enhanced to address the *method* deficiency, by developing a *method*-artefact. Initiation of the *development* process however triggered *circumscription,* i.e. awareness of another problem due to the act of developing the *method*.

Chapter 7 provides detail on another problem initiated due to circumscription. The other problem relates to the requirements-gathering process for developing the new *method*-artefact.

6.7 CONCLUSION

This chapter presented the first two steps of the main design research cycle, namely *awareness of problem* and *suggestion*. A survey and critical analysis were used to identify deficiencies in terms of the practical use of the operating model (OM) and core diagram that led to the *awareness of a problem* pertaining to the OM, and a *suggestion* to enhance the OM by addressing the *method* deficiency.

The *suggestion* initiated the *development* of the *method*, but led to the awareness of another problem namely that requirements gathering for developing the method, required additional context. The next chapter (Chapter 7) elaborates on the requirements-gathering problem.

Chapter 7. Requirements to identify process reuse opportunities

7.1 INTRODUCTION AND PROBLEM DEFINITION

One of the main objectives of this thesis is to enhance the operating model (OM), due to its inherent deficiencies. In the previous chapter (Chapter 6) the deficiencies regarding the practical use of the OM were identified. The *awareness* was that a well-formulated *method* was required in obtaining OM outputs. This chapter[3] delineates the first *development* sub-cycle (Figure 60, *Sub-cycle 1*) to develop the first part of PRIF (Figure 60, *Requirements for PRIF method, mechanisms and practices*), in addressing the second research question, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

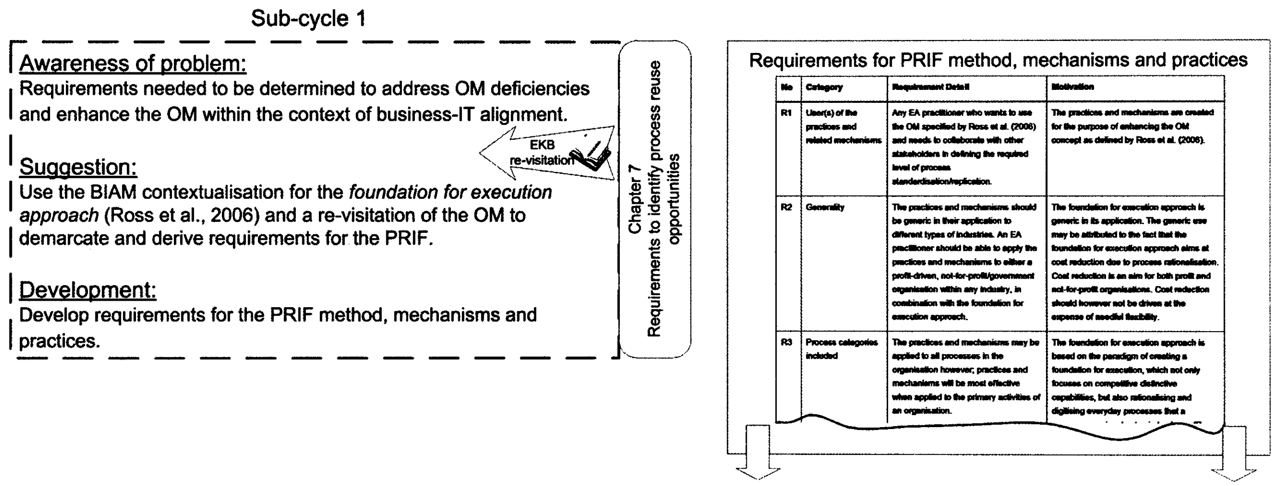


Figure 60: Design cycle context for Chapter 7 (duplicating part of Figure 15)

The initial development of the *method* for enhancing the OM, applied the logic of the *basic system design process* (see Figure 61, previously discussed in section 3.2.2). According to the *basic system design process*, the construction of an object system (e.g. a new *method)*, requires constructional knowledge of the using system (e.g. the construction of the OM), in *determining requirements* for the function of the object system (e.g. function of the new *method)*. The function of the object system is then used in *devising specifications* (constructional requirements) for the construction of the object system (e.g. the construction of the new *method*).

[3] The content of Chapter 7 is based on: De Vries, M., Van der Merwe, A., Gerber, A., & Kotzé, P. (2010). Refining the operating model concept to enable systematic growth in operating maturity. In C. Schutte (Ed.), *Proc. 24th SAIIE Conference* (pp. 32-46). Glenburn Lodge, Gauteng: SAIIE.

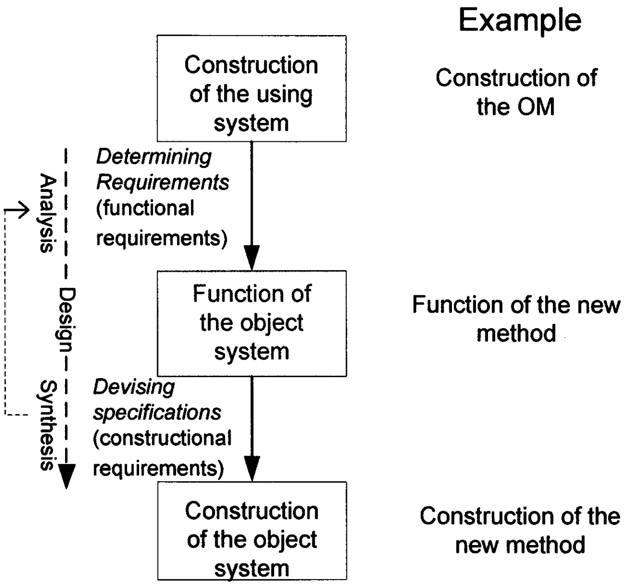


Figure 61: Using the basic system design process (from Dietz (2006)) in constructing a new method

The initial development of a *method* for enhancing the OM, led to circumscription and the *awareness* of another problem. Although the identification of OM deficiencies provided a good starting point for developing a supporting method, the requirements gathering process required additional context. According to the logic of the basic system design process, it is only feasible to *determine requirements* for the function of the new *method*, upon understanding the construction of the OM. The construction of the OM in turn, is not without context. The OM is used within the context of the *foundation for execution* approach, which contributes towards the *alignment of business with IT*. An understanding of the OM-construction, thus also requires contextual knowledge. Thus, an understanding of the OM-construction requires contextualisation in terms of the *foundation for execution* approach, but also in terms of *business-IT alignment*.

Supporting the notion that it is necessary to have a thorough understanding of context, Owen (1997) maintains that requirements need to be derived from the *value system of a specific discipline*. It is thus possible to argue that determination of requirements for the function of the new *method* has to be derived within the value system of the *business-IT alignment discipline*. In addition, a business-IT alignment contextualisation of the OM and *foundation for execution approach*, would enable the method-designer to search for possible solutions within the current knowledge base of the business-IT alignment discipline.

In summary, the *problem* (Figure 60, *Awareness of problem*) that needs to be addressed in developing the new *method*, is that the requirements for the new *method* had to solve the OM deficiencies and enhance the OM within the context of business-IT alignment. It was subsequently *suggested* (Figure 60, *Suggestion*) that the Business-IT Alignment Model (BIAM) was used to contextualise the *foundation for execution* approach. This implies, re-visiting the literature on the OM, including its purpose and construction. Because of the BIAM-contextualisation, the scope for enhancing the OM also changed. Instead of developing a method to address all OM deficiencies, the scope of the method was limited to address deficiencies pertaining to the identification of process reuse opportunities in an enterprise. Therefore, it was *suggested* (Figure 60, *Suggestion*) that requirements are only developed for the *method, mechanisms and practices* necessary for identifying *process reuse* opportunities at an enterprise.

This chapter addresses the *suggestion* (Figure 60, *Suggestion*) that the Business-IT Alignment Model (BIAM) is used to contextualise the *foundation for execution* approach. Section 7.2 addresses the *suggestion* of providing a business-IT alignment contextualisation of the *foundation for execution* approach. Section 7.3 discusses the additional OM deficiencies identified during a re-visitation of literature and the BIAM-contextualisation of the *foundation for execution* approach. In terms of *development* (Figure 60, *Development*), section 7.4 delineates a set of requirements to address OM deficiencies pertaining to the *identification of process reuse opportunities* at an enterprise. The chapter concludes in section 7.5.

7.2 A BIAM CONTEXTUALISATION OF THE FOUNDATION FOR EXECUTION APPROACH

The OM is used within the context of the *foundation for execution* approach, and the *foundation for execution* approach is in turn used within the context of *business-IT alignment.* This section therefore applies the BIAM components delineated in section 4.3 to provide a *business-IT alignment* contextualisation of the *foundation for execution* approach introduced in section 3.3.5. The following sub-sections correlate with the four main contextualisation components of the BIAM namely, (1) the paradigm of creating value; (2) the dimensions for alignment; (3) alignment mechanisms and practices; and (4) alignment approach classifiers.

7.2.1 Paradigm of creating value

The value-creation paradigm of the *foundation for execution* approach, is that value is created when enterprises digitise their operational processes. Before they can digitise their processes, managers need to have a vision (future view) of how the company *should operate* as articulated in an OM. The OM is thus used as a guide in the systematic development of the *foundation for execution* (Ross et al., 2006).

Lapalme (2011, p. 6) classifies the *foundation for execution* approach according to the EIT (enterprise IT architecting) school of thought (see EIT qualifiers in Table 8). However, a complete paradigmatic analysis that investigates the paradigmatic roots of the *foundation for execution approach* (e.g. using the paradigmatic framework of Iivari (1991)), has not been done up to date. Although proposed as a useful extension of the BIAM to enable a complete paradigmatic analysis (see Chapter 12), this study excludes a comprehensive paradigmatic analysis of the *foundation for execution* approach.

7.2.2 The dimensions for alignment

According to Figure 62, the *foundation for execution* approach does *not* provide a methodology for designing and constructing the entire enterprise (as an object system), but rather requires construction principles (derived from the OM) to guide the development of the ICT system as the object system. Figure 62 (*focus of the foundation for execution approach)* indicates the alignment focus of the *foundation for execution* approach.

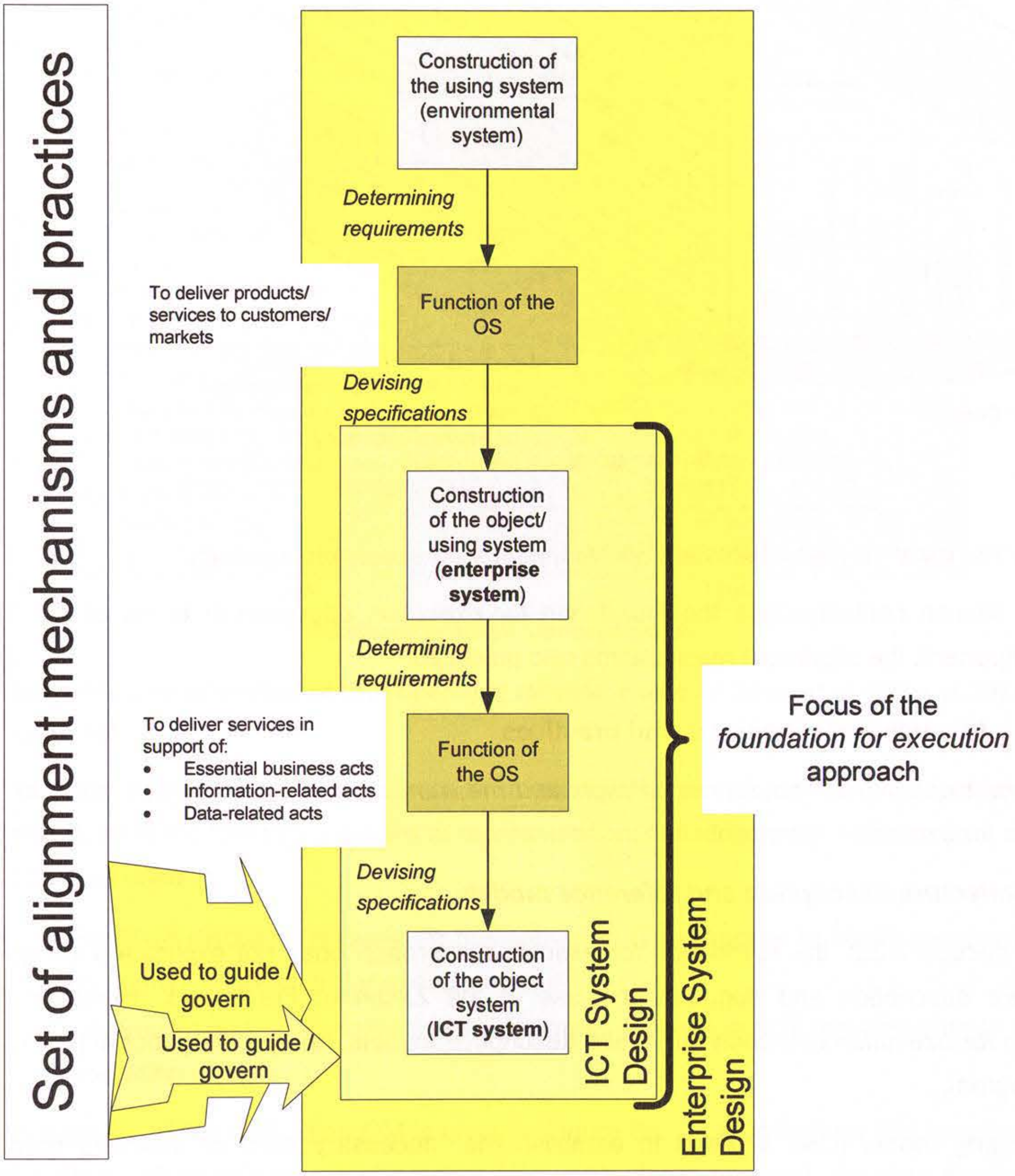


Figure 62: The foundation for execution approach focusing on ICT system design

In terms of the three BIAM dimensions for alignment, Ross et al. (2006) do not stipulate different *design domains (1), concerns & constraints (2),* or the *enterprise scope (3),* but they suggest the use of the Zachman Framework. The intent of the *foundation for execution* approach is to align business with IT within the boundaries of the enterprise, as indicated by the yellow-shaded part on Figure 63.

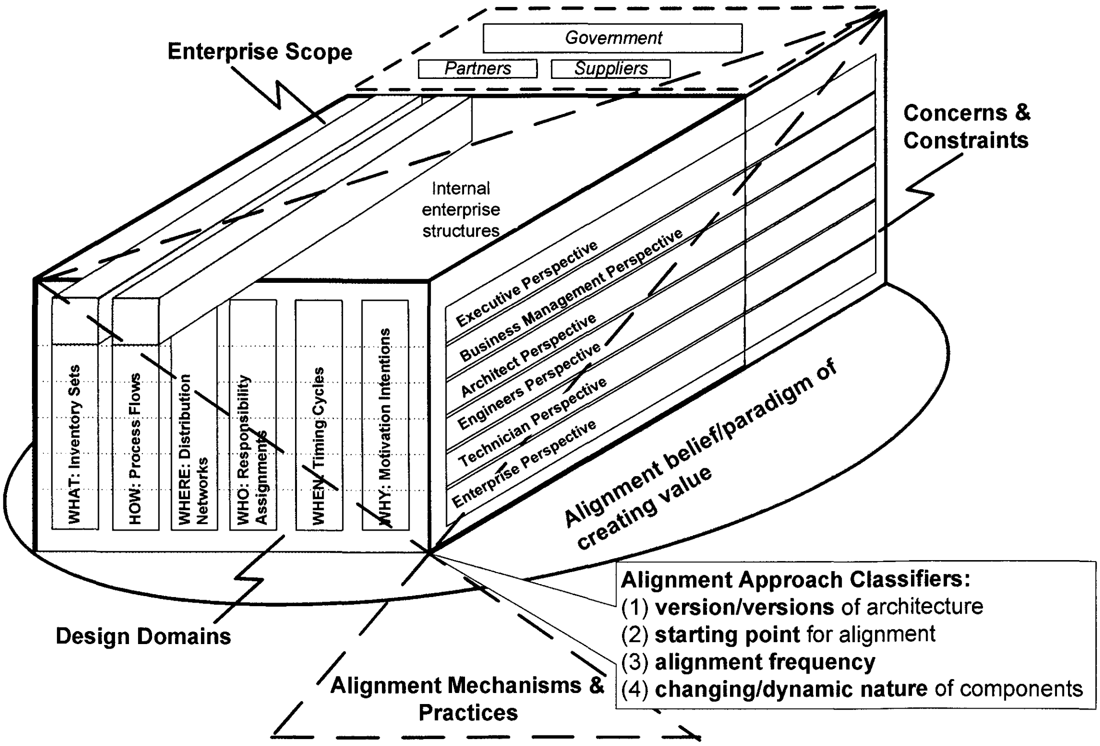


Figure 63: The BIAM contextualisation of the *foundation for execution* approach

The next section contextualises the *foundation for execution* approach in terms of the third BIAM component, the alignment mechanisms and practices.

7.2.3 Alignment mechanisms and practices

This section highlights the categories of *alignment mechanisms and practices* that apply to the *foundation for execution* approach.

1. Architecture description and reference models

As noted section 7.2.2, the *foundation for execution* approach does not explicate a complete *architecture description* and suggests the use of the Zachman Framework. However, the *foundation for execution* approach offers two descriptive models, an operating model (OM) and a core diagram.

The *operating model* (OM) is used to establish the "necessary level of business process integration and standardisation for delivering goods and services to customers" (Ross et al., 2006, p. 44). Based on the different levels of process standardisation and process integration Ross et al. (2006) provide four stereotypical OMs. The four OMs are not only dependent on the levels of process standardisation and integration, but are defined based on certain characteristics, (as depicted in Figure 64).

Business process integration	Coordination	Unification
High	**Coordination** • Shared customers, products, or suppliers • Impact on other business unit transactions • Operationally unique business units or functions • Autonomous business management • Business unit control over business process design • Shared customer/supplier/product data • Consensus processes for designing IT infrastructure services; IT application decisions made in business unit	**Unification** • Customers and suppliers may be local or global • Globally integrated business processes often with support of enterprise systems • Business units with similar or over-lapping operations • Centralised management often applying functional/process/business unit matrices • High-level process owners design standardised processes • Centrally mandated databases • IT decisions made centrally
Low	**Diversification** • Few, if any, shared customers or suppliers • Independent transactions • Operationally unique business units • Autonomous business management • Business unit control over business process design • Few data standards across business units • Most IT decisions made within business units	**Replication** • Few, if any, shared customers • Independent transactions aggregated at a high level • Operationally similar business units • Autonomous business unit leaders with limited discretion over processes • Centralised (or federal) control over business process design • Standardised data definitions but data locally owned with some aggregation at corporate • Centrally mandated IT services
	Low	High
	Business process standardisation	

Figure 64: Characteristics of four operating models, based on Ross et al. (2006, p. 29) (duplicate of Figure 52)

The *foundation for execution* approach translates the standardisation requirements/principles embedded in the OM into a graphical representation, called the *core diagram*. The core diagram should be used to:

- Facilitate discussions between business and IT managers to clarify requirements for the company's foundation for execution, and
- Communicate the vision (high-level business process and IT requirements of a company's operating model).

An example of the unification OM is given in Figure 65. As a unification OM requires high levels of process standardisation and process integration (data sharing), the core diagram needs to depict the standard (core) and linked processes, as well as shared data. The diagram also depicts key customer types and automating technologies.

Using Zachman's demarcation terminology, the OM emphasises two main *design domains* (data (WHAT: inventory sets) and process (HOW: process flows)), *concerns* of executives. In addition, the OM has as objective to share data and replicate processes across different business units within the enterprise boundaries, i.e. *enterprise scope*. Figure 63 (grey-shaded bars) represent the alignment intent of the OM (De Vries et al., 2010).

Ross et al. (2006) purposefully omit alignment with the motivational aspects (WHY: motivation intentions) of the business (see Figure 63). The rationale is that strategic initiatives, derived from the strategic direction, often lead to IT-enablement for each strategic initiative. This creates the delivery of piece-meal/disjointed IT solutions that are not integrated (Weill & Ross, 2008). The IT department constantly reacts to the latest strategic initiative and is always a bottleneck, operating in a reactive mode.

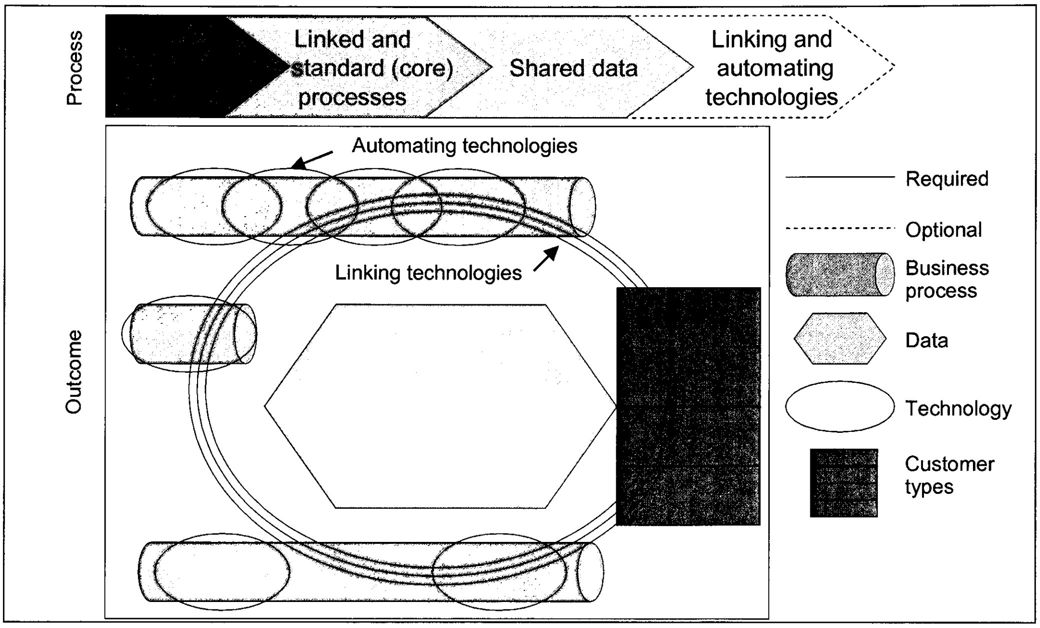


Figure 65: Core diagram template for a unification OM, based on Ross et al. (2006, p. 54) (duplicate of Figure 53)

The core diagram in essence represents a constructional view of the enterprise as a *required design* for addressing the functional requirements (i.e. to deliver products/services to customers/markets) of the using system (i.e. the environmental system). The *required design* thus leverages process standardisation, data sharing and technology sharing opportunities across enterprise structures.

2. Methodologies

Ross et al (2006) proposes an eight-step *method* (see section 3.3.5) to gradually develop the *foundation for execution*.

3. Principles and standards

Ross et al. (2006) offers the OM (operating model) as the foundation for identifying *integration and standardisation requirements/principles* to guide IT decision-making. The OM is however both descriptive (providing descriptive characteristics in Figure 64) and prescriptive (providing guidance on the required level of process standardisation and process integration), which makes the usability of the OM problematic (Hoogervorst, 2009, p. 297).

4. *Additional management mechanisms and practices*

The *foundation for execution* approach builds the foundation one project at a time and requires a system of governance mechanisms assuring that business and IT projects achieve both local and company-wide objectives. The mechanisms are structured as part of an IT engagement model that contains three main ingredients:

1. Company-wide IT governance, defined as the "decision rights and accountability framework to encourage desirable behaviour in using IT" (Ross et al., 2006, p. 119).
2. Project management, which requires a formalised project methodology with clear deliverables and checkpoints.
3. Linking mechanisms, which incorporates processes and decision-making bodies that need to align incentives and connect the project-level activities to the companywide IT governance.

5. *Maturity models*

Ross et al. (2006, p. 71) maintains that enterprises need to follow a systematic transformation process in changing towards the future architecture, as required by the OM. Enterprises should build out their enterprise architectures through four stages of *architecture maturity.* Figure 66 illustrates three axes representing different levels of sharing/replication: (1) technology sharing, (2) process replication, and (2) data sharing. Four stages of *architecture maturity* are related to the levels of sharing depicted on Figure 66:

1. *Business silos architecture,* where enterprises maximise individual business unit needs or functional needs (*low* technology sharing, *low* process replication, *low* data sharing).
2. *Standardised technology architecture*, i.e. gaining IT efficiencies through technology standardisation and increased centralisation of technology management (*high* technology sharing, *low* process replication, *low* data sharing).
3. *Optimised core architecture*, i.e. providing enterprise-wide data and process standardisation, appropriate for the OM (*high* technology sharing, *high* process replication, *low* data sharing) or (*high* technology sharing, *low* process replication, *high* data sharing).
4. *Business modularity architecture,* where enterprises manage and reuse loosely coupled IT-enabled business process components to preserve global standards while enabling local differences (*modularised process components* technology, *high* process replication, *high* data sharing).

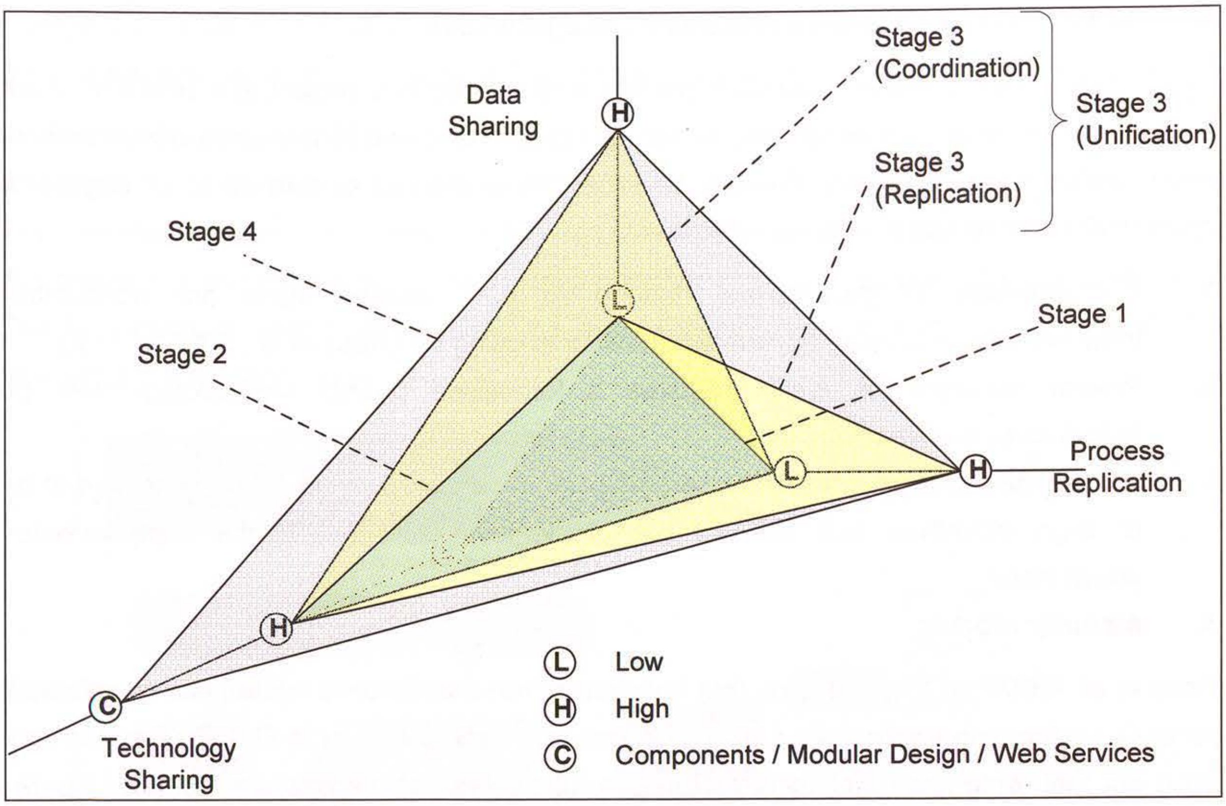


Figure 66: Architecture maturity stages, based on Ross et al. (2006)

6. *Skills/learning requirements*

Ross et al. (2006) define different skill sets for CIO's based on the maturity level of the enterprise. In addition, they provide a list of ten leadership principles for creating and exploiting a *foundation for execution*. The leadership principles were extracted from lessons learnt by top executives (Ross et al., 2006).

7.2.4 Alignment approach classifiers

The *foundation for execution* approach focuses mainly on the *future state* architecture, which is also used to define architecture principles. Ross et al. (2006, p. 44) maintain that a company needs to articulate a vision (*future* view) of how the company will operate, called the operating model (OM).

A *top-down* approach (starting at the executive perspective, translating through subsequent perspectives) is followed in terms of architecture development, emphasising the executive perspective. The top-down approach differs from other top-down alignment approaches in that an OM is used *as the strategy* to drive alignment, rather than driving alignment via ad-hoc strategic initiatives.

The *foundation of execution* approach is not in favour of a big bang approach, but rather suggests a *continuous* and incremental process, building the foundation *one project at a time*.

The *foundation for execution* approach aims at reducing architectural complexity by rationalising data and processes according to the OM requirements, thus limiting duplicated efforts in managing the *changing/dynamic nature* of architecture components.

To conclude, the BIAM provided a contextualisation of the *foundation for execution* approach in terms of the four main components of the BIAM (Figure 45 in section 4.3.2, Components 1 to 4). Based on the BIAM-contextualisation, the next section highlights additional deficiencies (see initial deficiencies in section 6.5) inherent in the operating model (OM).

7.3 ADDITIONAL OM DEFICIENCIES

Based on the BIAM-contextualisation of *the foundation for execution* approach (see previous section 7.4), the OM was re-visited and critical evaluations were made, which related to (1) *method* and, (2) *elevating to a fourth level of architecture maturity*. The two deficiencies are subsequently described in sections 7.3.1 and 7.3.2.

7.3.1 Method deficiency

The descriptive characteristics of the OM (see Figure 64) could be classified according to different categories, which imply different timings. The characteristics relate to:

- Current business architecture configurations that pose opportunities for sharing data and replicating similar processes/functions (e.g. shared customers/products/suppliers; operationally unique business units or functions).
- Shared data and standardised processes (e.g. shared customer/supplier/product data; standardised processes).
- Suggestions in terms of business and IT governance arrangements that go hand-in-hand with the other characteristics (e.g. autonomous business management; IT decisions made centrally).

An implicit process is thus suggested to derive a required OM (see Figure 67, left part, *Method deficiency*):

- The enterprise needs to analyse certain business architecture parameters to establish rationalisation opportunities.
- Rationalisation opportunities could be identified within two main areas: (1) Data (sharing data across enterprise entities), and (2) Process (replicating/re-using processes across enterprise entities). The levels of data sharing and process replication will provide opportunities for sharing certain technologies. A pure coordination OM could use common portals and middleware technology; a replication OM could use common system components; while a unification OM could use common application systems (Weill & Ross, 2008).
- Once rationalisation opportunities have been established an enterprise needs to derive a future OM that would exploit these opportunities.
- The future OM then needs to direct the design of appropriate governance mechanisms.

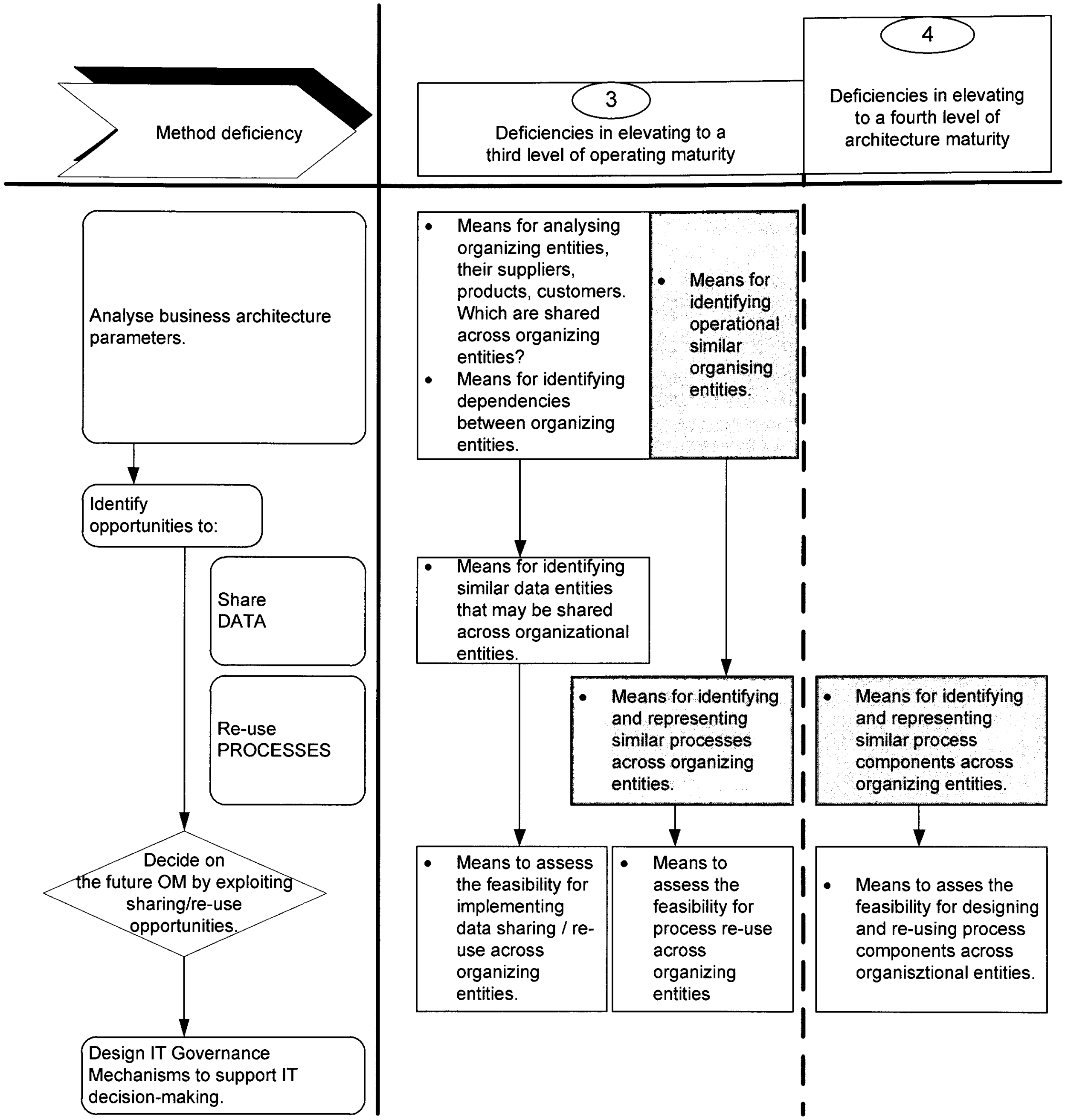


Figure 67: Deficiencies in defining and using the OM

The implicit process thus suggested that the enterprise needs to *analyse* certain business parameters prior to the identification of rationalisation opportunities. Once rationalisation opportunities have been established, a *decision-making* process is required to derive a future OM that would exploit the rationalisation opportunities. Only then, the OM could be used as a guide for designing appropriate governance mechanisms.

7.3.2 Deficiency in elevating to a fourth level of architecture maturity

Ross et al. (2006, p. 26) maintain that the choice of an OM is a critical decision for a company and that "it's the first step in building a foundation for execution". Re-visiting the role of the OM in transforming an enterprise through different levels of architecture maturity however revealed insightful results.

Section 7.2.3 indicates that the OM is only required to elevate an enterprise from a second level of architecture maturity to a third level of architecture maturity, which is also supported by a more recent publication of Weill & Ross (Weill & Ross, 2008), where standardisation objectives are defined for each type of OM as differentiators. The four OMs all require *shared services* and common *infrastructure technology* objectives (objectives for level two architecture maturity). Data sharing and process replication objectives differentiate the four OMs from one another and are objectives for reaching the third level of architecture maturity. Whereas the third level architecture maturity objectives are derived from the OM and exploit rationalisation opportunities across the enterprise, the fourth level of architecture maturity acknowledges the unique needs of business units and needs to be supported via IT-enabled *process components*. The use of *process components* refers to a different level of process granularity. The OM however does not facilitate the identification of process components that may be IT-enabled and re-used across the enterprise (see Figure 67, right part, *Deficiencies in elevating to a fourth level of architecture maturity*).

Based on the OM deficiencies, the next section demarcates requirements to address some of the identified OM deficiencies.

7.4 REQUIREMENTS TO ADDRESS OM DEFICIENCIES

In addressing the identified OM deficiencies stipulated in section 7.3, a practitioner needs to identify opportunities to (1) share data and (2) reuse processes across several business units. This section provides the rationale for only developing requirements pertaining to the identification of *process reuse opportunities* and concludes with a table of requirements.

Given that many enterprises have already seized the opportunity of sharing data by implementing centralised data management systems (Smith & Fingar, 2003), this thesis only highlighted the deficiencies pertaining to the identification of *process reuse opportunities.* The initial scope of developing a *method* for constructing an OM (Figure 61 in section 7.1), was thus reduced to the development of a *method* for identifying process reuse opportunities. According to the basic system design process (discussed in section 3.2.2), development of an object system (e.g. a *method* for identifying reuse opportunities) needs to follow a systematic and iterative design process, *deriving requirements* and *devising specifications*. Therefore, this thesis *derived a set of requirements* to define the scope of a supplementing *method, mechanisms and practices* in identifying *process reuse opportunities* at an enterprise, thus augmenting the OM concept.

Seven requirement categories were identified and the summary and rationale behind each requirement are provided in Table 15. The seven requirement categories include:

1. User(s) of the practices and related mechanisms
2. Generality
3. Process categories included
4. Current architecture capabilities

5. Process representation
6. Replication constraints
7. Feasibility analyses

Table 15: Requirements for addressing deficiencies pertaining to process reuse identification opportunities at enterprises

No	Category	Requirement Detail	Motivation
R1	User(s) of the practices and related mechanisms	Any EA practitioner who wants to use the OM specified by Ross *et al.* (2006) and needs to collaborate with other stakeholders in defining the required level of process standardisation/replication.	The practices and mechanisms are created for the purpose of enhancing the OM concept as defined by Ross *et al.* (2006).
R2	Generality	The practices and mechanisms should be generic in their application to different types of industries. An EA practitioner should be able to apply the practices and mechanisms to either a profit-driven, not-for-profit/government enterprises within any industry, in combination with the foundation for execution approach.	The foundation for execution approach is generic in its application. The generic use may be attributed to the fact that the foundation for execution approach aims at cost reduction due to process rationalisation. Cost reduction is an aim for both profit and not-for-profit enterprises. Cost reduction should however not be driven at the expense of needful flexibility.
R3	Process categories included	The practices and mechanisms may be applied to all processes in the enterprise however; practices and mechanisms will be most effective when applied to the primary activities of an enterprise.	The foundation for execution approach is based on the paradigm of creating a foundation for execution, which not only focuses on competitive distinctive capabilities, but also rationalising and digitising everyday processes that a company requires to stay in business (Ross et al., 2006, p. 4). The practices and mechanisms will however be most effective when applied to the primary activities of an enterprise, as support activities automatically provide the opportunity for enterprise-wide standardisation (Smith & Fingar, 2003, p. 63).
R4	Current architecture capabilities	The practices and mechanisms need to take current work in terms of Enterprise Architecture, Business Architecture and Process Architecture into account, but also need to provide sufficient detail if none of these architectures have been defined/documented.	According to Ross *et al.* (2006, p. 26), the first step in building a foundation for execution is to define the OM for the enterprise. No pre-conditions are defined for defining this model. The ability to define this model however is dependent on current architecture capabilities and documented/explicated architectures. Immature architecture capabilities may require additional architecture work, such as defining enterprise-wide process management standards and a centralised process

No	Category	Requirement Detail	Motivation
			repository (Smith & Fingar, 2003, p. 177).
R5	Process representation	The practices and mechanisms should encourage consistent process representation to ensure re-use. The extent of re-use includes the following: 1. It should be possible to add process measures if required for the purpose of performance measurement and/or process improvement. 2. The process representations should support end-to-end views of processes. 3. Process representations should not hamper the transition from the third to fourth levels of architecture maturity, i.e. it should allow for modular process design. 4. The representations that are used to communicate process replication opportunities should be understandable to business users (from the contextual and conceptual viewpoints).	A consistent representation may enhance communication about how the business operates, enable efficient hand-offs across enterprise boundaries and allow for consistent performance measurement across enterprise entities or similar competitors (Davenport, 2005). In addition, transitioning from a third to fourth level of architecture maturity (as defined by Ross *et al.*, 2006) requires the identification of business services that may be shared among different enterprise entities. Heinrich *et al.* (2009) maintain that the identification of business services requires a consistent representation of the enterprise's processes.
R6	Replication identification	The mechanisms and practices should enable the identification of operational similar organising entities.	Weill and Ross (2008) mention that replication opportunities may be defined across various types of entities (business units, regions, functions and market segments). The OM itself is however primarily used in defining replication and data sharing requirements across business units.
R7	Feasibility analyses	The mechanisms and practices should not suggest the means for assessing or measuring the feasibility of process replication/rationalisation. Feasibility analysis, e.g. operational, cultural, technical, schedule, economic and legal feasibility (Whitten & Bentley, 2007)) that may be associated with process rationalisation solutions are therefore excluded.	Although a feasibility analysis may direct the required level of process standardisation, this set of mechanisms and practices will merely propose a way of identifying replication opportunities, based on similarities between units. The means for selecting processes that will benefit most from standardisation and the prioritisation of end-to-end processes for standardisation may require a number of mechanisms and practices.

The requirements identified in this section led to another circumscription process, with the awareness that an appropriate *process representation language* was required to address two (Table 15, R5 and R6) of the seven requirement categories stipulated in this chapter. The next chapter, Chapter 8 proceeds with a discussion of the problem pertaining to the selection of an appropriate *process representation language*.

7.5 CONCLUSION

In this chapter, the BIAM was used to provide a business-IT alignment perspective on the *foundation for execution* approach of Ross et al. (2006). From this perspective, the main contribution of Ross et al. (2006) is to define on a contextual level the data that could be shared and the processes that could be replicated across different business units. Within this context, current OM deficiencies were highlighted. The chapter provided a rationale for focusing on process reuse, rather than data sharing, and defined a set of seven requirement categories for the systematic identification of opportunities for enterprise-wide process standardisation and replication. Seven process reuse requirement categories were:

1. User(s) of the practices and related mechanisms
2. Generality
3. Process categories included
4. Current architecture capabilities
5. Process representation
6. Replication constraints
7. Feasibility analyses

While determining process reuse requirements, circumscription led to another *problem awareness* that an appropriate *process representation language* was required to address two (Table 15, R5 and R6) of the seven requirement categories stipulated in this chapter. Chapter 8 delineates the problem pertaining to the selection of an appropriate *process representation language*.

8.1 INTRODUCTION AND PROBLEM DEFINITION

One of the main goals of this thesis is to enhance the operating model (OM), due to its inherent deficiencies, which were illuminated in Chapter 6. In the previous chapter (Chapter 7), seven requirement categories were identified for augmenting the OM concept, addressing the OM deficiencies pertaining to the identification of *process reuse* opportunities. This chapter [4]proceeds with the second *development* sub-cycle (Figure 68, *Sub-cycle 2*) to develop a part of PRIF (Figure 68, *The interaction model* component), in addressing the second research question, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

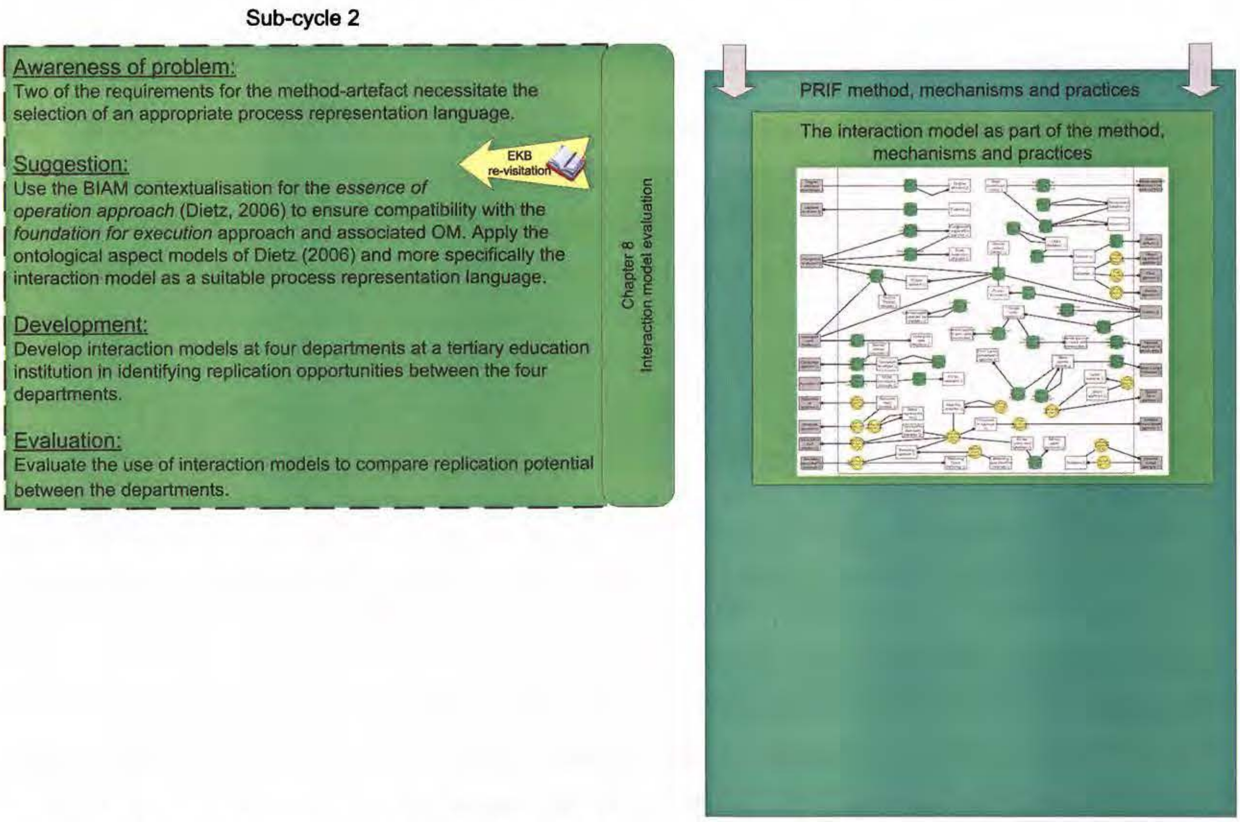


Figure 68: Design cycle context for Chapter 8 (duplicating part of Figure 15)

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[4] The content of Chapter 8 is based on: De Vries, M., Van der Merwe, A., Gerber, A., & Kotzé, P. (2011). Using the interaction model to identify replication potential between business units. In C. S. L. Schutte & L. Pretorius (Eds.), *Proc. 1st International Conference on Industrial Engineering, Systems Engineering and Engineering Management for Sustainable Global Development (ISEM)* (pp. 134_131 - 134_114). Stellenbosch: ISEM.

The first development sub-cycle of the PRIF (covered in the previous chapter), i.e. developing requirements for the PRIF *method, mechanism and practices*, led to circumscription and the awareness of another problem. The problem is that two of the requirement categories (Table 15 in section 7.4, R5 and R6), namely *process representation* and *replication identification*, necessitate the selection of a suitable *process representation language*. The requirement detail of the *process representation* requirement category indicates that consistent process representation should ensure re-use, in addition to allowing process measurement, end-to-end views of processes, modular process design, and ease of use/understanding for business users. The requirement detail of the *replication identification* requirement category pertains to the ease of identifying operational similar organising entities.

Since current *process representation languages* already address some of the last-mentioned requirements, the selection of a *suitable process representation language* that complied with both requirement categories was necessary. Re-visitation of literature revealed that the ontological aspect models, used within the *essence of operation* approach, looked promising in addressing the two requirement categories. The *essence of operation* approach (as discussed in section 3.3.6) has the objective to define the "essence of construction and operation" of an enterprise (Dietz, 2006, p. 8).

To ensure compatibility with the *foundation for execution* approach and its associated OM, a *suggestion* was made to contextualise the *essence of operation* approach and more specifically one of its ontological aspect models (the interaction model) within a business-IT alignment context. Using a common model for business-IT contextualisation, BIAM (as developed in 4.3.2), would enable one to compare the two alignment approaches (*foundation for execution* approach and *essence of operation* approach) and their supporting models.

In summary, the *problem* (Figure 68, *Awareness of problem*) is that two of the requirement categories (Table 15 in section 7.4, R5 and R6) necessitate the selection of a suitable *process representation* language. Based on a literature review, the ontological aspect models of the *essence of operation approach* could be suitable, but required additional contextualisation and evaluation. Thus, a *suggestion* (Figure 68, *Suggestion*) was made to apply a BIAM-contextualisation to the *essence of operation* approach to ensure compatibility with the *foundation for execution* approach and associated OM. A further *suggestion* was to use/evaluate the ontological aspect models of Dietz (2006) and more specifically the interaction model to confirm adherence to the two requirement categories.

This chapter addresses the *suggestion* (Figure 68, *Suggestion*) by providing a business-IT alignment contextualisation of the *essence of operation* approach, using the BIAM, in section 8.2. In addition, two BIAM-contextualised approaches and associated artefacts are compared in section 8.3 to highlight similarities and differences: the *foundation for execution* approach and operating model (OM), versus the *essence of operation* approach and the interaction model (IAM). The approach comparison is followed by a motivation to select the ontological aspect models and more specifically the interaction model as a *suitable process representation* *language*. Section 8.4 provides an *evaluation* method to evaluate the use of the interaction model as an appropriate *process representation language* for the required PRIF *method, mechanisms and practices*. The *developed* interaction models and *evaluation* results (Figure 68, *Development* and *Evaluation*) follow in section 8.5. The chapter concludes in section 8.6.

8.2 A BIAM CONTEXTUALISATION OF THE ESSENCE OF OPERATION APPROACH

Section 3.3.6 introduced the *essence of operation* approach and its association with five ontological aspect models (section 3.3.6.3). The purpose of the ontological aspect models was to define the essence of enterprise operation. One of the five ontological aspect models, the interaction model (IAM), could possibly be incorporated as part of the PRIF *method, mechanisms and practices*. However, prior to suggesting the use of the IAM as part of the PRIF *method, mechanisms and practices*, this section applies the BIAM components delineated in section 4.3 to provide a business-IT alignment contextualisation of the *essence of operation* approach introduced in section 3.3.6. The BIAM-contextualisation not only provides a business-IT alignment understanding of the *essence of operation* approach, but also allows comparison with the *foundation for execution* approach, that was already BIAM-contextualised in section 7.2. The following sub-sections correlate with the four main contextualisation components of the BIAM, namely (1) the paradigm of creating value; (2) the dimensions for alignment; (3) alignment mechanisms and practices; and (4) alignment approach classifiers.

8.2.1 Paradigm of creating value

The paradigm of value creation is that alignment of ICT systems with the enterprise system requires a *design process*, which requires constructional knowledge of the using system (i.e. the enterprise system) to derive functions for the object system (i.e. the ICT system). The approach reduces complexity of the constructional knowledge of the enterprise, by providing an implementation-independent view of enterprise construction, called enterprise ontology, and represented by ontological aspect models (OAMs) (Dietz, 2006).

Similar to Zachman, Dietz (2006) also emphasizes the value of *enterprise ontology*. Zachman includes both ontological and realisation models as part of his ontological framework, whilst Dietz explicitly distinguishes between ontological and realisation models. In addition, Dietz applies the language/action perspective (LAP) to represent enterprise ontology, where social beings achieve changes in the object world by means of communication. LAP offers a solution for the mismatch between social perspectives and technical perspectives (Dumay et al., 2005).

BIAM does not require a complete paradigmatic analysis, but the interested reader is referred to the paradigmatic analysis of the *essence of operation* approach performed by Dumay et al.(2005, pp. 86-89).

8.2.2 The dimensions for alignment

According to Figure 69, the *essence of operation* approach does *not* provide a methodology for designing and constructing the entire enterprise as the object system, but rather provides ontological models of the enterprise as the using system to design the ICT system as the object system. Dietz (2006, p. 77) explicitly mentions that his way of producing the ontology of an enterprise *does not* cover the ontological representation of the enterprise as the *object system*. Figure 69 (*Focus of the essence of operation approach)* clearly indicates the alignment focus of the *essence of operation* approach.

Hoogervorst (2009) incorporates the work of Dietz into a methodology to design the enterprise as the *object system*. In support of the primary function of the enterprise (i.e. delivering products/services to customers/markets) a number of constructional aspects are required in support of the primary function. In addition to the constructional aspects presented by Dietz (2006), enterprise construction also incorporates aspects such as norms, values, performance measurement, decision-structures, employee competencies, conflict resolution means and production means (material, equipment and methods). Many of the constructional elements are produced by default due to a dominant culture in the enterprise, and are *not produced by design* (Gharajedaghi, 2006). Figure 69 (*Focus of the Hoogervorst approach)* clearly indicates the alignment focus of the Hoogervorst approach.

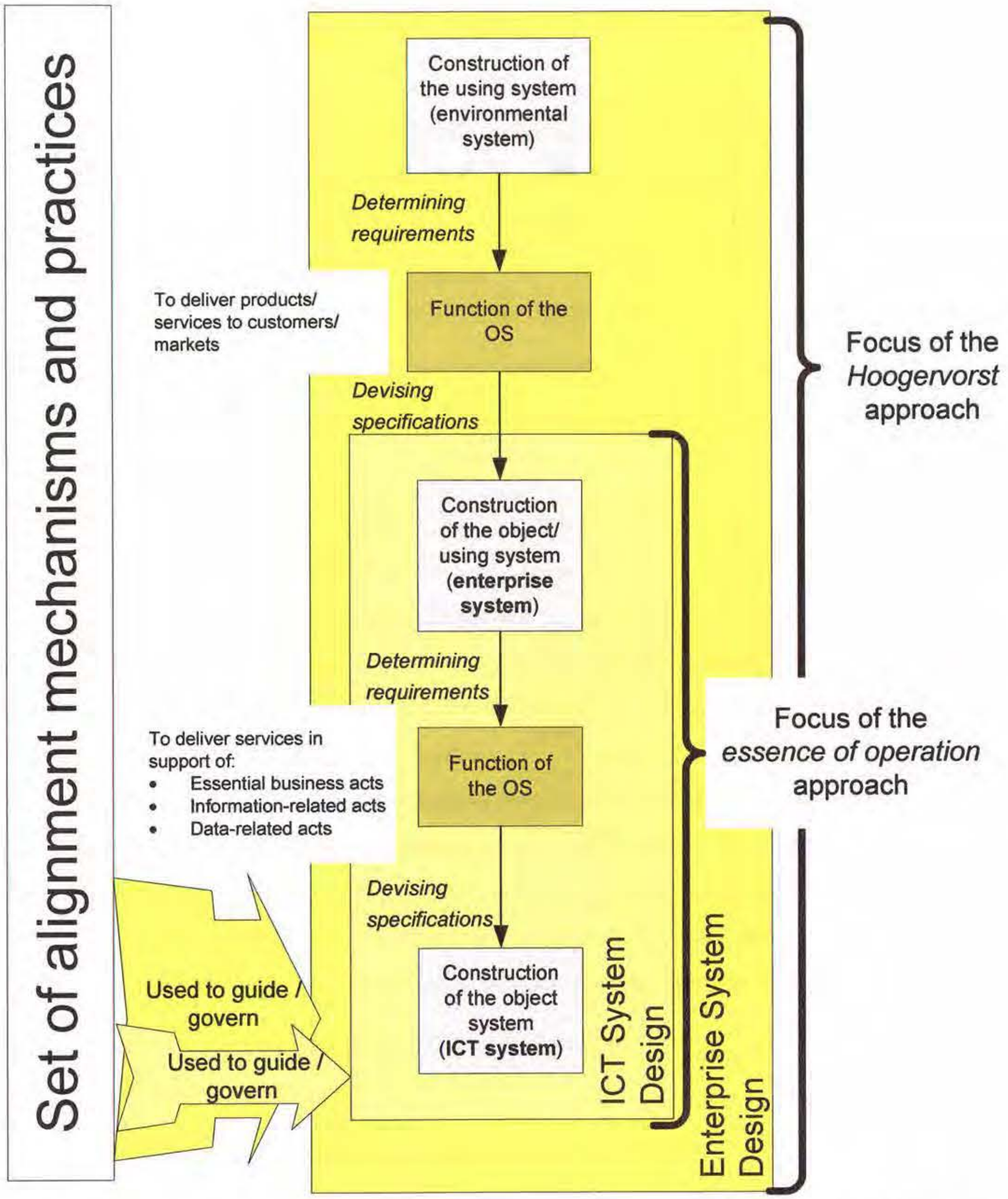


Figure 69: The essence of operations approach focusing on ICT system design

In terms of the first BIAM dimension, the *design domain* dimension, Hoogervorst (2009, p. 134) maintains that the demarcation of *design domains* should reveal "functional or constructional *system facets* for which *design activities* are required". Dietz (2006) takes a *layered systems* approach (as used by Bunge (1979)) to define *design domains*. According to Figure 70, the heterogeneous enterprise system consists of at least two sub-systems, the organisation system and an ICT system. The *organisation system* consists of the layered integration of *three aspect systems*, (1) the ontological aspect system (the **B**usiness-organisation), (2) the infological aspect system (the **I**ntellect-organisation), and (3) the datalogical aspect system (the **D**ocument-organisation). The three aspect systems are all of the same kind (social systems), but differ in their *kind of production*, such that the combination of the three homogenous aspect systems is a heterogeneous organisation system. In relating to the *kind of production*, the ontological aspect system produces ontological acts, such as decisions and judgements; the infological as aspect system produces infological acts, such as reproducing, deducing, reasoning and computing;

and the datalogical aspect system produces datalogical acts, such as storing, transmitting, copying and destroying.

In terms of the second BIAM dimension, the *concerns* dimension, Dietz does not emphasise the *specific* functional and non-functional *concerns* that should be considered while designing the various aspect systems. However, he uses the aspect systems to distinguish between business concerns (for the ontological aspect system), intellect concerns (for the infological aspect system) and document concerns (for the datalogical aspect system).

In terms of the third BIAM dimension, the *enterprise scope* dimension, the ontological aspect models are primarily used to design and align across the internal enterprise scope (Dietz, 2006, p. 215)

Dietz (2006) focuses on the ontological aspect system, which provides a view on the *essence of enterprise operation and construction.* Integration of the ontological aspect system with the two other aspect systems, is called the *realisation of the organisation* (see Figure 70, realisation arrow). Organisation realisation takes place due to the abilities of the *human being.* The human being could take on different roles (B-actor, I-actor or D-actor) to *realise* an ontological act, such as making a decision (e.g. *admitting* a student for enrolment at a college). The *implementation* of the organisation system (see Figure 70, implementation arrows) makes the organisation's realisation *operational* by means of technology (using software applications/services used in service-oriented architecture, and hardware). Although the *essence of operation* approach does not provide a complete methodology for aligning business with IT, the intent is to align business with IT, as indicated by the yellow-shaded part of Figure 70.

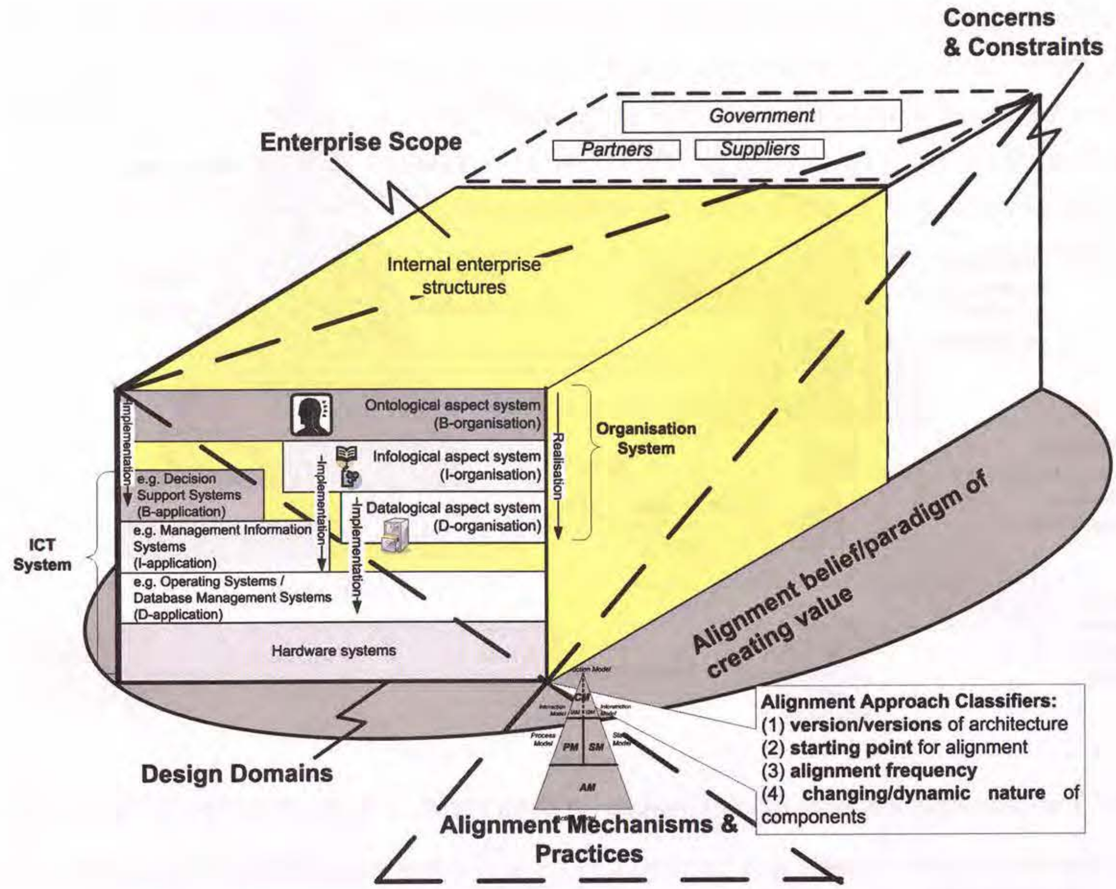


Figure 70: The BIAM contextualisation of the *essence of operation* approach

8.2.3 Alignment mechanisms and practices

This section highlights the categories of *alignment mechanisms and practices* that apply to the *essence of operation* approach.

1. Architecture description and reference models

Dietz (2006) provides a set of ontological aspect models to convey the ontological knowledge of enterprise construction. Figure 71 illustrates the three aspect systems and the set of OAMs to represent the ontological knowledge of an enterprise.

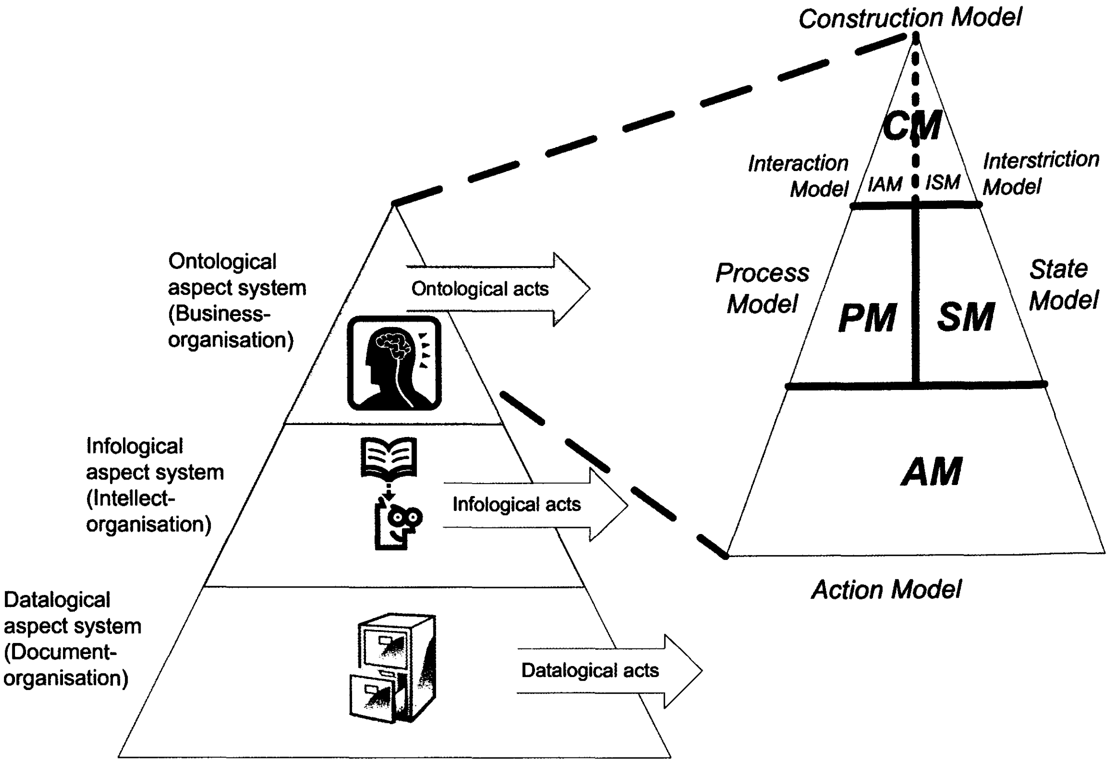


Figure 71: The ontological aspect models, based on Dietz (2006, p. 140) (duplicate of Figure 37)

Each of the four aspect models are represented by a number of graphical representations or diagrams (see Figure 72) based on a unique notation language. In addition, a number of cross-model tables ensure model-completeness.

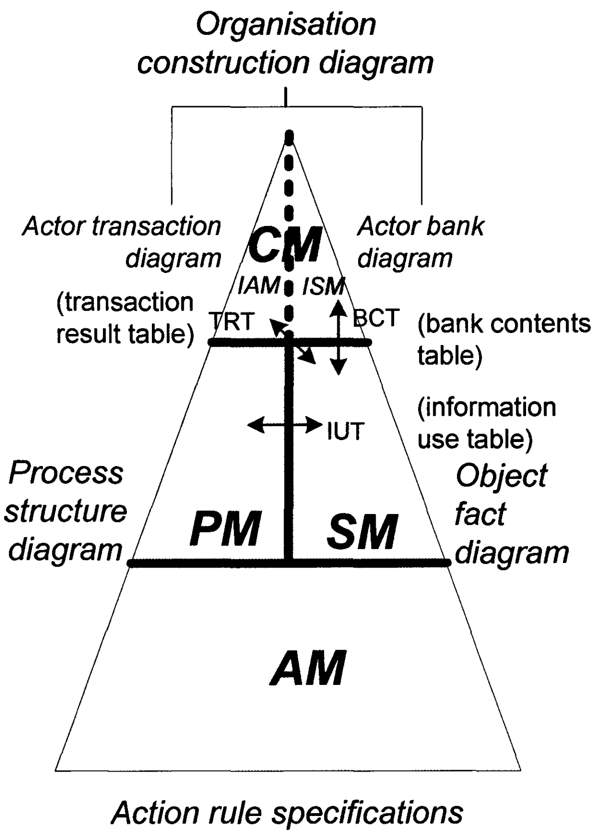


Figure 72: The OAM diagrams and tables, based on Dietz (2006, p. 141)

The first OAM, *interaction model* (see Figure 73, *IAM*), is the most compact ontological model of an enterprise that incorporates units of logic (transaction types) that are consistent in the detail embodied in the underlying transaction patterns. The interaction model is expressed in an *actor transaction diagram* and a *transaction result table*. The actor transaction diagram demonstrates interactions between actors during the execution of transactions. Figure 73 provides an example of an actor transaction diagram (modelled with the ABACUS toolset) of a hypothetical college that performs eight ontological transactions.

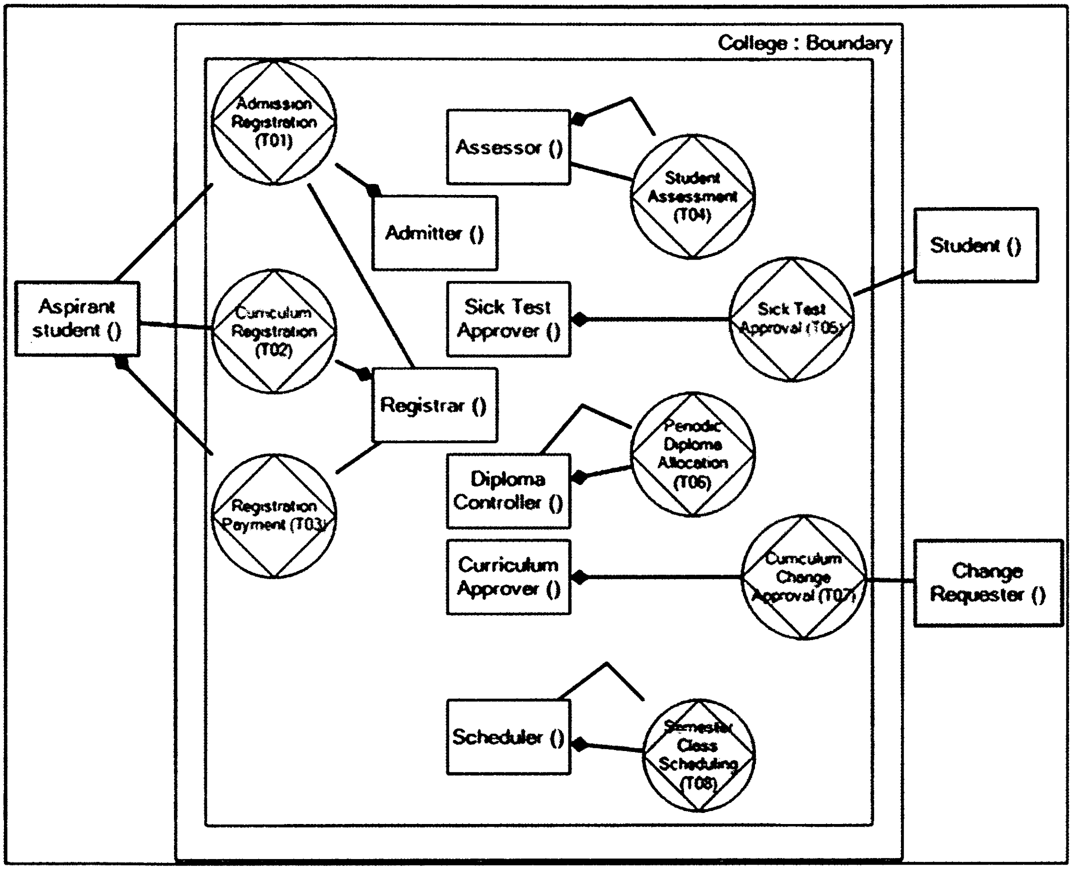


Figure 73: Actor transaction diagram for a hypothetical college (constructed using the ABACUS toolset)

The actor transaction diagram of Figure 73 consists of actors, transaction types, initiator links and executor links. The *actors* are indicated by rectangles (white rectangles represent elementary actors, whereas shaded rectangles represent composite actors). The *transaction types* are indicated by the disc-diamond combination. Each transaction type may be initiated by one or more actors - the *initiator link* is indicated by a solid line. Each transaction type is executed by only one actor - the *executor link* is indicated by a solid line with a diamond end that links to the executing actor. The transaction result table is merely an extension of the actor transaction diagram where the expected result of each transaction type is described. As an example, the result of the transaction type T01 (*Admission Registration*) in Figure 73 could be described as: *Admission A has been done.*

Each transaction type is a concise representation of a transaction pattern that consists of a number of coordination acts and facts that come into existence when actors start coordinating around the production of a production act and fact. When actors are consenting to each other's acts, a basic transaction pattern is followed (see Figure 74). Actors may also dissent to each other's acts and/or they may try to roll back part of the transaction acts/facts. When these deviations from the basic transaction pattern are incorporated, a complete/universal pattern exists that allows for the complete description of any transaction type (Dietz, 2006).

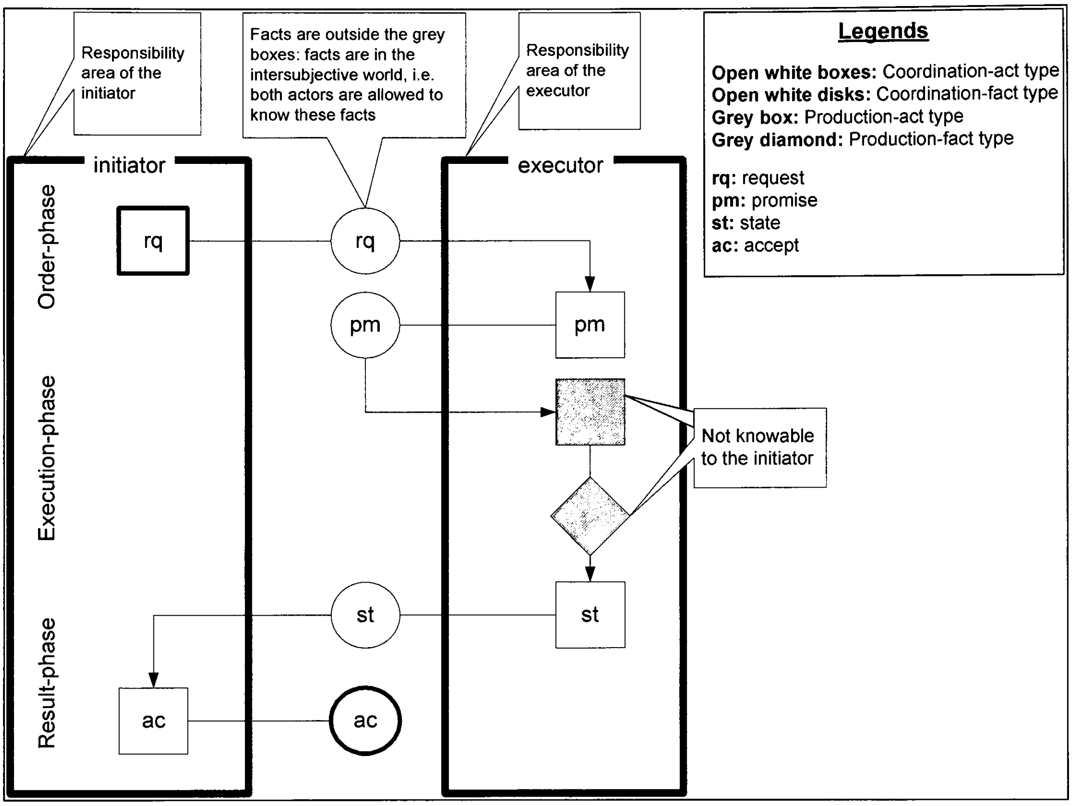


Figure 74: The basic transaction pattern, based on Dietz (2006)

The remaining three ontological aspect models (process model, action model and state model) and their respective diagrams extend the ontological knowledge of the interaction model. The *process model* details the *sequence* of coordination acts and production acts. The *action model* provides action rules to guide the behaviour of the actor in executing coordination acts and production acts. The state model specifies the object classes, fact types, result types and existential laws that hold.

According to Zachman terminology, ontological models need to be primitive models, i.e. a primitive model addresses the intersection of one column with one row on the Zachman Framework (see Figure 24). The ontological models of Dietz are however composite models. As an example, the interaction model contains actors (*who* / responsibility assignment column on the Zachman Framework), as well as transactions (*how* / process flows column on the Zachman Framework). As mentioned in section 5.2.3, composites are required for sense making. Figure 75 provides an indication of the columns and rows addressed by the interaction model. All ontological aspect models, including the interaction model, omits the motivations/mission of the enterprise (i.e. *why* / motivation intentions column on the Zachman Framework), as the ontological aspect models are only concerned about the means for realising the mission (Dumay et al., 2005).

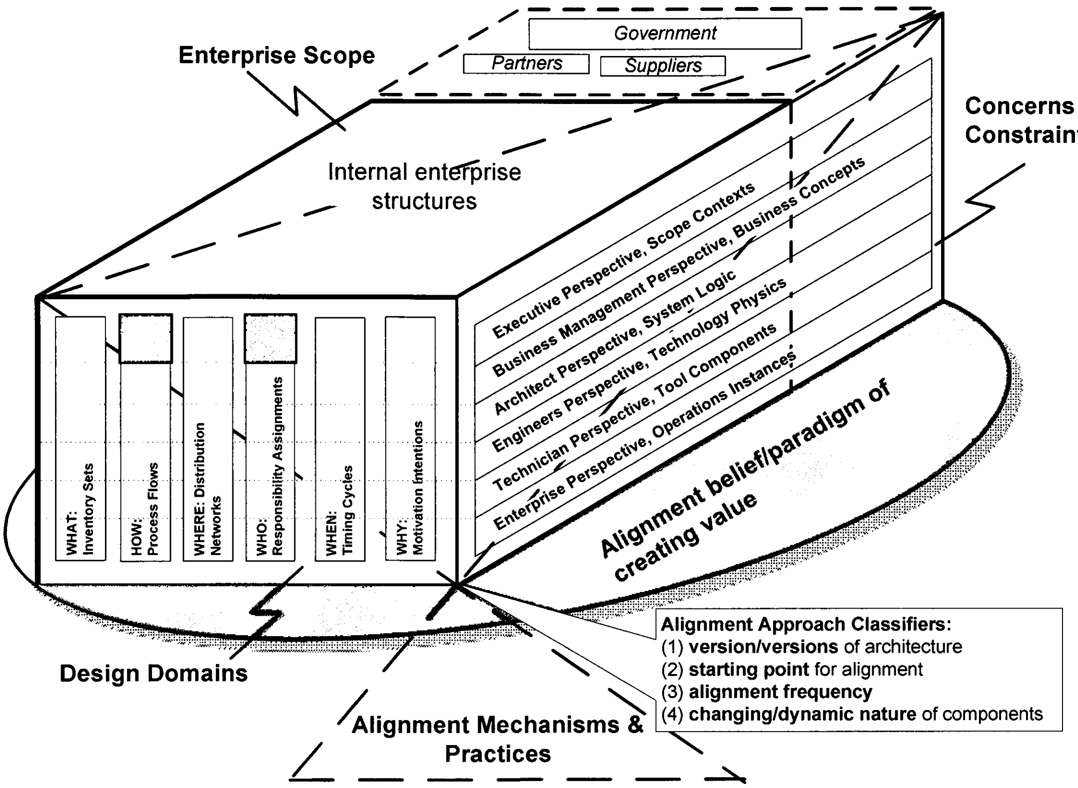


Figure 75: Alignment intent of the interaction model in terms of the Zachman Framework

2. Methodologies

Dietz provides a *method* (see section 3.3.5) for creating the OAMs of Figure 71, called DEMO (Design and Engineering Methodology for Organisations).

8.2.4 Alignment approach classifiers

The *essence of operation* approach primarily applies to the *future state* of the enterprise, i.e. conceiving the essence of the organisation system that is going to realise a new business (Dietz, 2006, p. 215).

A *top-down* approach is followed in terms of architecture development, i.e. starting at the enterprise as the using system and deriving requirements for the ICT system as the object system.

The *essence of operation* approach does not favour of a big bang approach, but rather *continuous*, systematic design according to the basic *system design process*.

The *essence of operation* approach aims at reducing architectural complexity by extracting the ontological construction of the enterprise (independent of realisation or implementation), "hence reducing the difficulty in understanding enterprises" (Hoogervorst, 2009). However, the mechanisms and practices do not explicitly address the problems associated with the *changing/dynamic nature* of architecture components.

To conclude, a BIAM-contextualisation of the *essence of operation* approach contextualised the *essence of operation* approach in terms of the four main components of the BIAM (Figure 45 in section 4.3.2, Components 1 to 4). The next section uses the BIAM-contextualisation to compare two alignment approaches, the *essence of operation* approach with the *foundation for execution* approach and propose the use of the interaction model (as part of the *essence of operation* approach) to address some of the deficiencies inherent in the operating model (as part of the *foundation for execution* approach).

8.3 COMPATIBILITY OF TWO ALIGNMENT APPROACHES

The purpose of this section is to compare two alignment approaches, based on their BIAM-contextualisation to motivate compatibility. According to Mingers & Brocklesby (1997) a variety of possibilities exist in combining approaches. According to their classification schema, this study applies approach enhancement, i.e. enhancing an approach (the *foundation for execution* approach) with elements from another (the *essence of operation* approach). Although Mingers & Brocklesby (1997) warn against various problems in combining approaches with different philosophical paradigms, this study does not suggest the parallel/combined implementation of two approaches, but rather an enhancement of a current approach, staying within the single paradigm of the *foundation for execution* approach.

This section further confirms the compatibility of the two approaches by providing a comparison between the approaches in section 8.3.1 provides a comparison of the two alignment approaches. Based on approach compatibility, section 8.3.2 motivates the selection of ontological aspect models as an appropriate process representation language in addressing two of seven requirement categories defined earlier in Chapter 7.

8.3.1 Comparison of two alignment approaches

As illustrated earlier in Figure 62 and Figure 69 both the *foundation for execution approach* and *essence of operation approach* focus on the design of ICT systems within the context of the enterprise as the using system. Similar alignment intent thus provides a starting point for comparison. Table 16 compares the two approaches in terms of the four main BIAM components to highlight differences/similarities.

Table 16: Comparison between two alignment approaches

Foundation for execution approach	***Essence of operation approach***	**Similarities / Differences**
Paradigm of creating value		
Value is created when enterprises *digitise their operational processes.* Before digitising their processes, managers need to have a vision (future view) of how the company	The paradigm of value creation is that alignment of ICT systems with the enterprise system requires a *design process*, which requires constructional	<u>**SIMILAR**</u> Both approaches states the requirement to decide on / understand the *operation* of the enterprise.

Foundation for execution approach	*Essence of operation approach*	**Similarities / Differences**
should operate, as articulated in an OM. The OM is used as a guide in the systematic development of the *foundation for execution.*	knowledge of the using system (i.e. the enterprise system) to derive functions for the object system (i.e. the ICT system). The approach reduces complexity of the constructional knowledge of the enterprise, by providing an implementation-independent view of *enterprise operation and construction*, called enterprise ontology, and represented by ontological aspect models (OAMs).	**DIFFERENT** The *foundation for execution* approach requires a *decision* about enterprise operation to guide the development of ICT systems, as articulated in the OM, whereas the *essence of operation* approach provides the *means to understand* the essence of operation and construction.
The dimensions for alignment		
Ross et al. (2006) do not stipulate different *design domains*, *concerns & constraints* or the *enterprise scope* to demarcate the three BIAM dimensions, but they suggest the use of the Zachman Framework. The Zachman framework focuses on two BIAM dimensions, *design domains* and *concerns & constraints*. The *design domains* consist of six interrogatives (what, how, where, who, when, why), whereas *concerns* of six audiences/stakeholders are defined (executives, business management, architects, engineers, technicians, enterprise). The Zachman Framework is used to do architecture work across the third BIAM dimension, *enterprise scope*, across different enterprises.	Dietz (2006) takes a *layered systems* approach to define *design domains.* The heterogeneous enterprise system consists of at least two sub-systems, the *organisation system* and an *ICT system*. The *organisation system* consists of the layered integration of *three aspect systems* In terms of *concerns* the aspect systems distinguish between three different concerns: business, intellect and document. In terms of the BIAM *enterprise scope* dimension, the ontological aspect models are primarily used to design and align across the internal enterprise scope.	**DIFFERENT** Although referring to the Zachman framework, the *foundation for execution* approach is not concerned with the detail of *architecture description.* In contrast, the main contribution of the *essence of operation* approach centres on an *architecture description*, which is based on systems theory. Although both the Zachman approach and *essence of operation* approach intends to create an enterprise ontology, they differ substantially in how they define *design domains.*
Alignment mechanisms and practices		
A key alignment mechanism is the operating model (OM) used to create *guidance* in developing a foundation for execution. The OM purposefully omits strategy as the	The most compact ontological model of an enterprise, is the interaction model (IAM), used to *understand* the essence of operation and construction of an	**DIFFERENT** The OM is primarily *normative* (provides guidance) for creating a foundation for execution, but also *descriptive* (see

***Foundation for execution* approach**	***Essence of operation* approach**	**Similarities / Differences**
driving force for business-IT alignment; however, the OM *becomes the strategy in itself*. Using Zachman's demarcation terminology, the OM emphasises two main *design domains* (data (WHAT: inventory sets) and process (HOW: process flows)), *concerns* of executives, and the objective to share data and replicate processes across different business units within the enterprise boundaries, i.e. *enterprise scope*. Figure 63 (grey-shaded bars) represents the alignment intent of the OM.	enterprise. The IAM does not concern itself with the enterprise mission, but only the means of realising it (Dumay et al., 2005, p. 86). Using Zachman's demarcation terminology for comparison purposes, the IAM contains actors (WHO: responsibility assignments) and transactions (HOW: process flows). Figure 75 (grey-shaded squares) represents the constructional knowledge of the IAM.	descriptive characteristics of the OMs in Figure 64). The IAM is *descriptive* in representing the constructional knowledge of the enterprise. **SIMILAR** The OM and IAM addresses a common descriptive facet: *processes* from a *contextual perspective*.
Alignment approach classifiers		
(1) Version of architecture		
Focus on *future state* architecture, which is also used to define architecture principles.	Focus on *future* state, i.e. conceiving the essence of the organisation system that will realise a new business.	**SIMILAR** Both focus on the *future state* architecture.
(2) Starting point for alignment		
Top-down approach (starting at the executive perspective and emphasizing the executive perspective)	A *top-down* approach is followed in terms of architecture development, i.e. starting at the enterprise as the using system and deriving requirements for the ICT system as the object system.	**SIMILAR** Both follow a *top-down* alignment approach.
(3) Alignment frequency		
Continuous, incremental alignment, building the foundation one project at a time.	Favours a *continuous*, systematic design according to the basic *system design process*.	**SIMILAR** Both favour a *continuous* alignment approach.
(4) Changing/dynamic nature of components		
Aims at reducing architectural complexity by rationalising data and	Aims at reducing architectural complexity by extracting the	

Foundation for execution **approach**	*Essence of operation* **approach**	**Similarities / Differences**
processes according to the OM requirements, thus limiting duplicated efforts in managing the *changing/dynamic nature* of architecture components.	ontological construction of the enterprise (independent of realisation or implementation), "hence reducing the difficulty in understanding enterprises" (Hoogervorst, 2009).	**DIFFERENT** Although both aims at reducing complexity, the *foundation for execution* approach focuses on data and process rationalisation, whereas the *essence of operation* approach reduces the difficulty in understanding enterprises.

Although Table 16 indicates differences between the *foundation for execution* approach and *essence of operation* approach, they could complement one another. The *foundation for execution* approach is primarily normative, focusing on guiding the development of ICT systems, whereas the *essence of operation* approach is primarily descriptive, representing the constructional knowledge of the enterprise. Furthermore, both the OM and IAM addresses a common facet: *processes* from a contextual perspective. The IAM (one of the ontological aspect models represented in Figure 71) may thus also have the potential to address the requirements relating to process representation and replication identification of Table 15 (R5 and R6), which is the topic of the next section.

8.3.2 A proposed process representation language

This section motivates the use of the ontological aspect models, and more specifically the interaction model (IAM), as an appropriate process representation language to address requirements R5 and R6 of Table 15.

In searching for alternative process representation languages, several languages comply with the requirements stated in Table 15 (R5 and R6). Examples include BPMN (Business Process Modelling Notation) (Object Management Group, 2009) and EPCs (Event-driven Process Chains) (Kindler, 2006; Van der Aalst, 1999). However, the OAMs (ontological aspect models) and associated notation standards are favoured. Contrary to other process representation languages, the OAMs represent enterprise operation independent of its realisation and implementation. By abstracting enterprise operation from the material aspects (i.e. excluding forms and files used for communication between participants), the identification of operational similar organising entities (Table 15, R6) is enhanced. In addition, the interaction model incorporates units of logic (transaction types) that are consistent in the detail embodied in the underlying transaction patterns – this characteristic contrasts with other process modelling techniques that are inconsistent in the aggregation of process logic for different levels of detail. The interaction model also encourages the identification of ontological units of competence, authorisation and responsibility, which will also assists the practitioner to compare different business units. Once ontological operational similarities have been established, 'flat' techniques (e.g. flow charts, EPCs, Petri Nets and BPMN diagrams) may be mapped to the ontological models and extended to accommodate variations in implementation at the different organising entities (Dietz, 2006). Configurable process models based on BPMN could for instance be used to accommodate implementation variations between different organising entities (Engelbrecht, 2010; La Rosa & Dumas, 2008).

In verifying the use of ontological aspect models (especially the interaction model) to identify *operational similar organising entities* (Table 15, R6), an experimental evaluation method was suggested and is discussed in the next section. Although the ontological aspect models satisfied the *process representation requirements* (Table 15, R5.1 to 5.3), they had to ensure *ease of understanding* (Table 15, R5.4), especially regarding the use of the interaction model. Table 17 repeats requirement categories R5 and R6 of Table 15 to highlight the need for additional experimentation.

Table 17: Adherence to requirement categories R5 and R6 of Table 15

No	Category	Requirement Detail	Means to address and additional verification required
R5	Process representation	The practices and mechanisms should encourage consistent process representation to ensure re-use. The extent of re-use includes the following: 1. It should be possible to add process measures if required for the purpose of performance measurement and/or process improvement.	Assuming that suitable measures have already been derived, Aveiro, Silva & Tribolet (2011) extend the ontological aspect models to specify measures and associated control limits. The process model (one of the five OAMs) collapses transaction types into process steps. Unfortunately, the ontological nature of the process model hampers performance measurement, i.e. informational and documental levels are aspects that are normally considered during performance measurement (Van Reijswoud & Dietz, 1999). Recent research however extends BPMN models from the ontological aspect models, which would allow for simulation and performance measurement based on the BPMN models (Van Nuffel, Mulder, & Van Kervel, 2009). Process models may also be converted to Petri Net models, which are suitable for process simulation (Dumay et al., 2005, p. 91).
		2. The process representations should support end-to-end views of processes.	The interaction model enhances the end-to-end view of processes via the wholeness of the transaction pattern. Contrary to almost all implementations of enterprises that separate sales from delivery, the interaction model emphasises the indivisible responsibility of taking customer orders, satisfying them and delivering the result (Dietz, 2006, p. 170).
		3. Process representations should not hamper the transition from the third to fourth levels of architecture maturity, i.e. it should allow for modular process design.	Services-oriented architecture (SOA) serves as a vehicle to implement modular process design. The service definition should make enterprise-wide reuse possible. Enterprise process design, based on the identification of transactions (as modelled in the interaction model) must precede the discussion about services. The interaction model is essential for defining the type of services and their

No	Category	Requirement Detail	Means to address and additional verification required
			granularity, their utilisation, performance and support requirements (Hoogervorst, 2009, p. 336).
		4. The representations that are used to communicate process replication opportunities should be understandable to business users (from the contextual and conceptual viewpoints).	**EXPERIMINTATION REQUIRED:** If an interaction model (IAM) is used to communicate process replication opportunities to *business users*, does the IAM enhance *ease of understanding*?
R6	Replication identification	The mechanisms and practices should enable the identification of operational similar organising entities.	**EXPERIMENTATION REQUIRED:** Does the interaction model (IAM) *enable the identification of operational similar organising entities* from a *practitioner's* perspective?

8.4 EVALUATION METHOD

The development and evaluation strategy followed a participative approach. Four research participants (industrial engineers) received extensive training in the use of the interaction model (IAM) and the underlying theory. Each participant was responsible for developing an IAM for a different engineering department at a tertiary education institution. The purpose was to develop an initial IAM for a department (say Department 1) and to verify (establishing the correctness) the contents of the interaction model consecutively at the different departments to identify replication potential.

An initial interaction model was developed by two of the engineers, working in Department 1. The initial interaction model content was based on their own knowledge about the department and analyses of the content available on the shared departmental repository. About twenty seeding transactions were identified during the first verification session. The verification sessions were structured as follows:

1. An introductory presentation was given to the head of department (HOD) on using the interaction model (IAM).
2. One of the participants presented the IAM of Department 1 to the HOD.
3. The HOD suggested changes to the IAM to reflect ontological transactions for his/her own department.
4. Changes (additions/deletions) could also be valid for other departments and were consequently verified separately.
5. The HOD was also requested to provide comments on the usability of the IAM to identify ontological similarity between departments and the *ease of understanding*.
6. Each participant modelled the IAM for their assigned department, using ABACUS (an enterprise architecture software tool).

7. The results (transaction similarity) were analysed using ABACUS.

8.5 INTERACTION MODELS AND EVALUATION RESULTS

The study produced four IAMs for the respective departments; represented by an *actor transaction diagram* and a *transaction result table* (see Figure 72). Each HOD received a copy of their departmental IAM. Figure 76 presents the *actor transaction diagram* of one of the departmental interaction models.

The resulting IAMs demonstrated that the departments provided process replication potential due to their ontological similarity. All departments perform the same forty-five (45) ontological transactions out of a total number of forty-six (46), i.e. only one department does not perform the transaction: “License approval for special materials”. Using ABACUS, a visual comparison (a matrix of transactions versus department) was extracted. Manual inspection of the *actor transaction diagrams* exposed differences regarding the initiators of the transactions (unfortunately ABACUS could not be used to highlight initiation differences, which is a limitation of the tool and not the interaction model).

The results concerning the practical use of the interaction models is now discussed from (1) a practitioner’s viewpoint (section 8.5.1); and (2) from a business user’s viewpoint (section 8.5.2), in addressing the requirement pertaining to *ease of understanding* (Table 15, R5.4).

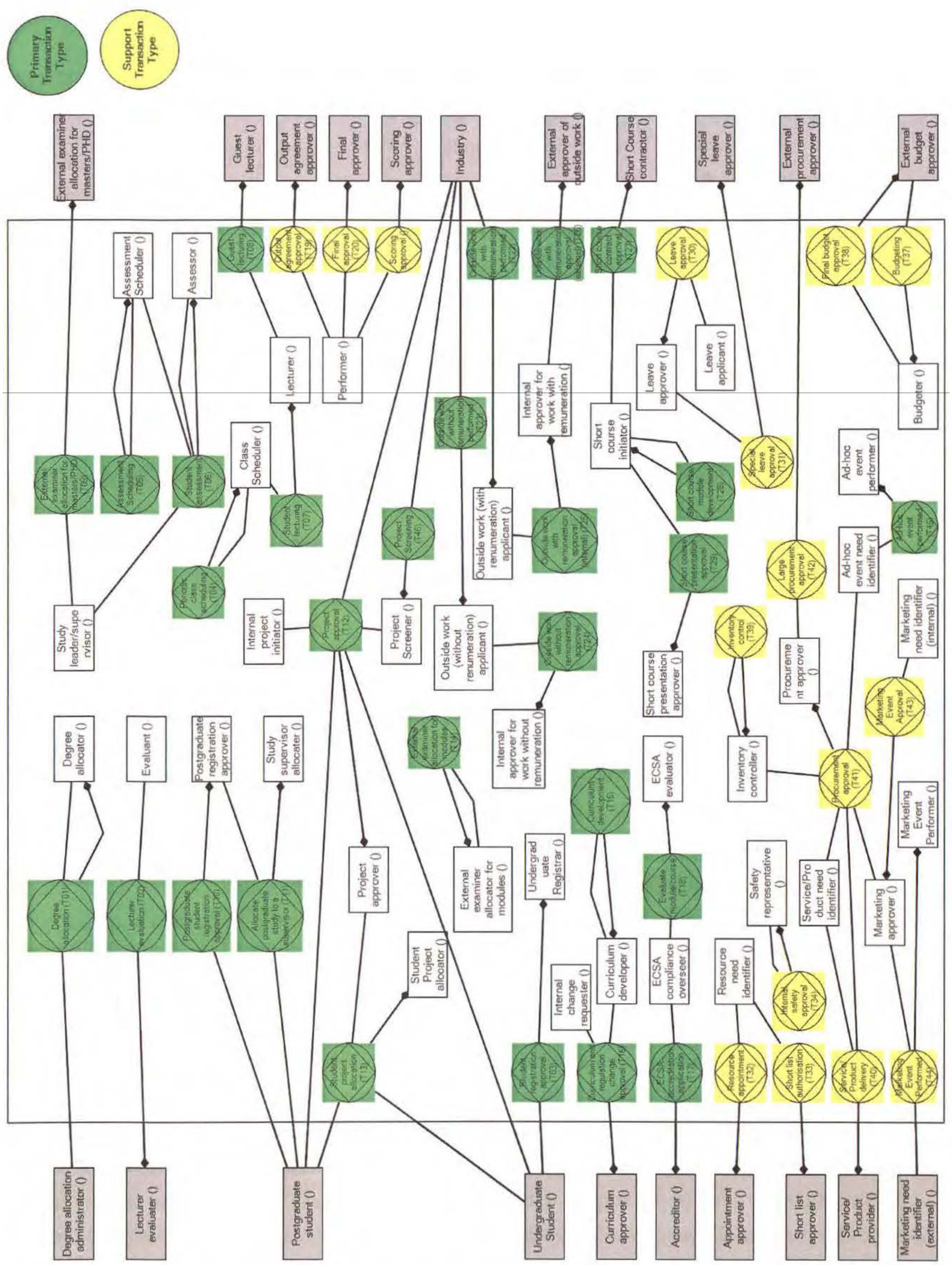


Figure 76: Example of a departmental actor transaction diagram (using the ABACUS software tool)

8.5.1 The practitioner's viewpoint

The feedback provided in this section incorporates the reflections of the four participants as well as the observations of the main researcher during the validation sessions and the discussion sessions that followed. A few deficiencies and/or limitations pertaining to the interaction model have been identified:

1. The participants did not follow a specific order in verifying the content of the actor transaction diagram. This partially contributed to some of the comments made by the HODs that a transaction sequence is required to enhance the use of the actor transaction diagram.
2. Each transaction may only have one executor according to the actor transaction diagram rules specified by Dietz (2006). This posed a problem in the scenario because a transaction (e.g. performance approval) could either be approved by an internal actor (an HOD) or an external actor (the dean of the faculty). The transaction pattern is exactly the same, but the executor differs. One solution is to duplicate the transaction and to assign different executors to the separate transactions. However, the problem is essentially a result of the definition of a boundary; if no boundary existed, one would simply have one executor.
3. All participants (including the HODs) expressed the need to express knowledge about the status of one transaction type as a prerequisite for executing another transaction type. Dietz (2006) accommodates this need by expressing the required access to transaction information per actor via information links. The interaction model is then converted to an interstriction model (one of five ontological aspect models represented in Figure 71).
4. Participants (including the HODs) expressed the need to show optional and conditional initiation and execution links on the actor transaction diagram. In its current format, all initiation and execution links seem to be mandatory. Dietz (2006) accommodates conditional logic only on the next level of detail embodied in the process model (one of five ontological aspect models represented in Figure 71).

8.5.2 The business user's viewpoint

The comments received from the HODs were positive. The training material used during the verification sessions was sufficient to provide the HODs with an understanding of the purpose, use and constructional elements of the interaction model. Questions from HODs regarding sequence and conditional execution of transaction types however emphasised the need to explain the entire set of ontological aspect models in addressing concerns about the interaction model limitations. Three of the four HODs provided additional comments pertaining to the use of the interaction model:

1. HOD 1 expressed the need to extend the analysis effort by analysing the implementation logic for some of the problematic transaction types as to suggest improvements that could be replicated to all departments.

2. HOD 2 highlighted the importance of distinguishing between core transaction types and supporting transaction types (via colour-coding) and emphasised the need to focus on the core transaction types during improvement analyses. This requirement was accommodated with ease (see Figure 76, using green for primary transaction types and yellow for supporting transaction types).
3. HOD 3 expressed the value of an interaction model (and other ontological aspect models) to her own department and their potential to capture knowledge about the operation of the department. Valuable operational knowledge is lost when HODs are replaced every four years. Explication of operational knowledge will contribute towards continuity and customer service.

Although the positive results pertaining to the experimental evaluation substantiates inclusion of the interaction model as part of the *new method, mechanisms and practices* of the PRIF, further development of the PRIF *method, mechanisms and practices*, led to another circumscription process. During circumscription, the awareness was that a *creative process* was required in developing the PRIF *method, mechanisms and practices*, whilst including the interaction model as part of the PRIF *method, mechanisms and practices.* Chapter 9 proceeds with a discussion of the problem pertaining to the development of the PRIF *method, mechanisms and practices*.

8.6 CONCLUSION

This chapter provided a business-IT alignment contextualisation of the *essence of operation* approach, using the BIAM, to compare the *essence of operation* approach with the *foundation for execution* approach. Subsequently, similarities and differences between the two alignment approaches were highlighted, followed by a motivation on selecting the ontological aspect models, and more specifically the interaction model (IAM), as a suitable process representation language. In verifying the use of ontological aspect models (especially the interaction model) within the context of two requirement categories (*replication identification* and *process representation*), an experimental evaluation method was suggested.

The positive results pertaining to the experimental evaluation, substantiates inclusion of the interaction model as part of the new *method, mechanisms and practices* of the PRIF to augment the OM concept in addressing the *replication identification* requirement (Table 15, R6). In addition, the interaction model promoted *ease of understanding* (Table 15, R5.4) from both practitioner and business user viewpoints. Some of the interaction model limitations identified by the participants were due to a limited understanding of the combined use of the ontological aspect models and the purpose or use of each ontological aspect model. The feedback is useful for future research to refine the method for constructing an interaction model and refining the constructs of the interaction model.

Based on the positive evaluation results of the interaction model, the next chapter proceeds with the third development sub-cycle of the PRIF, developing a PRIF *method, mechanisms and practices*, in accordance with the seven requirement categories that were identified in

Chapter 7. However, the development of the PRIF *method, mechanisms and practices*, led to another circumscription process and the awareness of another *problem*. The added *problem* is that a *creative process* was required in developing the PRIF *method, mechanisms and practices*, also including the interaction model as part of the PRIF *method, mechanisms and practices*. Chapter 9 addresses the *problem* pertaining to the development of the PRIF *method, mechanisms and practices*.

Chapter 9. The PRIF method, mechanisms and practices

9.1 INTRODUCTION AND PROBLEM DEFINITION

One of the main objectives of this thesis is to enhance the operating model (OM), due to its inherent deficiencies, which were illuminated in Chapter 6. In Chapter 7, seven requirement categories were identified for augmenting the OM concept, addressing the OM deficiencies pertaining to the identification of process reuse opportunities. In the previous chapter (Chapter 8), the use of the ontological aspect models was evaluated, and more specifically the interaction model, to address *two of the seven requirement categories* for developing the PRIF *method, mechanisms and practices*. This chapter[5] proceeds with the third development sub-cycle (Figure 77, *Sub-cycle 3*) to develop the second part of the PRIF (Figure 77, PRIF *method, mechanisms and practices*), in addressing the second research question, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

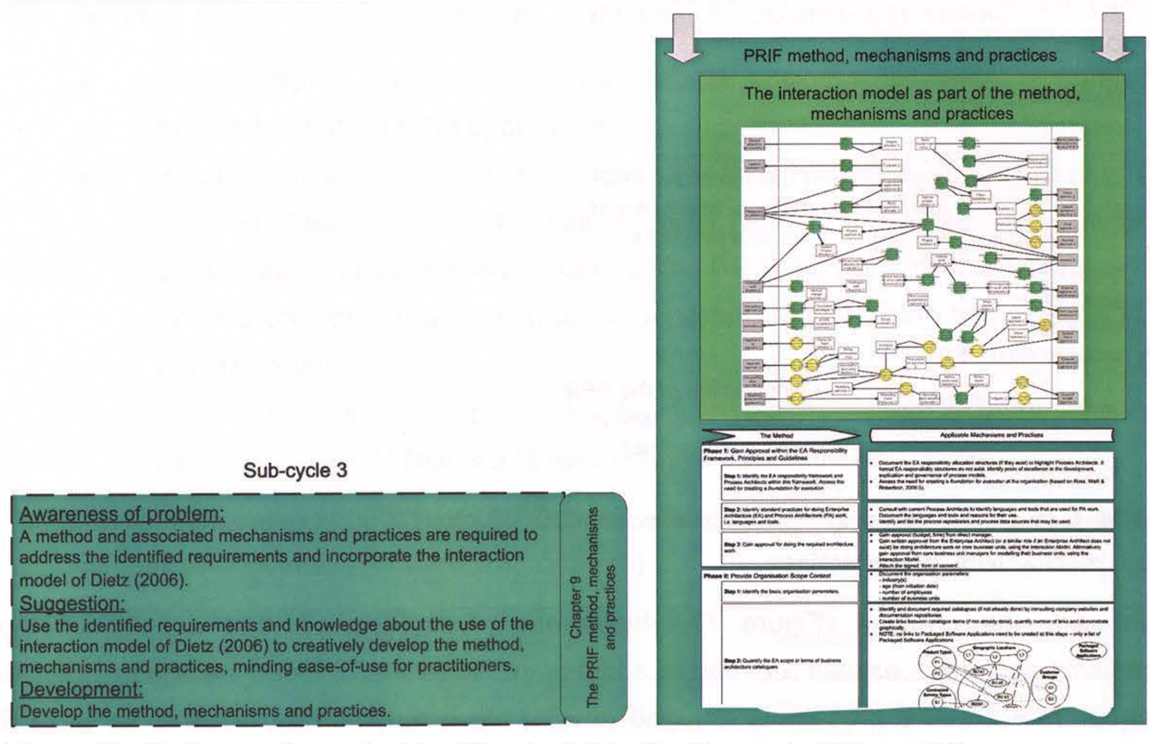


Figure 77: Design cycle context for Chapter 9 (duplicating part of Figure 15)

[5] The content of Chapter 9 is based on: De Vries, M., Van der Merwe, A., Kotzé, P., & Gerber, A. (2011). A method for identifying process reuse opportunities to enhance the operating model. In *IEEE International Conference on Industrial Engineering and Engineering Management (IEEM) 2011* (pp. 1005-1009). Singapore: IEEE.

The second development sub-cycle of the PRIF (discussed in the previous chapter), evaluated the use of interaction models to compare replication potential between departments. The second development sub-cycle led to circumscription and the awareness of another problem, i.e. a *creative process* was required in developing the PRIF *method, mechanisms and practices*, also including the interaction model as part of the PRIF *method, mechanisms and practices*.

With reference to the *basic system design process* (Figure 78), construction of the object system (e.g. construction of the PRIF *method, mechanisms and practices*), requires a process of *devising specifications*, i.e. translating the function of the object system (e.g. the function/requirements of the PRIF *method, mechanisms and practices*) into the construction of the object system (e.g. construction of the PRIF *method, mechanisms and practices*). According to Dietz (2006, p. 73) the process of *devising specifications*, is a creative process, since the constructional designer has to bridge the mental gap between function and construction. According to Hoogervorst (2009) *devising specifications* may also be interpreted as *devising constructional requirements*.

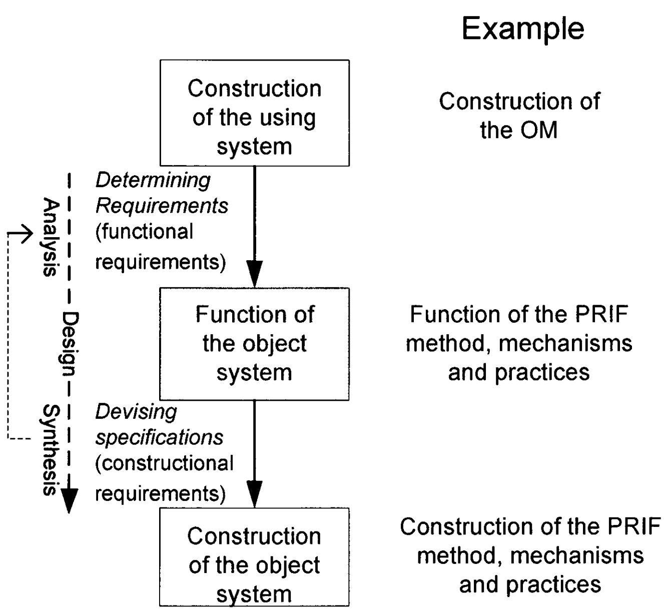


Figure 78: Using the basic system design process (from Dietz (2006)) in constructing a new method, mechanisms and practices

In summary, the *problem* (Figure 77, *Awareness of problem*) is that a PRIF *method, mechanisms and practices* was required to address the seven requirement categories identified in Chapter 7. A *creative process* is required to translate functional requirements for the PRIF *method, mechanisms and practices* into the construction of the PRIF *method, mechanisms and practices,* whilst ensuring *ease-of-use*. In solving the problem, it is *suggested* (Figure 77, *Suggestion*) that a creative development approach is followed for developing the PRIF *method, mechanisms and practices*.

This chapter addresses the *suggestion* (Figure 77, *Suggestion*) by *developing* a PRIF *method, mechanisms and practices* (Figure 77, *Development*). Section 9.2 presents the creative development process for developing the PRIF *method, mechanisms and practices.* Section 9.3 delineates the three phases and phase-steps of the *method.* In addition, applicable *mechanisms and practices* are provided for each phase step. As to guide the practitioner in the correct use of the *method, mechanisms and practices*, mechanisms and practices *motivations, considerations and implications* are also provided. Each phase also triangulates the *mechanisms and practices* against the requirement categories defined in Chapter 7. The chapter concludes in section 9.4.

9.2 THE DEVELOPMENT PROCESS

The initial development of the PRIF *method, mechanisms and practices* (Chapter 8), already motivated the inclusion of the interaction model (associated with the *essence of operation* approach). According to the basic system design process (Figure 78) construction of the full PRIF *method, mechanisms and practices* require a creative development process to address all requirements. Other than the requirement categories stated in Table 15 (and repeated in Table 18 below), three additional *constructional requirements* have been identified, i.e. the PRIF *method, mechanisms and practices* need to:

1. Enhance ease-of-use. The PRIF *method, mechanisms and practices* should enable cognition and thus promote its use.
2. Incorporate the interaction model as a part, as motivated in Chapter 8.
3. Address the *implicit method* defined by the OM characteristics (see section 7.3.1):

    - The enterprise needs to analyse certain business architecture parameters to establish rationalisation opportunities.
    - Rationalisation opportunities could be identified within two main areas: (1) Data (sharing data across enterprise entities), and (2) Process (replicating/re-using processes across enterprise entities). The PRIF *method, mechanisms and practices* focus is on identifying rationalisation opportunities pertaining to the second area, i.e. process reuse.
    - Once rationalisation opportunities have been established an enterprise needs to derive a future OM that would exploit these opportunities.

Table 18: Requirements for addressing deficiencies pertaining to process reuse identification opportunities at enterprises (duplicate of Table 15)

No	Category	Requirement Detail	Motivation
R1	User(s) of the practices and related mechanisms	Any EA practitioner who wants to use the OM specified by Ross *et al.* (2006) and needs to collaborate with other stakeholders in defining the required level of process standardisation/replication.	The practices and mechanisms are created for the purpose of enhancing the OM concept as defined by Ross *et al.* (2006).
R2	Generality	The practices and mechanisms should be generic in their application to	The foundation for execution approach is generic in its application. The generic use

No	Category	Requirement Detail	Motivation
		different types of industries. An EA practitioner should be able to apply the practices and mechanisms to either a profit-driven, not-for-profit/government enterprises within any industry, in combination with the foundation for execution approach.	may be attributed to the fact that the foundation for execution approach aims at cost reduction due to process rationalisation. Cost reduction is an aim for both profit and not-for-profit enterprises. Cost reduction should however not be driven at the expense of needful flexibility.
R3	Process categories included	The practices and mechanisms may be applied to all processes in the enterprise however; practices and mechanisms will be most effective when applied to the primary activities of an enterprise.	The foundation for execution approach is based on the paradigm of creating a foundation for execution, which not only focuses on competitive distinctive capabilities, but also rationalising and digitising everyday processes that a company requires to stay in business (Ross et al., 2006, p. 4). The practices and mechanisms will however be most effective when applied to the primary activities of an enterprise, as support activities automatically provide the opportunity for enterprise-wide standardisation (Smith & Fingar, 2003, p. 63).
R4	Current architecture capabilities	The practices and mechanisms need to take current work in terms of Enterprise Architecture, Business Architecture and Process Architecture into account, but also need to provide sufficient detail if none of these architectures have been defined/documented.	According to Ross *et al.* (2006, p. 26), the first step in building a foundation for execution is to define the OM for the enterprise. No pre-conditions are defined for defining this model. The ability to define this model however is dependent on current architecture capabilities and documented/explicated architectures. Immature architecture capabilities may require additional architecture work, such as defining enterprise-wide process management standards and a centralised process repository (Smith & Fingar, 2003, p. 177).

No	Category	Requirement Detail	Motivation
R5	Process representation	The practices and mechanisms should encourage consistent process representation to ensure re-use. The extent of re-use includes the following: 1. It should be possible to add process measures if required for the purpose of performance measurement and/or process improvement. 2. The process representations should support end-to-end views of processes. 3. Process representations should not hamper the transition from the third to fourth levels of architecture maturity, i.e. it should allow for modular process design. 4. The representations that are used to communicate process replication opportunities should be understandable to business users (from the contextual and conceptual viewpoints).	A consistent representation may enhance communication about how the business operates, enable efficient hand-offs across enterprise boundaries and allow for consistent performance measurement across enterprise entities or similar competitors (Davenport, 2005). In addition, transitioning from a third to fourth level of architecture maturity (as defined by Ross *et al.*, 2006) requires the identification of business services that may be shared among different enterprise entities. Heinrich *et al.* (2009) maintain that the identification of business services requires a consistent representation of the enterprise's processes.
R6	Replication identification	The mechanisms and practices should enable the identification of operational similar organising entities.	Weill and Ross (2008) mention that replication opportunities may be defined across various types of entities (business units, regions, functions and market segments). The OM itself is however primarily used in defining replication and data sharing requirements across business units.
R7	Feasibility analyses	The mechanisms and practices should not suggest the means for assessing or measuring the feasibility of process replication/rationalisation. Feasibility analysis, e.g. operational, cultural, technical, schedule, economic and legal feasibility (Whitten & Bentley, 2007)) that may be associated with process rationalisation solutions are therefore excluded.	Although a feasibility analysis may direct the required level of process standardisation, this set of mechanisms and practices will merely propose a way of identifying replication opportunities, based on similarities between units. The means for selecting processes that will benefit most from standardisation and the prioritisation of end-to-end processes for standardisation may require a number of mechanisms and practices.

9.3 RESULTS – NEW METHOD, MECHANISMS AND PRACTICES

This section conveys the resulting PRIF *method, mechanisms and practices* (see Figure 79, Figure 80 and Figure 81) to address the seven requirement categories discussed in Chapter 7. The sub-sections (sections 9.3.1, 9.3.2 and 9.3.3) delineate three phases and phase-steps of the PRIF *method*. For every phase-step, applicable *mechanisms and practices* are also provided, offering additional guidance with *motivations, considerations and implications*. Each phase also triangulates the *mechanisms and practices* against the requirement categories defined in Chapter 7.

9.3.1 Phase 1: Gain approval

The first phase involves gaining approval within the EA responsibility framework, principles and guidelines and consists of three steps:

Step 1: Figure 79 presents *mechanisms and practices* that address the requirement that the EA practitioner needs to collaborate with other stakeholders in gathering evidence for identifying the process standardisation/replication requirements in defining an OM (Table 18, R1). The *mechanisms and practices* also acknowledge that current architecture work needs to be taken into account (Table 18, R4).

Steps 2 and 3: The *mechanisms and practices* presented in Figure 79 once again ensures that current architecture work is taken into account (Table 18, R4) by identifying current languages and tools that are used by the enterprise to do process architecture (PA) work. In addition, execution of the method requires that architecture work is performed, which will have resource implications and consequently needs management approval.

The Method	Applicable Mechanisms and Practices	Motivations, Considerations and Implications	Req
Phase I: Gain Approval within the EA Responsibility Framework, Principles and Guidelines			
Step 1: Identify the EA responsibility framework and process architects within this framework. Assess the need for creating a *foundation for execution*.	• Document the EA responsibility allocation structures (if they exist) to highlight process architects. If formal EA responsibility structures do not exist, identify pools of excellence in the development, explication and governance of process models. • Assess the need for creating a *foundation for execution* at the organisation (based on Ross, Weill & Robertson, 2006:5).	• The maturity of process architecture and process management will determine the scope of architecture work that may be required. • The method, mechanisms and practices need to address the deficiencies of the OM. The OM will ultimately be used to direct the enterprise towards building a *foundation for execution*. The practitioner thus first needs to assess if a *foundation for execution* has already been established at the enterprise.	**R1** **R4**
Step 2: Identify standard practices for doing enterprise architecture (EA) and process architecture (PA) work, i.e. languages and tools.	• Consult with current process architects to identify languages and tools that are used for PA work. Document the languages and tools and reasons for their use. • Identify and list the process repositories and process data sources that may be used.	• The practitioner needs to communicate/ motivate the use of the interaction model to the enterprise architect / relevant stakeholders and how the model could be used in combination with current enterprise-specific process models to address re-use requirements.	
Step 3: Gain approval for doing the required architecture work.	• Gain approval (budget, time) from direct manager. • Gain written approval from the enterprise architect (or a similar role if an enterprise architect does not exist) for doing architecture work on core business units, using the interaction model. Alternatively gain approval from core business unit managers for modelling their business units, using the interaction model. • Keep a signed 'form of consent'.		

Figure 79: Phase 1 of the *new method, mechanisms and practices*

9.3.2 Phase 2: Provide enterprise scope context

The second phase provides enterprise scope and context and consists of three steps:

Step 1: The identification of certain enterprise parameters (presented in Figure 80) provides an indication of industry-type and size, and conforms to the requirement in category R2 (Table 18, R2) of accommodating different types of enterprises (e.g. manufacturing / services and profit-driven / not-for-profit).

Step 2: The mechanisms and practices demonstrated in Figure 80 still adhere to the requirements in category R2 (Table 18, R2) by accommodating enterprises that produce tangible products (categorised by product types) and/or immaterial products (service types). In addition, a graphical technique is proposed whereby operational similar organising entities are identified, in accordance with requirement category R6 (Table 18, R6). The graphical technique that is proposed in *Step 2* refers to core business units that are responsible for the primary activities of the business in addressing the requirement category R3 (Table 18, R3). The list of packaged software applications that are identified in this step is used later on in the method.

Step 3: The mechanisms and practices demonstrated in Figure 80 extend the analysis effort in the previous step by identifying similarities between core business units, which may have different geographical locations, but are similar in their production of product types / contracted service types. Similar organising entities (core business units) are thus identified according to the requirement category R3 (Table 18, R3) and hypotheses are created about possible business unit types (i.e. several core business units may conform to the operation of a business unit type).

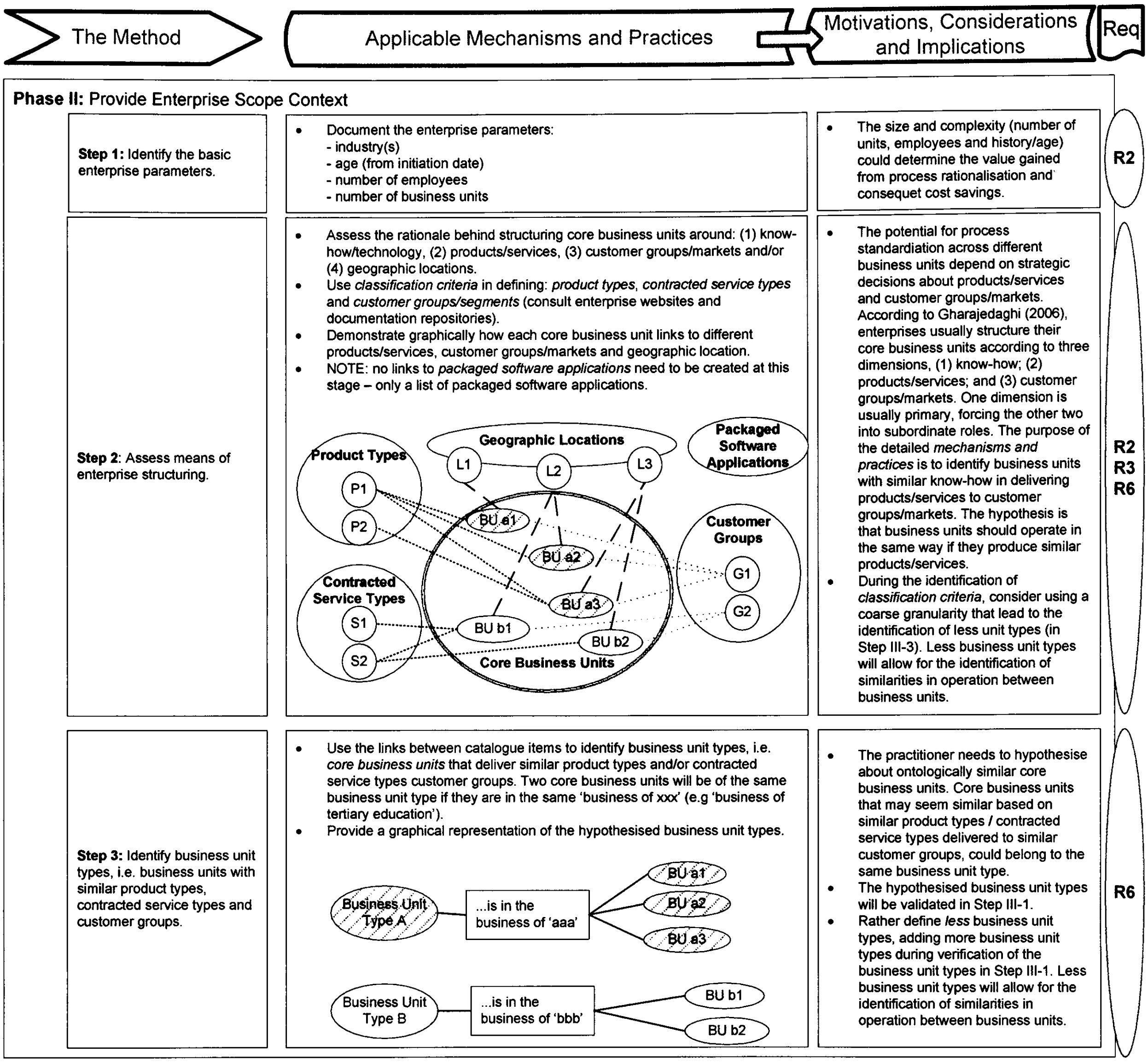


Figure 80: Phase 2 of the *new method, mechanisms and practices*

9.3.3 Phase 3: Identify process standardisation opportunities

The third phase identifies current process standardisation and opportunities for standardisation and consists of three steps:

Step 1: Current architecture work (e.g. process models) are used as information sources, conforming to requirement category R4 (Table 18, R4) to develop interaction models for each business unit type (see mechanisms and practices in Figure 81). Section 8.3.2 motivated the selection of the ontological aspect models, and more specifically the use of the interaction model as an appropriate process representation language to address requirements R5 and R6 (Table 18, R5 and R6). Contrary to other process representation languages, the ontological aspect models represent enterprise operation independent of its realisation and implementation. By abstracting enterprise operation from the material aspects (i.e. excluding forms and files used for communication between participants), the identification of operational similar organising entities (Table 18, R6) is enhanced. In addition, the interaction model incorporates units of logic (transaction types) that are consistent in the detail embodied in the underlying transaction patterns – this characteristic contrasts with other process modelling techniques that are inconsistent in the aggregation of process logic for different levels of detail. The interaction model also encourages the identification of ontological units of competence, authorisation and responsibility, which will also assists the practitioner to compare different business units.

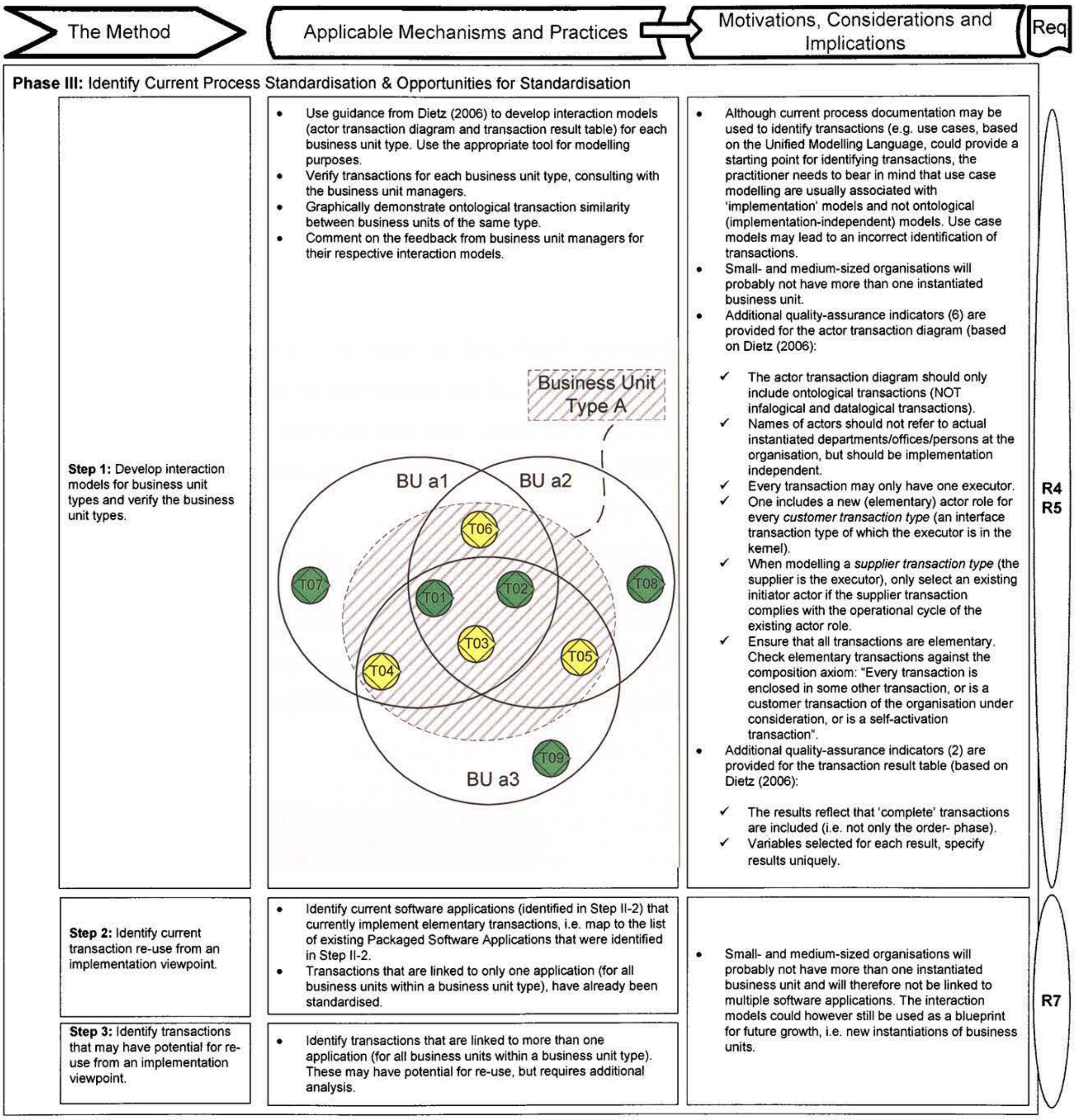


Figure 81: Phase 3 of the *new method, mechanisms and practices*

Steps 2 and 3: The last two steps of the *method* conclude with the identification of transactions that have already been standardised across different business units via the implementation of shared software applications. In addition, ontological transactions that seems to be similar across different business units, but implemented with different software applications, may have the potential for standardisation. The method thus excludes the means for assessing or measuring the feasibility of process replication/rationalisation as stated in the requirement category R7 (Table 18, R7).

9.4 CONCLUSION

This chapter discussed the newly developed PRIF *method, mechanisms and practices* based on the requirements stipulated in Chapter 7. Furthermore, this chapter explicated the three phases and phase-steps of the *method.* In addition, applicable *mechanisms and practices* were designed for each method step, triangulating against the seven requirement categories stipulated in Chapter 7. As to guide the practitioner in the correct use of the *method, mechanisms and practices*, the chapter also included mechanisms and practices *motivations, considerations and implications.*

The chapter concluded with the third and last sub-cycle of the *development* phase of the main design cycle. The PRIF *method, mechanisms and practices* form part of the entire PRIF, which requires final evaluation. The next chapter proceeds with the main design cycle in *evaluating* the entire PRIF.

Chapter 10. Process Reuse Identification Framework evaluation

10.1 INTRODUCTION

One of the main goals of this thesis is to enhance the operating model (OM), due to its inherent deficiencies, which were illuminated in Chapter 6. In Chapter 7, seven requirement categories were identified for augmenting the OM concept, addressing the OM deficiencies pertaining to the identification of process reuse opportunities. In Chapter 8, the use of the ontological aspect models was evaluated, and more specifically the interaction model, to address *two of the seven requirement categories* for developing the PRIF *method, mechanisms and practices.* The previous chapter (Chapter 9) discussed the third and last sub-cycle of the *development* phase of the main design cycle to develop the PRIF *method, mechanisms and practices.* Thus, Chapters 7, 8 and 9 contributed towards the development of the PRIF, in addressing the second research question, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

Based on the newly developed PRIF, this chapter proceeds with an *evaluation* of the entire PRIF, *concluding* with evaluation results (Figure 82, *Evaluation* and *Conclusion*).

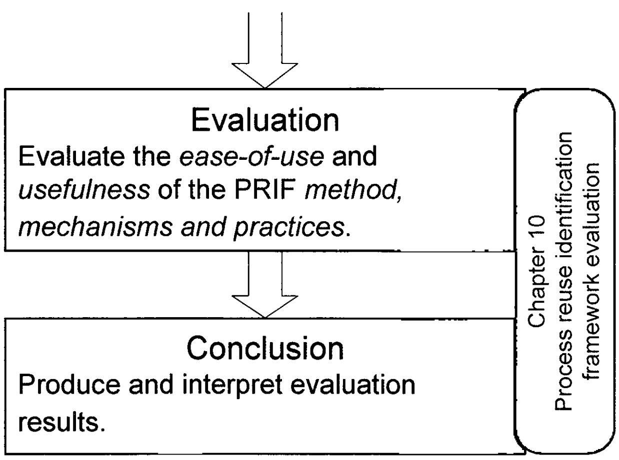


Figure 82: Design cycle context for Chapter 9 (duplicating part of Figure 15)

Since the first part of PRIF merely provides the *requirements* for the PRIF *method, mechanisms and practices* (Figure 83, the purple part), the final evaluation of the PRIF only focuses on the evaluation of the second part of PRIF (Figure 83, the sea-green part), the PRIF *method, mechanisms and practices.*

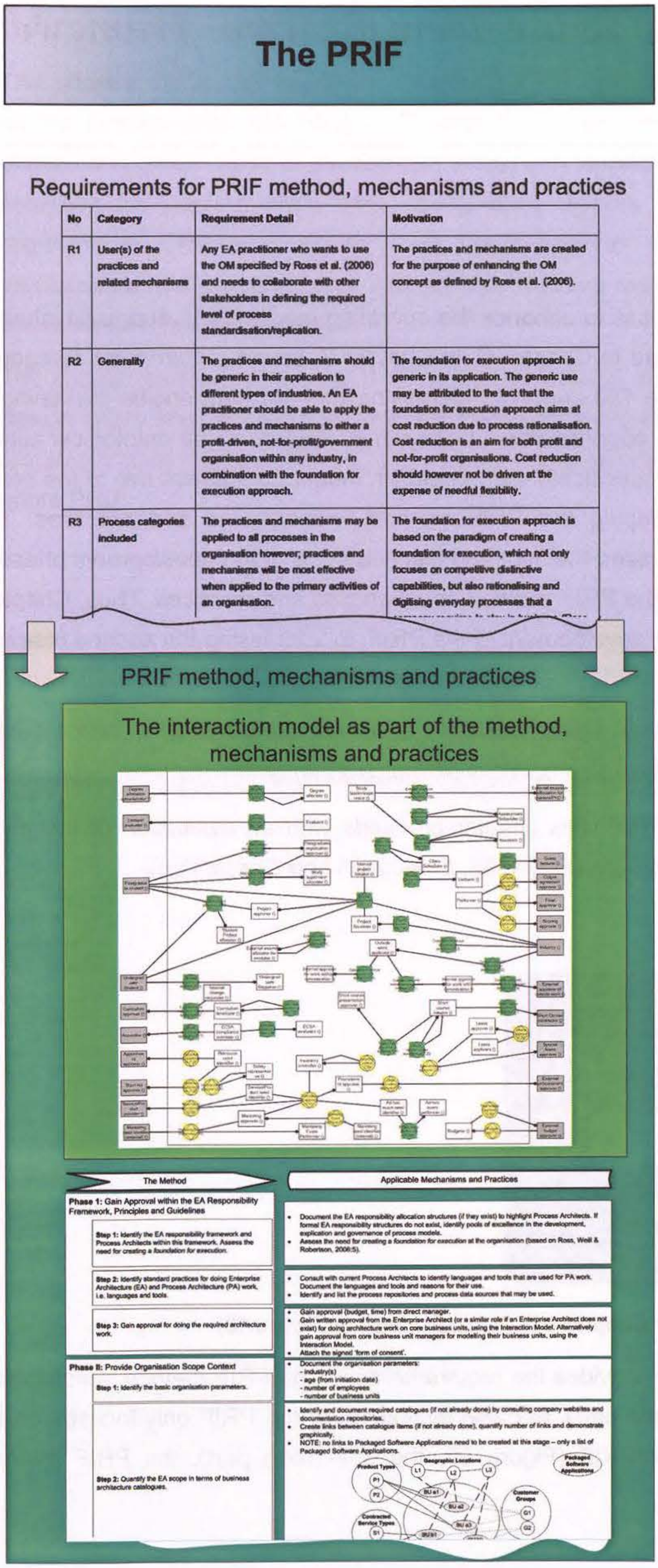


Figure 83: The content of PRIF (duplicating part of Figure 15)

Section 10.2 provides a motivation for an appropriate evaluation method to evaluate the PRIF. Based on the evaluation method, section 10.3 conveys the results, whereas section 10.4 interprets the results. The chapter concludes in section 10.5.

10.2 EVALUATION METHOD

The purpose of the PRIF was to enhance the OM within the context of business-IT alignment, as stipulated in the *suggestion* of the main design cycle. The first part of PRIF merely provides the *requirements* for the PRIF *method, mechanisms and practices* to enhance the OM pertaining to the identification of *process reuse opportunities* at an enterprise. Evaluation of the PRIF thus requires an evaluation of the PRIF *method, mechanisms and practices* that are based on the *requirements*. Two measures, *usefulness* and *ease-of-use,* were used to formulate two questions:

- *Usefulness* answers the question: "Is the PRIF *method, mechanisms and practices* (which include the interaction model) of value to all enterprises in identifying *process re-use opportunities* (i.e. enhancing the OM)?"
- *Ease-of-use* answers the question: "*How easy* is it to use the PRIF *method, mechanisms and practices* (which include the interaction model), to identify process re-use opportunities at an enterprise?"

Similar to the approach followed in section 6.3 (evaluating the practicality of defining an OM), an experimentation process was used, collecting data via a questionnaire) to evaluate the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices.*

This study took the stance that EA practitioners will be primarily responsible (in consultation with the chief executive officer and business managers) to use the PRIF *method, mechanisms and practices* in defining process re-use opportunities at an enterprise. Questionnaires would thus be a suitable instrument to obtain feedback from EA practitioners on the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices.*

10.2.1 The experimentation process

The experimentation process included several phases to ensure that participants were knowledgeable within the theoretical areas of concern:

1. *Training phase:* The study provided training to the research participants to ensure that they were knowledgeable on business-IT alignment, strategic decision-making, the *foundation for execution* approach and associated artefacts as defined by Ross et al. (2006), and the *essence of operation approach* and its associated ontological aspect models of Dietz (2006). Training consisted of live presentations, course notes, and literature references for further reading.
2. *Learning/formative assessment phase:* Participants had the opportunity to work individually to select an enterprise to *apply* phases 1 and 2 of the PRIF *method, mechanisms and practices* (see Figure 79 and Figure 80 in section 9.3, for phase 1 and

phase 2 respectively) in a first task. Participants received a template for their task and were instructed to follow the PRIF *method, mechanisms and practices* (phases 1 and 2) in completing the template. Based on their interpretation of the PRIF *method, mechanisms and practices* in completing the task, they received individual feedback on the correct use of phases 1 and 2. In addition, supplementary literature content was given in subsequent contact sessions to clarify misconceptions. The content of phases 1 and 2 of the PRIF *method, mechanisms and practices* was also updated to clarify misconceptions.

3. *Experimentation phase:* Participants had to re-do certain parts of task 1 to rectify previous misinterpretations about the content of phases 1 and 2 (PRIF *method, mechanisms and practices*). In addition, each participant had to *apply* phase 3 of the PRIF *method, mechanisms and practices* (see Figure 81 in section 9.3, for phase 3) in a second task. Participants once again received a template for their task and were instructed to follow the PRIF *method, mechanisms and practices* (phase 3) in completing the template. Based on their experience of *applying* the complete PRIF *method, mechanisms and practices*, participants had to complete a questionnaire. Although participants had to provide feedback on the entire PRIF *method, mechanisms and practices*, phase 3 (Figure 81 in section 9.3) was scaled down due to time limitations. Rather than developing interaction models for each business unit type, participants had to develop an interaction model for a single business unit type.
4. *Evaluation phase:* Analysis of questionnaire feedback gave new insight into the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices.*

10.2.2 The questionnaire

According to Rea & Parker (2005) quantitative research requires a research hypothesis about the relationship(s) between variables/parameters. This study does not aim to defend a hypothesis about parameters and their relationships. Instead, parameters have been identified to provide sufficient context in evaluating the usefulness and ease-of-use of the PRIF *method, mechanisms and practices.* Similar to the survey that measured the practicality of the OM and core diagram ((see section 6.3), *parameters* that could influence the usefulness and ease-of-use of the PRIF *method, mechanisms and practices* (see Figure 84), had to be identified. Figure 84 indicates that the *participant profile* (*Parameter 1*) and *enterprise profile* (*Parameter 2*) were also used as influencing parameters on the practicality of defining operating models (OMs) and core diagrams (see previous survey in section 6.3). Contrary to the survey in section 6.3, this survey does not use *current architecture status* as the third influencing parameter. Due to the demarcation of requirements to enhance the OM, only pertaining to the identification of *process reuse opportunities* at an enterprise, this study rather used *standard practices for doing process architecture (PA) work (Parameter 3).*

Table 19 provides a summary of the relevant questions that were derived to evaluate the four parameters. Some of the questions, pertaining to the enterprise profile and participant profile, were taken from a previous questionnaire, which measured the practicality of the OM and core diagram (see section 6.3). The original questionnaire consisted of thirty-two questions (both closed-ended and open-ended) embedded in two tasks (see Appendix A, *Task 1* and *Task 2*). Not all questions were used for the purpose of this study.

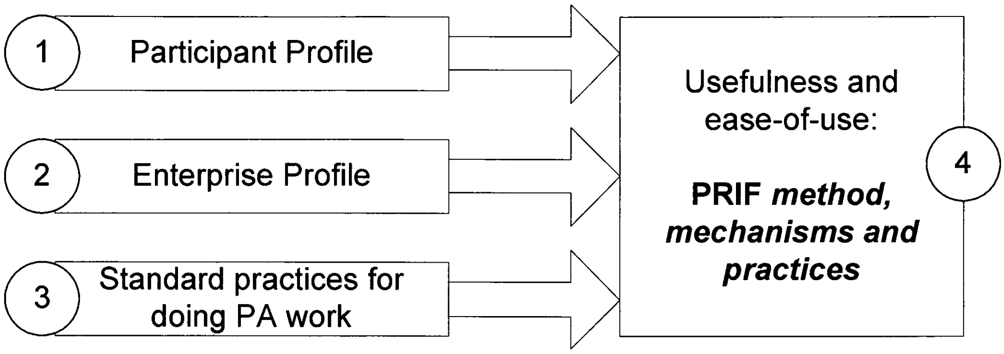


Figure 84: Parameters that influence the usefulness and ease-of-use of the PRIF *method, mechanisms and practices*

Table 19: Questions related to the four parameters

Questionnaire questions related to the four parameters
Parameter 1: Participant profile
1.1. Please specify your tertiary qualification, e.g. BEng (Industrial).
1.2. What is your current position (e.g. Systems Analyst, Full-time student, etc.)?
1.3. Please specify any business or IT modelling-related courses that you attended in the past (e.g. Information Systems Design).
1.4. Did you have any work exposure to Information Systems (e.g. worked in the IT department as a Systems Analyst / worked on a SAP implementation project to implement new procedures, etc.)?
1.5. Did you have any work exposure to Information Systems (e.g. worked in the IT department as a Systems Analyst / worked on a SAP implementation project to implement new procedures, etc.)?
1.6. Did you have any work exposure to Business Process Modelling/Tools (e.g. worked as a Business Process Manager at a plant, modelling their processes in Visio).
Parameter 2: Enterprise profile
2.1. Specify the number of employees of the entire enterprise.
2.2. What is the primary business activity(s) of your enterprise?
Parameter 3: Standard practices for doing process architecture work
3.1. What process modelling languages are used by the enterprise?
3.2. What architecting software tools are used by the enterprise?
Parameter 4: Usefulness and ease-of-use of the PRIF method, mechanisms and practices
4.1. Six rating questions measuring usefulness (see Table 20)
4.2. Six rating questions measuring ease-of-use (see Table 21)

This section delineated the experimentation process to evaluate the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices*. As indicated, the intent of the questionnaire was to provide sufficient context in terms of three parameters (participant profile, enterprise profile and standard practices for doing architecture work), which could have an influence on the fourth parameter (usefulness and ease-of-use of the PRIF *method, mechanisms and practices*). The next section discusses the questionnaire results.

10.3 RESULTS

A convenience sample of *fourteen* participants was initially used. However, two participants were excluded; one participant was absent from both training sessions on the interaction model and underlying theory, whereas the second participant applied a different method than stipulated by the PRIF *method, mechanisms and practices*. A small sample (*twelve* participants) was used if compared to a sample of *thirty* participants in the survey pertaining to the practicality of the OM and core diagram (discussed in section 6.3). Yet, the small sample enabled highly interactive training sessions, consequently participants gained a thorough understanding of the underlying theories covered during the contact sessions. The following sections convey the results of the questionnaire in terms of the four parameters (Figure 84, Parameters 1 to 4).

Since some of the questions of Parameter 1 and Parameter 2 in this survey *were similar* to questions of a previous survey pertaining to the practicality of the OM and core diagram (see section 6.3), percentages are used for comparison purposes.

For the remaining questions, actual numbers are used, which is more informative for a small sample such as this one.

10.3.1 Parameter 1: Participant profile

The *participant profile* parameter provides an indication of the knowledge and experience of the participant. The questionnaire therefore gathered data about the participant in terms of his/her teriary qualification, current working position. The questionnaire also assessed prior knowledge about information systems in terms of work exposure and previous enrolments in IT-architecture modelling related courses. In addition, the questionnaire assessed prior knowledge about business process modelling in terms of work exposure and previous enrolments in business-modelling courses.

The profiles of the *twelve* participants indicated that seventy-five percent (75%) of the participants previously obtained an industrial engineering degree, eight percent (8%) a mechanical engineering degree, eight percent (8%) a technical diploma and eight percent (8%) did not indicate the tertiary qualification (see Figure 85). Thirty-three percent (33%) of the participants were *academics,* whereas the remaining participants represented a spread of positions related to the core *business activities*, i.e. excluding supporting activities, such as finances, HR and infrastructure (see Figure 86).

Questions regarding prior work exposure to information systems (e.g. worked in the IT department as a systems analyst / worked on a SAP implementation project to implement new procedures, etc.) indicated that fifty percent (50%) had work exposure. In addition, eighty-three percent (83%) of all participants indicated that they attended IT-architecture modelling courses.

Questions regarding prior work exposure to business process modelling (e.g. worked as a business process manager at a plant, modelling their processes, etc.) indicated that fifty-eight percent (58%) had work exposure. In addition, seventy-five percent (75%) of all participants indicated that they attended business-modelling courses.

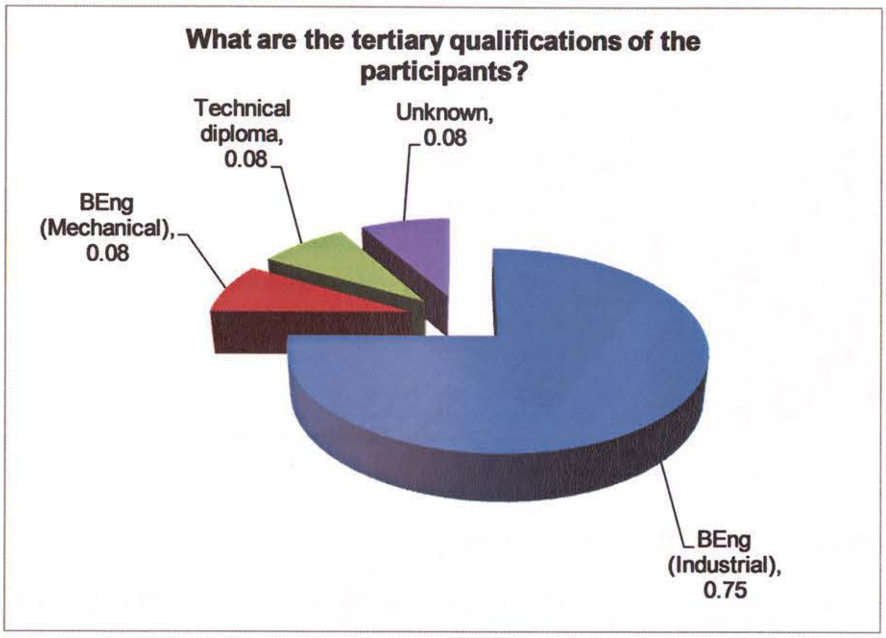


Figure 85: Tertiary qualifications of the participants

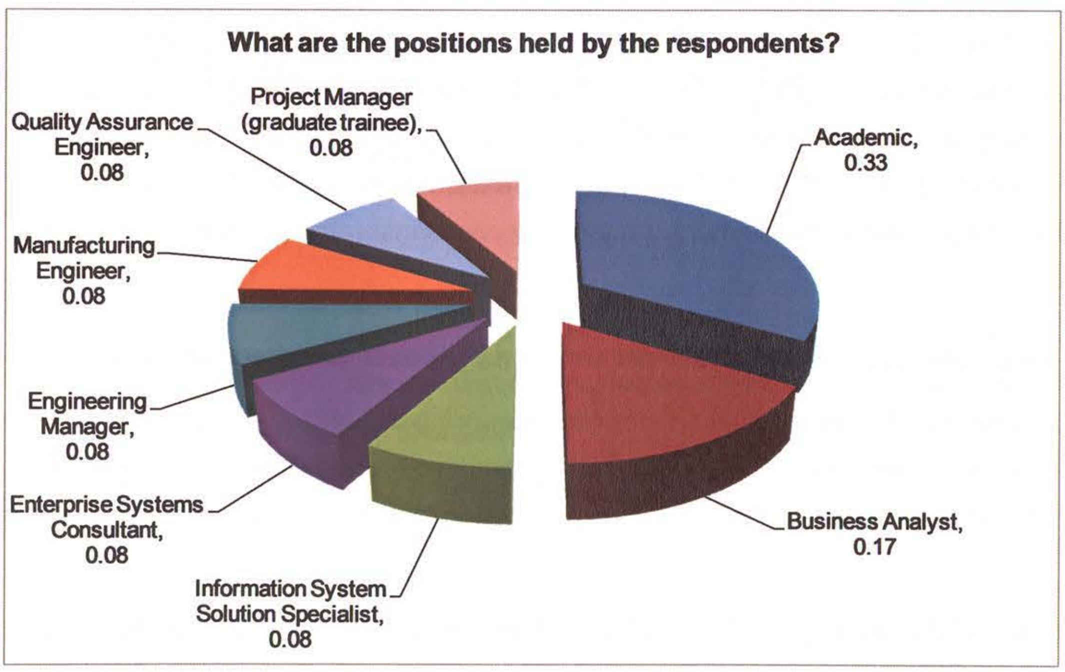


Figure 86: Positions held by participants

10.3.2 Parameter 2: Enterprise profile

The *enterprise profile* parameter provides an indication of the size and type of enterprises that were used by the participants during the experimentation process.

Although a large portion (33%) of the enterprises that were used for analysis purposes by the participants employed between 100 and 10 000 employees (Figure 87, purple section), small and medium-sized enterprises were also represented (22%) (Figure 87, light-blue section).

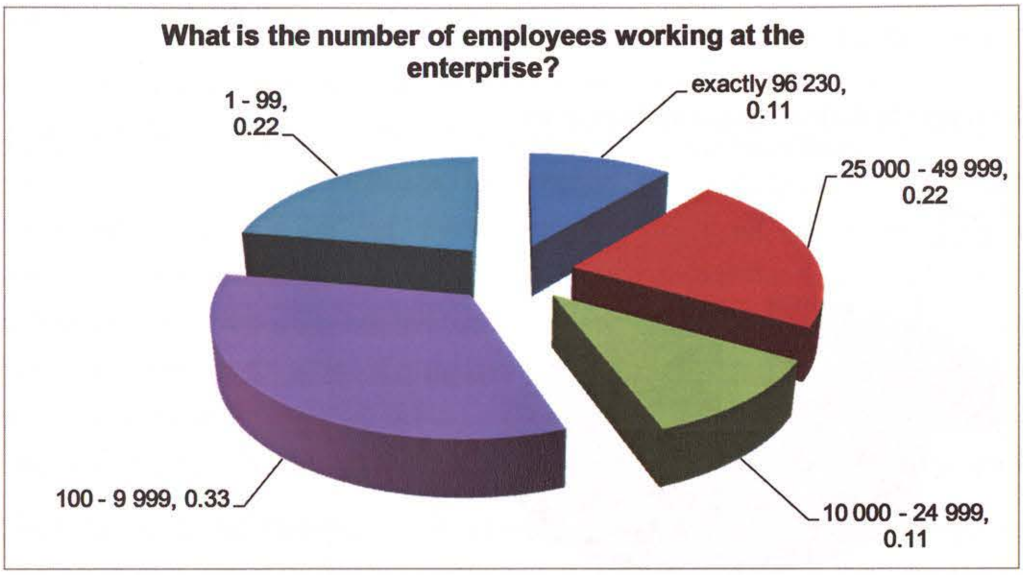


Figure 87: Number of employees working at the enterprises

As *four* of the *twelve* participants selected the same enterprise for analysis, a total number of *eight* (8) enterprises were analysed. From the *eight* (8) enterprises, a wide spread of twenty (20) business activities were involved – an enterprise could be involved in multiple business activities. The activities included research (4 out of 8), the automotive manufacturing (3 out of 8), chemicals (3 out of 8), industrial manufacturing (2 out of 8), application service provider (2 out of 8), construction/engineering (2 out of 8), natural resources (2 out of 8), oil and gas (2 out of 8), outsourcing (2 out of 8), and 11 remaining business activities, each represented by one enterprise (1 out of 8). Business activities that were excluded include aerospace and defence manufacturing, media and entertainment, financial services/insurance, health care, travel and transportation.

10.3.3 Parameter 3: Standard practices for doing process architecture work

The *standard practices for doing process architecture work* parameter provided an indication of the level of process architecture maturity of the analysed enterprises. The questionnaire therefore gathered data about the use of process modelling languages and architecting software tools.

The study indicated that the eight enterprises used three process modelling languages, of which UML (40%) and ARIS (30%) are well represented (see Figure 88). In addition, three different architecting software tools were used, of which MS Visio (50%) and ARIS (30%) are well represented (see Figure 89).

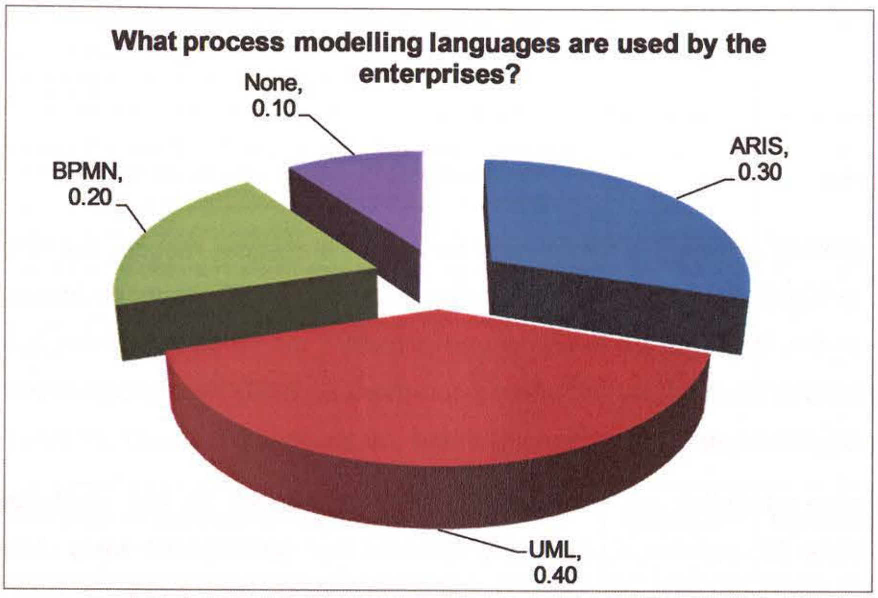


Figure 88: Process modelling languages used

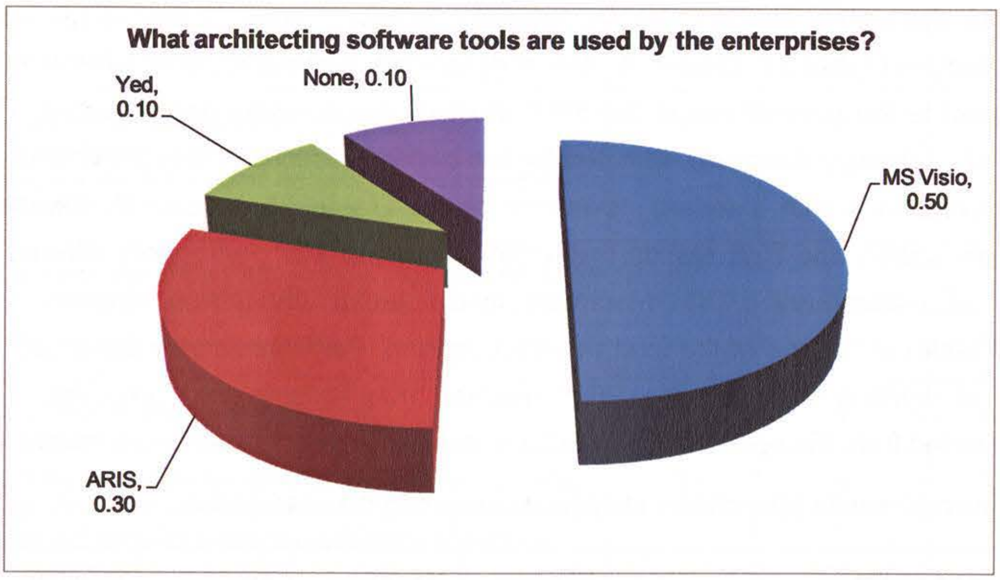


Figure 89: Architecting software tools used

10.3.4 Parameter 4: The perceived usefulness and ease-of-use of the PRIF method, mechanisms and practices

One way of measuring opinions about the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices*, is to use a Likert scale (previously discussed in section 2.4.2). Although the five-point Likert scale is popular (Rea & Parker, 2005), this study used a four-point scale, which forced the *twelve* participants to either agree or disagree, disallowing a neutral position. The interpretation of the four-point scale is as follows:

Value	Description
1	Strongly disagree
2	Disagree
3	Agree
4	Strongly agree

This thesis did not aim to confirm or reject a hypothesis based on statistical results, but rather use the statistical analysis to highlight areas that require further research. Descriptive statistics were calculated according to the formulas for *average* and *standard deviation* in section 2.4.2. In addition, open-ended questions allowed participants to comment on difficulties experienced in using the PRIF *method, mechanisms and practices*.

Table 20 provides descriptive statistics on the question results related to the *usefulness* category. The averages (Table 20, column 4, *Average*) indicate that participants were overall positive with respect to the *usefulness* of the PRIF *method, mechanisms and practices*, with no minimum score below 2 (disagree). The comments that resulted from the open-ended questions (discussed later) reveal more insight.

Table 21 provides descriptive statistics on the question results related to the *ease-of-use* category. The averages (Table 21, column 4, Average) indicate that participants were overall positive with respect to the *ease-of-use* of the PRIF *method, mechanisms and practices*. The minimum scores of 1 (strongly disagree), selected for two of the questions (Table 21, column 1, ii and iii) also corresponds with standard deviations of 0.9 (Table 21, column 5, *Standard deviation*). The low scores and high standard deviations indicate that participants differed in their confidence of understanding the interaction model (actor transaction diagram and transaction result table) at the end of the fourth contact session. Participants also disagreed on the consistency of wording using in the PRIF *method, mechanisms and practices*. The comments that resulted from the open-ended questions (discussed later) reveal more insight.

Table 20: Questions and results (descriptive statistics) measuring the usefulness

Question -> Descriptive Statistics	Minimum	Maximum	Average	Standard deviation
The method, mechanisms and practices provided a structured approach to identify the required levels of process standardisation (i.e. transaction re-use) enterprise-wide, as required from the operating model (Ross et al., 2006)	2	4	3.25	0.62
The interaction model could be used to identify similarities between business units.	3	4	3.58	0.51
I (as EA practitioner) thoroughly explained the use and purpose of interaction model to the **business unit manager**, prior to his/her verification of the interaction model.	2	4	3.25	0.62

Question -> Descriptive Statistics	Minimum	Maximum	Average	Standard deviation
The method, mechanisms and practices were well-accepted by the **business unit manager** during verification of the interaction model.	2	4	3.17	0.72
Given the nature of the core activities in my company, I (as EA practitioner) do believe that there is a need for process standardisation across the core activities.	2	4	3.33	0.78
I (as EA practitioner) would recommend the use of the method, mechanisms and practices to our enterprise to identify transaction re-use opportunities enterprise-wide.	2	4	3.50	0.80

Table 21: Questions and results (descriptive statistics) measuring the ease-of-use

Question -> Descriptive Statistics	Minimum	Maximum	Average	Standard deviation
Content supporting the interaction model, (part of the method, mechanisms and practices)				
i)The DEMO-contents (on ClickUP and handouts about the interaction model) assisted me (the EA practitioner) with understanding the presentation content prior to attending the presentation session about the interaction model.	2	4	3	0.74
ii) I (as EA practitioner) felt confident in my understanding of the interaction model (actor transaction diagram and transaction result table) at the end of the related presentation sessions.	1	4	3.08	0.90
Ease of use of the PRIF method, mechanisms and practices				
iii) The wording was consistent.	1	4	3.42	0.90
iv) The process sequence is clear.	2	4	3.25	0.62
v) The *applicable mechanisms and practices* provided on the method-roadmap are clear (given the additional content provided during contact sessions/handouts).	2	4	3.08	0.51
vi) The *motivations, considerations and Implications* on the method-roadmap are helpful in terms of the correct use of the method.	2	4	3.08	0.51

The following section provides a summary of the responses to the four open-ended questions. Resulting comments have also been re-allocated to the open-ended questions (Questions 1, 2, 3 and 4 below) to consolidate duplicate results. Due to the re-allocation of comments to questions, Questions 1 to 3 provide *critical comments*, pertaining to the *usefulness* and *ease-of-use* of the *method, mechanisms and practices*, whereas Question 4 provides *positive comments*. Additional **interpretive comments** (made by the researcher) are also provided.

Question 1: Please provide reasons if you scored any of the options related to usefulness (of the method, mechanisms and practices) with either a '1' or '2'.

- Although process standardisation is required, *processes require agility* to suit customer requirements, which would imply that processes could change bi-weekly. A template process may be a better solution.
- One enterprise (analysed by a participant) *already standardised* its core processes using an enterprise-specific standard process model, which limits the value of the PRIF *method, mechanisms and practices.*
- For *enterprises that provide client solution services*, the method, mechanisms and practices *do not allow for the standardisation* of software applications across various transactions. It is recommended that the full use of the method, mechanism and practices be *excluded for solution provider enterprises.* **Interpretive comments:** the focus should perhaps not be on standardising software solutions for clients, but standardising on software applications that the consultant use in building software solutions.

Question 2: If you did not feel confident in using the interaction model, specify the difficulties or problems that you experienced with the model, i.e. commenting on the ease-of-use of the interaction model.

- Being used to process flows, the actor transaction diagram requires a *different way of thinking*, i.e. identifying enclosed transactions to model end-to-end processes. *Enclosed transactions* require additional explanation/examples. The interaction model needs further refining, as it *differs from the standard process flows* normally used at enterprises to communicate business processes.
- There is a need to *incorporate support transactions* that form part of the end-to-end process view of the enterprise.
- Using the mindset of a process flow, it is *difficult to verify the completeness* of actors and transactions in the actor transaction diagram (ATD), as the ATD does not highlight transaction sequence/dependencies.
- There is a *need for conditional transactions* / decision transactions. **Interpretive comments:** conditions are modelled using other ontological models, namely the process model and action model, rather than the interaction model.
- Prior to modelling the actor transaction diagram, some participants wrote a business summary to highlight performa actions, which is difficult. *Distinguishing between ontological, infological and datalogical transactions* is difficult.
- It is difficult to identify actors where systems are the initiators of transactions. **Interpretive comments:** Although posed as a problem, Dietz (2006) states that systems cannot initiate ontological transactions. The participant thus included infological / datalogical transactions, which highlights the problem of *distinguishing between ontological, infological and datalogical* transactions.

- Identification of *actor roles* is difficult where a single individual acts out different roles at the enterprise. The difficulty is evident in small enterprises, where single individuals take responsibility for numerous transactions. It is difficult to extract transactions.
- Class examples and examples obtained from articles on using the interaction model were too elementary. More *complex examples are required.*
- The interaction model is *difficult to explain* to a first time audience. It should not require more than 5 minutes of explanation, since managers do not have the time for intensive presentations about a new proposed methodology. **Interpretive comments:** the comment should be contrasted with that of another participant who expressed his/her astonishment at the simplicity of representation: "The actor transaction diagram can be *easily understood*, which is an advantage if business managers do not have time for training".

Question 3: Discuss difficulties (if any) that you experienced in using any of the mechanisms and practices, i.e. commenting on the <u>ease-of-use of the entire method, mechanisms and practices</u>. Provide reasons and recommended changes.

- The terminology in the methods and practices needs *additional qualification*, e.g. 'pools of excellence' was not qualified. The terminology is very technical.
- It was difficult to make a *distinction between business unit type and business units.*
- It is challenging to *obtain the required information and data* in the *allocated time period.* It is difficult to meet with business unit managers with short notice, especially when the purpose of the meeting is not directly related to the business.

Question 4: Provide any comments/experiences related to the use of the method, mechanisms and practices.

- It is a *useful method* to study the potential standardisation of the various departments. The opportunity for standardisation is important to help save costs in terms of licences. When software is standardised, it becomes easier to execute control and possibly integrate business units by sharing information effectively.
- The structured approach followed by the method, mechanisms and practices makes it *easy to use*. The concept of process standardisation is complex and this method simplifies it as much as possible by *guiding the user in every step* that is needed.
- The interaction model reflects the *empowerment of employees*, and the roles that they play in aiding *strategic alignment.*
- By developing an interaction model, it will be possible to derive/construct an action model, which *focuses on the implementation* of which an enterprise can greatly benefit.
- The interaction model maps all the transactions in a *clear way* and organises the activities within a business extremely well.

The results indicate some problems in terms of the *usefulness* and *ease-of-use* in using the PRIF *method, mechanisms and practices*. The following section provides an interpretation and summary of the results.

10.4 INTERPRETATION AND SUMMARY OF RESULTS

Based on the results of the previous section (section 10.3), this section provides a summary and interpretation of the results obtained, referring to the four parameters (Figure 84) that influence the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices*. Since the study applied a relative small *convenience sample* (*twelve* participants), the statistical results could not be used to generalise findings about the *usefulness* and *ease-of-use*. Yet, the statistical results highlighted areas that require further inquiry and/or improvement.

In terms of the *participant profile (Parameter 1)*, thirty-three percent (33%) of the participants were *academics,* whereas the remaining participants represented a spread of positions related to the core *business activities*, i.e. excluding supporting activities, such as finances, HR and infrastructure. The sample thus allows for critical evaluation from both academic and core business viewpoints. Participants also had sufficient knowledge of information systems and business process modelling.

Concerning the *enterprise profile (Parameter 2)*, small, medium and large enterprises were all represented, and enterprises were involved in a large number of business activities including research, the automotive manufacturing, chemicals, industrial manufacturing, application service provider, construction/engineering, natural resources, oil and gas, outsourcing, and 11 less-represented business activities. Business activities that were excluded are aerospace and defence manufacturing, media and entertainment, financial services/insurance, health care, and travel and transportation.

In terms of the *standard practices for doing process architecture work (Parameter 3)* the study indicated that two process modelling languages were well represented (UML (40%) and ARIS (30%)), whereas two architecting software tools were well represented (MS Visio (50%) and ARIS (30%)).

Quantitative results pertaining to the *perceived usefulness* and *ease-of-use of the PRIF method, mechanisms and practices (parameter 4)*, are positive. Pertaining to *ease-of-use*, two of the questions obtained minimum scores of 1 (strongly disagree), which corresponded with high standard deviations of 0.9. The low scores and high standard deviations indicate that participants differed in their confidence of understanding the interaction model (actor transaction diagram and transaction result table) at the end of the fourth contact session. Participants also disagreed on the consistency of wording using in the PRIF *method, mechanisms and practices*. The comments that resulted from four open-ended questions revealed more insight and are summarised in Table 22 and Table 23. Both tables comment on additional problems and pose suggestions to improve the PRIF *method, mechanisms and practices* based on the feedback from participants (Table 22 / Table 23, *Problem awareness / suggestion*), which could lead to another design cycle, but not covered in this study.

Table 22: Summarised comments on the usefulness of the PRIF method, mechanisms and practices

Comments on usefulness	**Problem awareness / suggestion**
Although process standardisation is required, processes *require agility* to address customer requirements.	The purpose of the *foundation for execution* approach, is to digitise core business processes, making "the individual processes less flexible while making a company more agile" (Ross et al., 2006, p. 4). The PRIF *method, mechanisms and practices* enhances the OM, in identifying opportunities to reuse processes. However, as Ross et al. (2006) indicate, enterprises may also choose a diversification/coordination OM, deciding not to pursue process standardisation. As stated by Hitchins (2003), perception of *value* (in this case the value of the PRIF *method, mechanisms and practices*) is relative (not absolute) and highly context base. **Suggestion:** Prior to using the PRIF *method, mechanisms and practices*, the enterprise should have the need to identify process standardisation opportunities.
Enterprises that have already standardised the core processes, do not need the PRIF *method, mechanisms and practices.*	In its aim to enhance the OM, the PRIF *method, mechanisms* will only be of value to enterprises that do not have a *foundation for execution.* **Suggestion:** As suggested before, a prerequisite for using the PRIF *method, mechanisms and practices*, is that the enterprise should have the need to identify process standardisation opportunities.
For enterprises that provide client solution services (e.g. software applications), the *method, mechanisms and practices* do not allow for the standardisation of software applications across various transactions.	The interaction model provides the ontological knowledge of the enterprise as a system (Dietz, 2006), that produces products and/or services to the environment. If an enterprise delivers software applications as products to the environment, the PRIF *method, mechanisms and practices* should be used to identify process reuse opportunities in *developing and delivering* the software applications to clients. **Suggestions:** The PRIF *method, mechanisms and practices* should emphasise the intent to identify process reuse opportunities pertaining to the *operation of the enterprise.*

Table 23: Summarised comments on the ease-of-use of the PRIF method, mechanisms and practices

Comments on ease-of-use	**Problem awareness / suggestion**
Being used to flow charts, a paradigm shift to the modelling required by the interaction model, is difficult. In the interaction model, the concept of end-to-end process flows are addressed via *enclosed transactions* and need more explanation. There is also	The interaction model enhances the end-to-end view of processes via the wholeness of the transaction pattern. Contrary to almost all implementations of enterprises that separate sales from delivery, the interaction model emphasises the indivisible responsibility of taking customer orders, satisfying them and delivering the result (Dietz, 2006, p. 170). However, the use of a system boundary (e.g. a business unit as a sub-system of the enterprise) only includes transactions that are executed within the boundary of the business unit, thus excluding transactions that are required

Comments on ease-of-use	Problem awareness / suggestion
the need to incorporate support transactions that form part of the end-to-end process view of the enterprise.	by an end-to-end process, but executed by other departments (e.g. support departments). **Suggestion:** Although the PRIF *method, mechanisms and practices* only claim to identify process re-use opportunities at an enterprise, by comparing different business units, a different *boundary* will be required when analysing end-to-end processes for performance improvement.
It is difficult to verify the completeness of actors and transactions, as the actor transaction diagram (ATD) does not highlight transaction sequence/dependencies. There is a need for conditional transactions / decision transactions.	The sequence/dependencies/conditions are modelled using different ontological aspect models, i.e. the process model and action model. Verification in terms of completeness only takes place based on the action model. According to Dietz (2006, p. 185) the action model is the "most detailed and comprehensive aspect model. It is atomic on the ontological level". **Suggestion:** Practitioners not only need to have an in-depth understanding of the interaction model prior to using the PRIF *method, mechanisms and practices*, but also of the other ontological aspect models, especially the process model and action model. Additional modelling (using the process model and action model) may be required to verify completeness of transactions.
It is difficult to distinguish between ontological, infological and datalogical transactions.	The problem is aggravated if the main business activity is to render information services. **Suggestion:** More practice and examples are required, including an example where the main business of the enterprise is to deliver information services.
It is difficult to identify actor roles where a single individual acts out different roles at the enterprise, especially in the case of a small enterprise.	The problem is that multiple iterations are required to create a comprehensive interaction model; self-activation transactions are easily missed/left out. **Suggestion:** Multiple iterations are required in verifying the interaction model. The PRIF *method, mechanisms and practices* need to reflect the iterative nature of building the interaction model for a business unit type.
More complex examples of the interaction model are required.	**Suggestion:** Case studies, using the interaction model to represent different types of enterprises, are required.
The interaction model is difficult to explain to a first time audience.	A Microsoft PowerPoint presentation was used to explain the interaction model within the context of the theoretical background provided by Dietz (2006), within 30 minutes to departmental managers. The interaction model does however require a paradigm shift for those used to process flowcharts. **Suggestion:** A short presentation needs explication (as an additional *mechanism*), in selling the value of the interaction model and its relationship with 'flat' process modelling techniques (e.g. flow charts) to a first time audience.
The terminology in the methods, mechanisms and practices needs additional qualification, e.g. 'pools	**Suggestion:** Some of the mechanisms and practices need additional qualification.

Comments on ease-of-use	Problem awareness / suggestion
of excellence' was not qualified. The terminology is very technical. It was difficult to make a distinction between business unit type and business units.	
It is challenging to obtain the required information and data in the allocated period, as business unit managers were not available.	The problem is a result of the deadlines provided for the task and not a deficiency of the method, mechanisms and practices. **Suggestion:** The research process should be more flexible regarding time constraints.

10.5 CONCLUSION

This chapter evaluated the PRIF to conclude the main design research cycle, *evaluation* and *conclusion.*

The chapter provided a motivation for an appropriate evaluation method to evaluate the PRIF, i.e. using two measures (*usefulness* and *ease-of-use*) to evaluate the second part of PRIF (the PRIF *method, mechanisms and practices*). According to the results, research participants were positive towards the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices*. However, qualitative feedback suggested further improvement of the PRIF *method, mechanisms and practices*, which may be incorporated in future research.

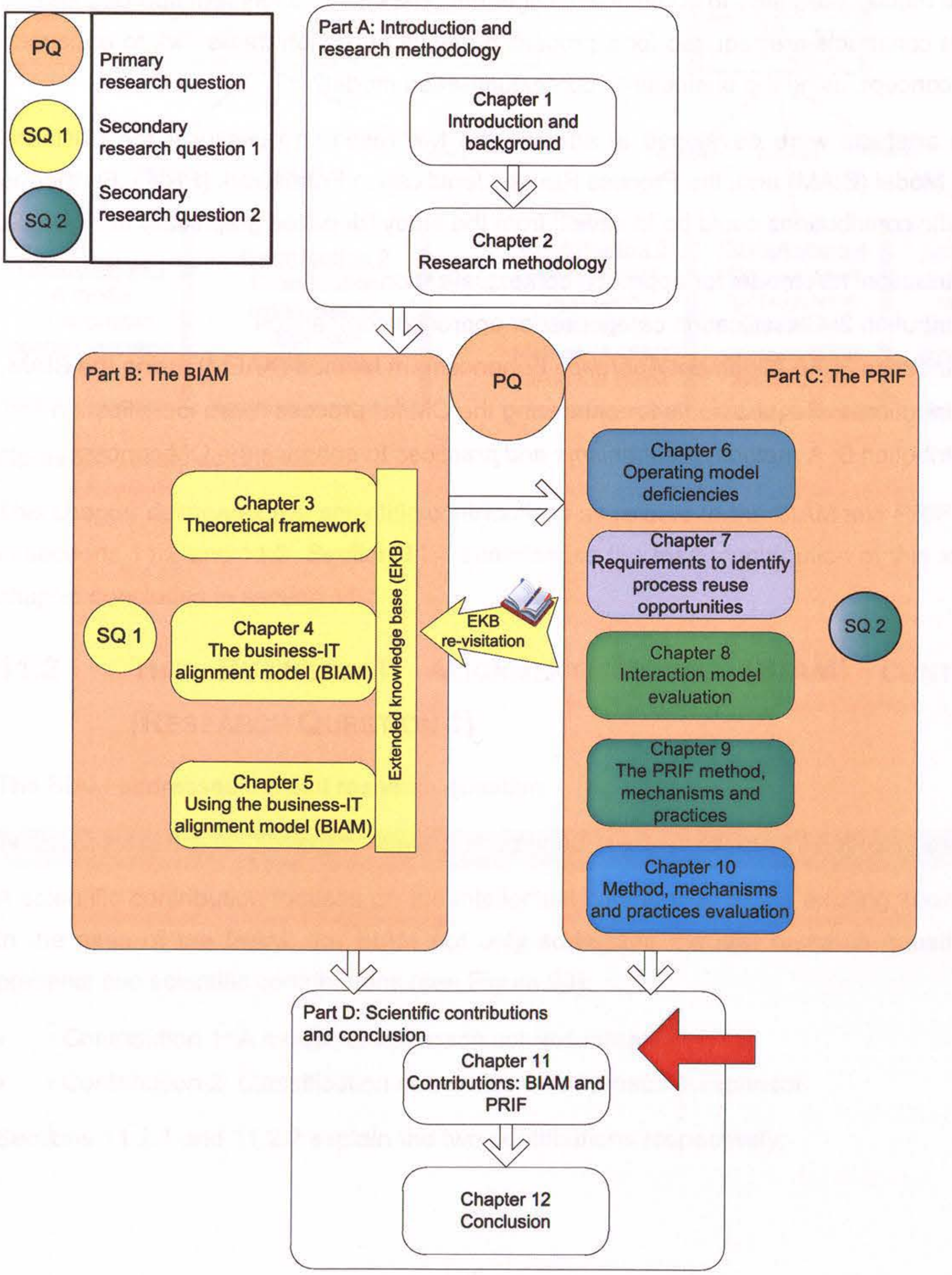
Part C developed the PRIF using *design research* as the *primary research design component* of this study. The use of BIAM (as developed in Part B) was also demonstrated during the development of the PRIF. BIAM was developed, using *exploratory design* as the *supplementary research design component* of this study. The final part (Part D) concludes on the BIAM and PRIF as the two main contributions of this thesis.

PART D: SCIENTIFIC CONTRIBUTION AND CONCLUSION

The act of discovery consists not in finding new lands but in seeing with new eyes. ~ Marcel Proust

Part D, the final part of this thesis, contains Chapters 11 and 12 to discuss the contributions and final conclusions:

- Chapter 11 presents five contributions extracted from the BIAM and PRIF.
- Chapter 12 delineates the thesis findings and recommendations for further research.



Chapter 11. Contributions: BIAM and PRIF

11.1 INTRODUCTION

The main contribution of this study could be summarised as the *enhancement of the OM concept*, which is facilitated by a *business-IT alignment contextualisation model*. This study answered the main research question, by addressing two secondary questions:

1. What model is required to contextualise different business-IT alignment approaches?
2. What constructs are required for a process reuse identification framework to enhance the OM concept, using the business-IT contextualisation model?

Two main artefacts were developed to address the two research questions: the Business-IT Alignment Model (BIAM) and, the Process Reuse Identification Framework (PRIF). Furthermore, five scientific contributions could be identified from the study (depicted graphically in Figure 90):

- Contribution 1: A model for approach contextualisation
- Contribution 2: Classification categories for approach comparison
- Contribution 3: An Alignment Approach Enhancement Method (AAEM), using the BIAM
- Contribution 4: Requirements for enhancing the OM for process reuse identification
- Contribution 5: A *method, mechanisms and practices* to enhance the OM concept

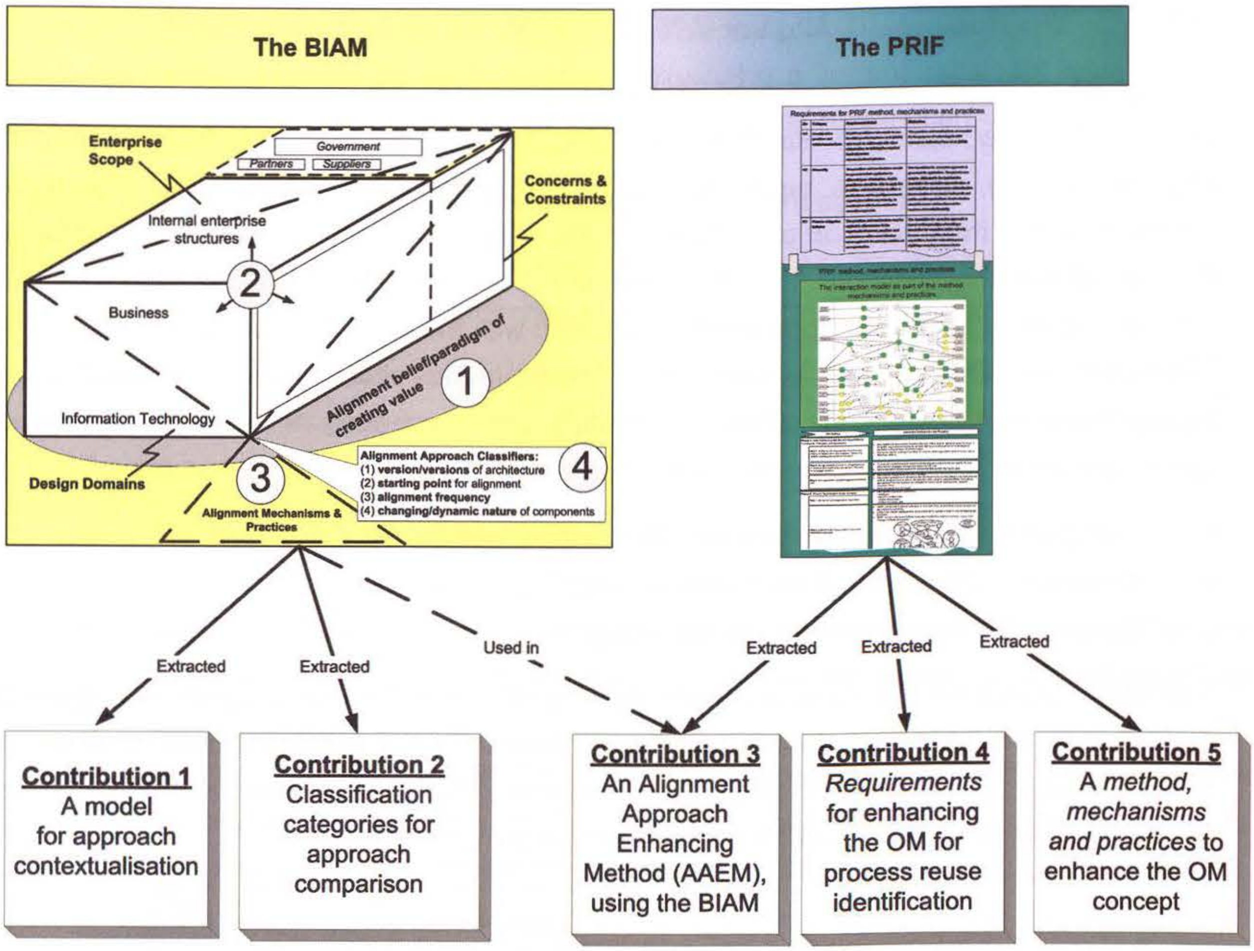


Figure 90: Thesis contributions

This chapter delineates five scientific contributions as related to the BIAM and PRIF respectively in sections 11.2 and 11.3. Section 11.4 summarises the main contribution of this study and the chapter concludes in section 11.5.

11.2 THE BUSINESS-IT ALIGNMENT MODEL (BIAM) CONTRIBUTIONS (RESEARCH QUESTION 1)

The BIAM addresses the first research question:

What model is required to contextualise different business-IT alignment approaches?

A scientific contribution focuses on the intellectual contribution to the existing knowledge base. In the case of the BIAM, the BIAM not only addresses the first research question, but also presents two scientific contributions (see Figure 90):

- Contribution 1: A model for approach contextualisation
- Contribution 2: Classification categories for approach comparison

Sections 11.2.1 and 11.2.2 explain the two contributions respectively.

11.2.1 The Business-IT Alignment Model (BIAM) for contextualisation

The BIAM provides a scientific contribution since the BIAM partially addresses the fragmentation that exists in literature pertaining to three emerging disciplines, enterprise engineering (EE), enterprise architecture (EA) and enterprise ontology (EO). The current irregularities and fragmentation of literature on the *three disciplines*, creates misunderstanding and limited use/consolidation of existing literature (Lapalme, 2011). Created inductively from current theoretical alignment approaches associated with the disciplines of EE, EA and EO, the BIAM provides a common frame of reference. The BIAM thus circumvents the irregularities and fragmentation that exists in literature, by providing a common analysis model to *understand* a current alignment approach in terms of *three questions*:

- Question 1: *Why* should the enterprise use the proposed approach to align?
- Question 2: *What* should the enterprise align?
- Question 3: *How* should the enterprise align?

The BIAM addresses the three questions by way of four alignment components (Figure 91, Components 1 to 4). As a scientific contribution (extending the existing knowledge base), the BIAM provides a business-IT alignment perspective to analyse and understand current alignment approaches in terms of the four alignment components.

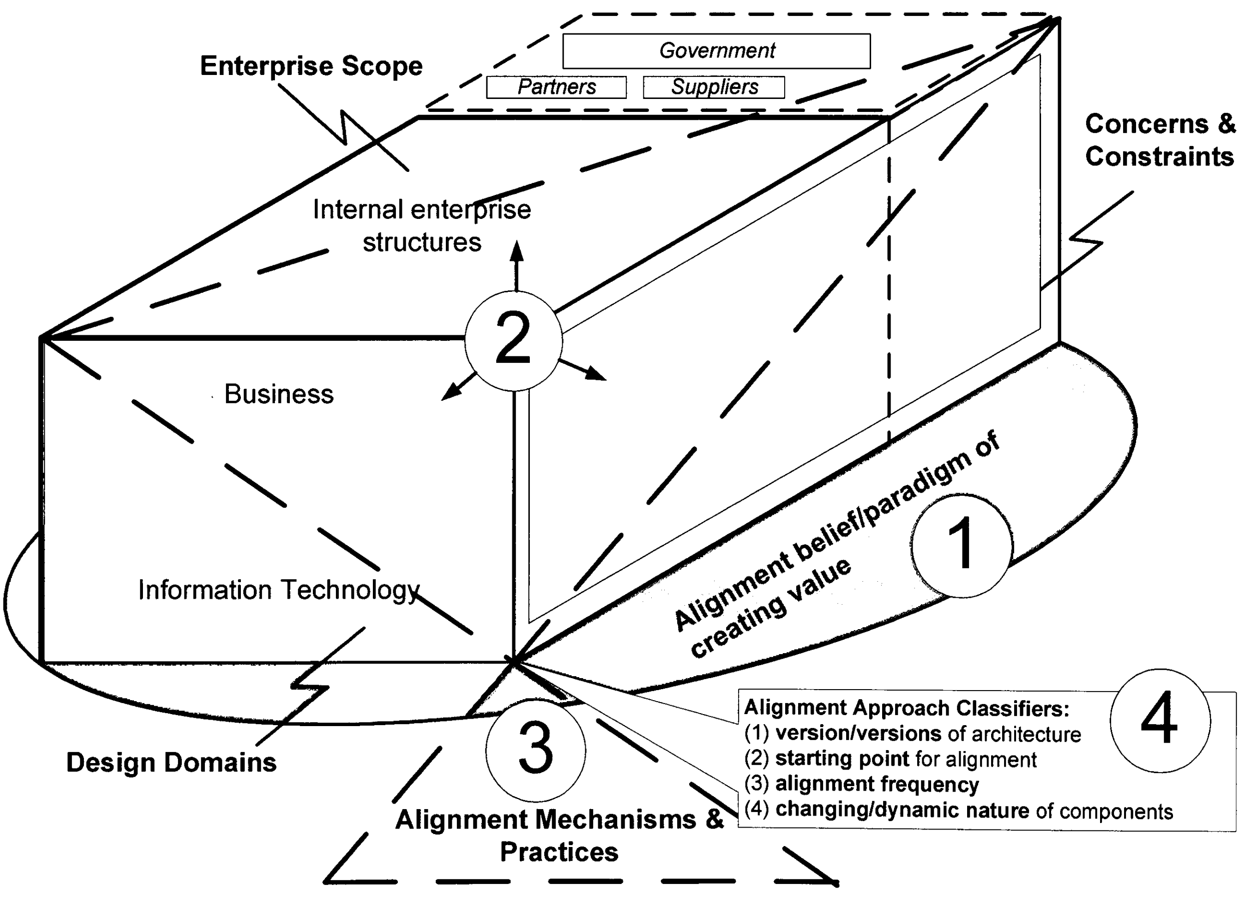


Figure 91: The BIAM (duplicate of Figure 45)

Since the interpretation of every component of BIAM has already been discussed in section 4.3.2, this section extracts the *method for contextualising* a current alignment approach, and concludes with prospective *users* of the BIAM as an additional contribution.

11.2.1.1 Method for contextualising a current alignment approach

The order of the BIAM components is meaningful, indicating an underlying *method-sequence* to contextualise current alignment approaches in terms of the BIAM components:

1. Analyse the *alignment belief/paradigm of creating value*, (Figure 91, *Component 1*).
2. Identify the alignment *dimensions* that explicate the extent of alignment (Figure 91, *Component 2*):
   - Identify explicit demarcation/separation of *design domains* (Figure 91, *Component 2, front pane)* used to classify *architecture descriptions*.
   - Identify *concerns and constraints* (Figure 91, *Component 2, side pane)* that are explicated by the alignment approach, addressed during design/alignment of multiple *design domains.*
   - Identify *enterprise scope* (Figure 91, *Component 2, top pane),* explicating the *structural alignment elements* (e.g. business units, lines of business, departments etc., abstract or real) that need to be aligned via the alignment approach.
3. Identify *alignment mechanisms and practices* (Figure 91, *Component 3*), which provides other means/ways to support alignment across the *design domains*, *concerns & constraints*, and *enterprise scope.* Use the ten categories of *alignment mechanisms and practices* provided in section 5.3.3 as a starting point, and add more if the ten categories are insufficient.
4. Analyse the alignment approach in terms of the four *alignment approach classifiers* (Figure 91, *Component 4*).

As evidence of this scientific contribution, this thesis described examples of BIAM-contextualisations for four alignment approaches where this method was followed:

1. The Zachman approach (see section 5.2)
2. The Open Group approach (see section 5.3)
3. The *foundation for execution* approach (see section 7.2)
4. The essence of operation approach (see section 8.2)

Thus, the BIAM contextualisation not only provided a common understanding of the various alignment approaches, but the descriptive analysis also highlighted deficiencies of current alignment approaches. As an example, the BIAM-contextualisation of the *foundation for execution* approach, and more specifically the OM, led to the identification of additional OM deficiencies (see section 7.3).

11.2.1.2 Prospective users of the BIAM

The BIAM is useful to both *academics* and *practitioners*. *Academics* will be able to use the BIAM as a common reference to understand existing alignment approaches (either theoretical alignment approach, commercial-off-the-shelf alignment approaches, or an enterprise-specific alignment approach). The pedagogic value of the BIAM was already demonstrated in using the BIAM to present content on multiple alignment approaches to several audiences. *Practitioners* will also be able to use the BIAM to contextualise the alignment approach currently used at an enterprise. The BIAM contextualisation will present the *practitioner* with a tool to understand the current alignment approach from a business-IT alignment perspective, prior to extending/improving the current alignment approach. Thus, academics and practitioners alike will be able to use the BIAM as a common frame of reference to discuss and understand existing alignment approaches.

In summary, the first scientific contribution of the BIAM, is a model for approach contextualisation. This section provided a summary of the main BIAM components and added a *method-sequence* to enable a practitioner to use the BIAM. Using BIAM-contextualisation of several alignment approaches, according to the *method-sequence* conveyed in this section, additional comparison and enhancement of alignment approaches are possible. The next section presents the second scientific contribution of the BIAM, i.e. the approach comparison abilities of the BIAM.

11.2.2 The Business-IT Alignment Model (BIAM) for approach comparison

The second scientific contribution of the BIAM pertains to the classification categories for approach comparison. Since many enterprises use hybrid alignment approaches (Blowers, 2012), the BIAM facilitates comparison between the approaches and assists with evaluating their compatibility. Compatible alignment approaches could then be used in combination, or elements from one approach may be incorporated within another approach, such as suggested by Mingers & Brocklesby (1997) . This section refers to limited generalisation, based on a single case presented in this thesis that demonstrates the use of BIAM. The case refers to the comparison of two alignment approaches (the *foundation for execution* approach and *essence of operation* approach). This section conveys the use of BIAM to compare alignment approaches for compatibility.

The case presented in this thesis, used the descriptive analyses of two alignment approaches to discuss similarities and differences with respect to the four BIAM components (see Table 16 in section 8.3.1). However, the interpretation of the similarities and differences between the approaches are context-sensitive and depends on the intent of the comparison exercise. Since the case presented in this thesis, intended to *enhance* the OM of an existing approach with an element (interaction model) from another approach, *similarities in paradigm* provides a good indication of approach compatibility according to Mingers & Brocklesby (1997). However, the *differences* between the *foundation for execution* approach and *essence of operation* approach may indicate that one approach may complement the other, or more specifically, one approach may address deficiencies of another. Thus, comparison of alignment approaches for compatibility purposes, can only be generalised in terms of a comparison table.

The comparison table (Table 24) compares two approaches (Approach 1 and Approach 2) to highlight similarities and differences in terms of four comparison categories. The comparison categories (shaded in grey on Table 24) represent the main components of the BIAM, which are:

- Component 1: Alignment belief/paradigm of creating value.
- Component 2: The dimensions for alignment (design domains, concerns & constraints, and enterprise scope).
- Component 3: Alignment mechanisms and practices.
- Component 4: Aligment approach classifiers (version/versions of architecture, starting point for alignment, alignment frequency, changing/dynamic nature of components).

Table 24: Alignment approach comparison grid

Approach 1	Approach 2	Similarities / Differences
	Paradigm of creating value	
	The dimensions for alignment	
	Alignment mechanisms and practices	
	Alignment approach classifiers	
	(1) Version of architecture	
	(2) Starting point for alignment	
	(3) Alignment frequency	
	(4) Changing/dynamic nature of components	

Based on approach compatibility, it may be feasible to use two approaches in combination. The single case presented in this thesis enhanced the *foundation for execution* approach with an element (interaction model) from the *essence of operation* approach.

In summary, the second scientific contribution of the BIAM is an approach comparison table, derived from the four main components of the BIAM. The approach comparison table is useful when *practitioners* or *academics* need to compare two approaches to assess their compatibility.

The next section elaborates on the contributions that were extracted due to the enhancement of the *foundation for execution* approach and the development of a Process Reuse Identification Framework (PRIF).

11.3 The Process Reuse Identification Framework (PRIF) contributions (Research Question 2)

The PRIF addresses the second research question:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

The BIAM not only addresses the first research question, but also presents three scientific contributions (see Figure 90):

- Contribution 3: An Alignment Approach Enhancement Method (AAEM), using the BIAM
- Contribution 4: Requirements for enhancing the OM for process reuse identification
- Contribution 5: A *method, mechanisms and practices* to enhance the OM concept

Sections 11.3.1 to 11.3.2 explain the three contributions respectively.

11.3.1 An Alignment Approach Enhancement Method (AAEM), using BIAM

As mentioned in the previous section, the BIAM was instrumental in the process of enhancing the OM (associated with the *foundation for execution* approach) with the interaction model (associated with the *essence of operation* approach), which resulted in the construction of the PRIF. The purpose of this section is to present the method that was used to enhance the OM (in Part C of this thesis), as an Alignment Approach Enhancement Method (AAEM) and therefore a scientific contribution. Although not the initial aim of this thesis, the AAEM is an added contribution resulting from the design research approach that was followed. The section starts with the delineation of the AAEM, followed by the prospective *users* of the AAEM.

11.3.1.1 The Alignment Approach Enhancement Method (AAEM)

The theoretical foundations of the AAEM is the *design cycle* (Vaishnavi & Kuechler, 2004/5) as discussed in section 2.3.2.1, the basic *systems design process* defined by Dietz (2006) and discussed in section 3.2.2, and the BIAM as defined in section 4.3.2.

The AAEM (Figure 92) follows the *design cycle* to enhance an existing approach (Approach 1) with another approach (Approach 2):

1. The design cycle thus starts with the initial *awareness* that Approach 1 needs enhancement due to deficiencies (Figure 92, *Awareness of problem*).
2. The *suggestion* (Figure 92, *Suggestion*) implies that Approach 1 will be enhanced, using elements from another approach.
3. *Development* of enhancements to Approach 1 (Figure 92, *Development*) requires a *basic system design process* (Figure 92, *Basic system design process*):

- The constructional understanding of Approach 1 is a prerequisite for *determining functional requirements for Approach 1 enhancements* (Figure 92, *Determining functional requirements for Approach 1 enhancements* arrow). A BIAM-contextualisation of Approach 1 (Figure 92, *Contextualisation 1)* contributes towards a constructional understanding of Approach 1.
- Based on the functional requirements, a suitable approach (e.g. Approach 2) is selected to enhance Approach 1 (Figure 92, *Selecting a suitable approach to enhance Approach 1* arrow).
- A BIAM-contextualisation of Approach 2 (Figure 92, *Contextualisation 2*) is then required to understand the construction of Approach 2 and the construction of its associated elements.
- The function for Approach 1 enhancements are used to *devise constructional requirements for Approach 1 enhancements* (Figure 92, *Devising constructional requirements for Approach 1 enhancements* arrow).
- Finally, a creative process is used to incorporate *constructional requirements* and the selected elements from Approach 2 (Figure 92, *Selecting elements from Approach 2* arrow) to construct Approach 1 enhancements (Figure 92, *Construction*).

4. The enhancements are evaluated (Figure 92, *Evaluation*).
5. The design cycle finally concludes (Figure 92, *Conclusion*).

The *circumscription* arrows (Figure 92, *Circumscription*) allows for additional cycles during the *development* and *evaluation* steps, to accommodate the unique context of the research project and the selected alignment approaches.

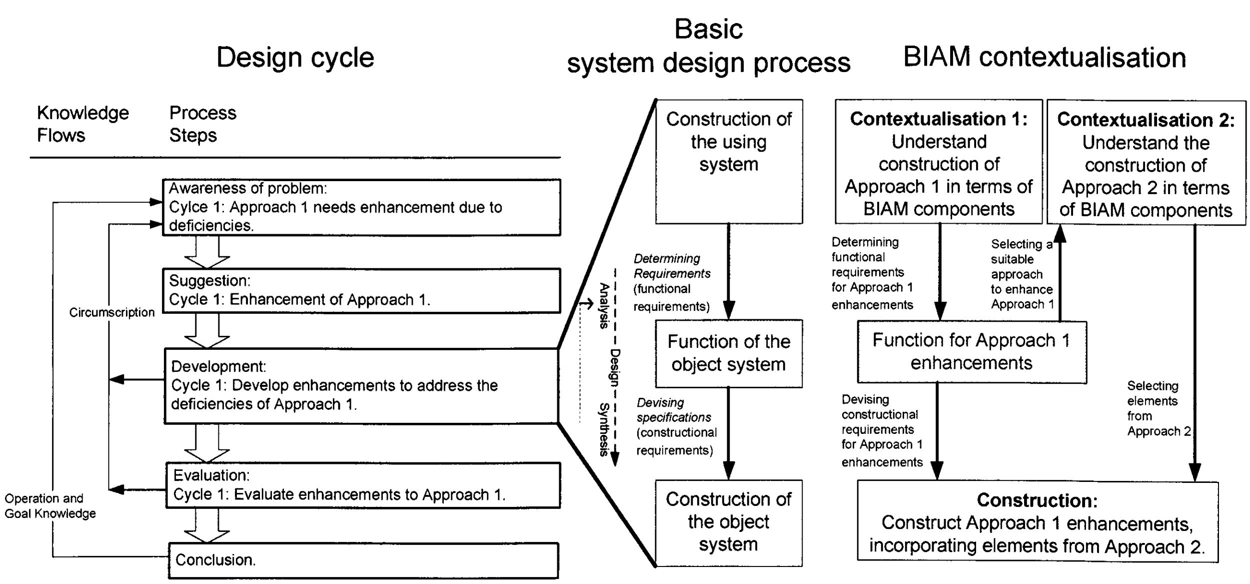


Figure 92: Alignment approach enhancement process

11.3.1.2 Prospective users of the Alignment Approach Enhancement Method (AAEM)

Researchers should use the AAEM to enhance an existing business-IT alignment approach, with the aim of extending the current scientific knowledge base. Once verified, the enhanced business-IT alignment approach may be applied by practitioners.

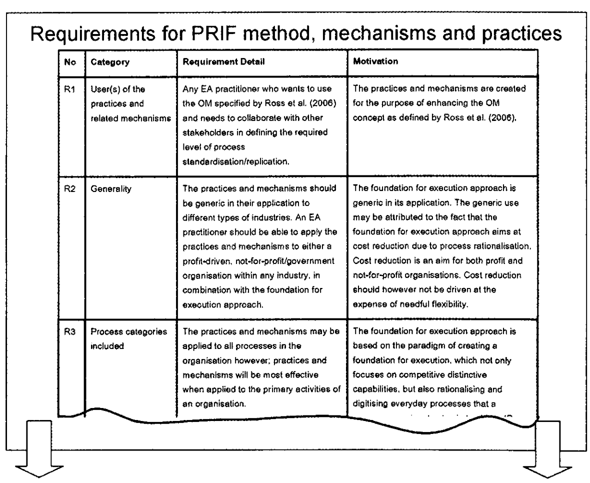
This study demonstrated a single case of the AAEM to enhance the OM (associated with the *foundation for execution* approach) with the interaction model (associated with the *essence of operation* approach).

In summary, the third scientific contribution from this study is the AAEM, which is useful to researchers when an existing business-IT alignment approach need to be enhanced with another alignment approach.

The next two sections convey the results of the single case when the AAEM is used to develop a Process Reuse Identification Framework (PRIF). The PRIF can be decomposed into two scientific contributions: a set of *requirements* for enhancing the OM for process reuse identification (the fourth scientific contribution), and a *method, mechanisms and practices* to enhance the OM concept (the fifth scientific contribution).

11.3.2 Requirements for enhancing the OM for process reuse identification

The design research approach was instrumental in the development of a PRIF (Process Reuse Identification Framework) to address some of the OM deficiencies. As discussed in the previous section (section 11.3.2), new knowledge (an AAEM) was created due to the iterative nature of the design cycle. The iterative nature of the design cycle ultimately produced two main outputs: (1) a set of *requirements* for enhancing the OM for process reuse identification, and (2) a *method, mechanisms and practices* to enhance the OM concept. This section discusses the first part of PRIF, the set of requirements for enhancing the OM for process reuse identification, as a scientific contribution.


Requirements for PRIF method, mechanisms and practices

No	Category	Requirement Detail	Motivation
R1	User(s) of the practices and related mechanisms	Any EA practitioner who wants to use the OM specified by Ross et al. (2006) and needs to collaborate with other stakeholders in defining the required level of process standardisation/replication.	The practices and mechanisms are created for the purpose of enhancing the OM concept as defined by Ross et al. (2006).
R2	Generality	The practices and mechanisms should be generic in their application to different types of industries. An EA practitioner should be able to apply the practices and mechanisms to either a profit-driven, not-for-profit/government organisation within any industry, in combination with the foundation for execution approach.	The foundation for execution approach is generic in its application. The generic use may be attributed to the fact that the foundation for execution approach aims at cost reduction due to process rationalisation. Cost reduction is an aim for both profit and not-for-profit organisations. Cost reduction should however not be driven at the expense of needful flexibility.
R3	Process categories included	The practices and mechanisms may be applied to all processes in the organisation however; practices and mechanisms will be most effective when applied to the primary activities of an organisation.	The foundation for execution approach is based on the paradigm of creating a foundation for execution, which not only focuses on competitive distinctive capabilities, but also rationalising and digitising everyday processes that a

The requirements for PRIF *method, mechanisms and practices* stated a set of seven requirement categories (see Table 25) to address several OM deficiencies (see sections 6.6 and 7.3).

Table 25: Requirements for addressing deficiencies pertaining to process reuse identification opportunities at enterprises (duplicate of Table 15)

No	Category	Requirement Detail	Motivation
R1	User(s) of the practices and related mechanisms	Any EA practitioner who wants to use the OM specified by Ross *et al.* (2006) and needs to collaborate with other stakeholders in defining the required level of process standardisation/replication.	The practices and mechanisms are created for the purpose of enhancing the OM concept as defined by Ross *et al.* (2006).
R2	Generality	The practices and mechanisms should be generic in their application to different types of industries. An EA practitioner should be able to apply the practices and mechanisms to either a profit-driven, not-for-profit/government enterprises within any industry, in combination with the foundation for execution approach.	The foundation for execution approach is generic in its application. The generic use may be attributed to the fact that the foundation for execution approach aims at cost reduction due to process rationalisation. Cost reduction is an aim for both profit and not-for-profit enterprises. Cost reduction should however not be driven at the expense of needful flexibility.
R3	Process categories included	The practices and mechanisms may be applied to all processes in the enterprise however; practices and mechanisms will be most effective when applied to the primary activities of an enterprise.	The foundation for execution approach is based on the paradigm of creating a foundation for execution, which not only focuses on competitive distinctive capabilities, but also rationalising and digitising everyday processes that a company requires to stay in business (Ross et al., 2006, p. 4). The practices and mechanisms will however be most effective when applied to the primary activities of an enterprise, as support activities automatically provide the opportunity for enterprise-wide standardisation (Smith & Fingar, 2003, p. 63).
R4	Current architecture capabilities	The practices and mechanisms need to take current work in terms of Enterprise Architecture, Business Architecture and Process Architecture into account, but also need to provide sufficient detail if none of these architectures have been defined/documented.	According to Ross *et al.* (2006, p. 26), the first step in building a foundation for execution is to define the OM for the enterprise. No pre-conditions are defined for defining this model. The ability to define this model however is dependent on current architecture capabilities and documented/explicated architectures. Immature architecture capabilities may require additional architecture work, such as defining enterprise-wide process management standards and a centralised process repository (Smith & Fingar, 2003, p.

No	Category	Requirement Detail	Motivation
			177).
R5	Process representation	The practices and mechanisms should encourage consistent process representation to ensure re-use. The extent of re-use includes the following: 1. It should be possible to add process measures if required for the purpose of performance measurement and/or process improvement. 2. The process representations should support end-to-end views of processes. 3. Process representations should not hamper the transition from the third to fourth levels of architecture maturity, i.e. it should allow for modular process design. 4. The representations that are used to communicate process replication opportunities should be understandable to business users (from the contextual and conceptual viewpoints).	A consistent representation may enhance communication about how the business operates, enable efficient hand-offs across enterprise boundaries and allow for consistent performance measurement across enterprise entities or similar competitors (Davenport, 2005). In addition, transitioning from a third to fourth level of architecture maturity (as defined by Ross *et al.*, 2006) requires the identification of business services that may be shared among different enterprise entities. Heinrich *et al.* (2009) maintain that the identification of business services requires a consistent representation of the enterprise's processes.
R6	Replication identification	The mechanisms and practices should enable the identification of operational similar organising entities.	Weill and Ross (2008) mention that replication opportunities may be defined across various types of entities (business units, regions, functions and market segments). The OM itself is however primarily used in defining replication and data sharing requirements across business units.
R7	Feasibility analyses	The mechanisms and practices should not suggest the means for assessing or measuring the feasibility of process replication/rationalisation. Feasibility analysis, e.g. operational, cultural, technical, schedule, economic and legal feasibility (Whitten & Bentley, 2007)) that may be associated with process rationalisation solutions are therefore excluded.	Although a feasibility analysis may direct the required level of process standardisation, this set of mechanisms and practices will merely propose a way of identifying replication opportunities, based on similarities between units. The means for selecting processes that will benefit most from standardisation and the prioritisation of end-to-end processes for standardisation may require a number of mechanisms and practices.

The requirement categories also demarcated the scope of enhancing the OM in terms of *process reuse identification*. In addition to the seven requirement categories, additional *constructional requirements* were also identified (see section 9.2) for OM enhancements:

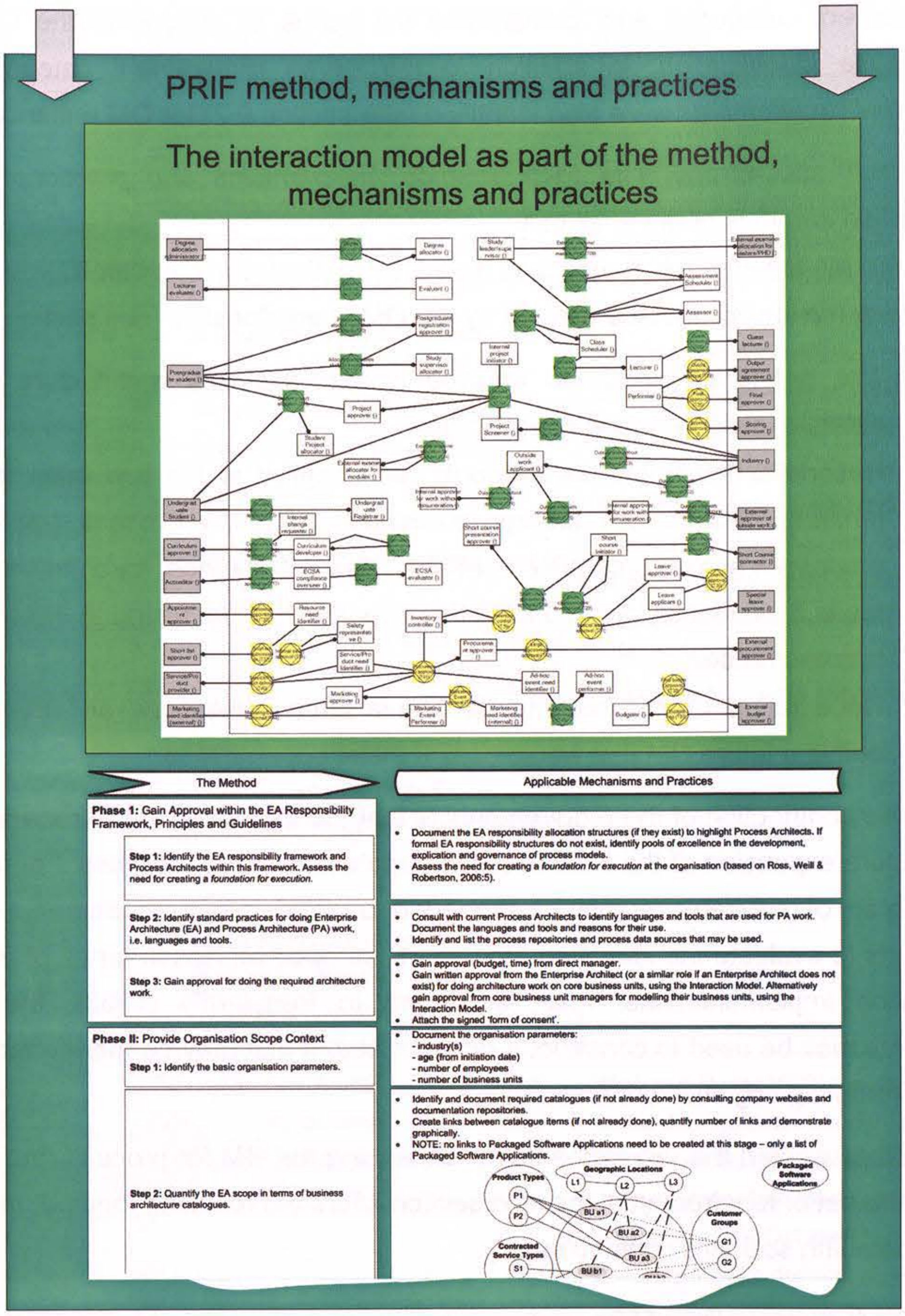
1. Enhance ease-of-use. The PRIF *method, mechanisms and practices* should enable cognition and thus promote its use.
2. Incorporate the interaction model as a part, as motivated in Chapter 8.
3. Address the *implicit method* defined by the OM characteristics (see section 7.3.1):
   - The enterprise needs to analyse certain business architecture parameters to establish rationalisation opportunities.
   - Rationalisation opportunities could be identified within two main areas: (1) Data (sharing data across enterprise entities), and (2) Process (replicating/re-using processes across enterprise entities). The PRIF *method, mechanisms and practices* focus is on identifying rationalisation opportunities pertaining to the second area, i.e. process reuse.
   - Once rationalisation opportunities have been established an enterprise needs to derive a future OM that would exploit these opportunities.

The scientific contribution of the requirements is that the explicated set of requirements may be used for future expansion of the PRIF *method, mechanisms and practices*. For future research, the existing set of requirements may be expanded to include other requirements, e.g. stipulating requirements to evaluate the identified process reuse opportunities in terms of feasible process rationalisation implementations. Also, according to Bertalanffy (1968), the same set of requirements may be used to construct a different output that may be more effective, i.e. easier to use in promoting cognitive understanding.

This section presented the requirements for enhancing the OM for process reuse identification. Based on the set of requirements, the next section offers the resulting *method, mechanisms and practices* as a fifth scientific contribution.

11.3.3 *Method, mechanisms and practices* to enhance the OM concept

This section delineates the second part of PRIF, the *method, mechanisms and practices* to enhance the OM concept, as a scientific contribution.



The *method, mechanisms and practices* consists of three phases (with phase-steps), applicable *mechanisms and practices* for every phase-step, as well as additional guidance with *motivations, considerations and implications*. Section 9.3 presented the detailed *method, mechanisms and practices*.

The scientific contribution of the *method, mechanisms and practices*, is the extension of the existing published knowledge base by addressing deficiencies pertaining to the OM. Since Ross (2010) indicated that they "have never written an academic paper on the topic of the operating model", this thesis not only provides a critical analysis of the OM identifying deficiencies (see sections 6.6 and 7.3), but also provide a solution (a *method, mechanisms and practices*) to address OM deficiencies pertaining to process reuse identification.

As developed from the *requirements* that were identified as a scientific contribution in the previous section, the *method, mechanisms and practices* are primarily useful to EA practitioners. The evaluation results discussed in section 10.4 indicated that EA practitioners will only find the *method, mechanisms and practices* useful if the enterprise of interest has a need to standardise processes, and therefore apply the *method, mechanisms and practices* to identify process reuse opportunities in the enterprise.

Although not a primary contribution of this thesis, it is possible to argue that the inclusion of the interaction model as part of the *method, mechanisms and practices*, is a valuable contribution because it assists with the ontological understanding of enterprise operation. The interaction models that are developed, due to an application of the *method, mechanism and practices*, may be further extended (developed for other business units) and translated into a complete set of ontological aspect models for the enterprise, which defines/documents the essential construction and operation of an enterprise.

11.4 MAIN CONTRIBUTION OF THIS STUDY

The purpose of this section is to summarise the main contribution of this study, which is the *enhancement of the OM concept*, facilitated by a *business-IT alignment contextualisation model*.

Business-IT alignment has been a top concern for IT managers for almost 30 years (Luftman & Ben-Zvi, 2010) and remains a challenge in both the private and public/non-profit sectors. Numerous approaches have been developed in the past to pre-empt the problems associated with misalignment between business and IT. Every approach has its own alignment intent, scope and means for alignment. Yet, every alignment approach has its own deficiencies, as exemplified in this thesis with the *foundation for execution approach* and associated OM. One way to enhance and existing alignment approach is to use elements from another approach. However, combined use of alignment approaches requires a common *frame of reference* to ensure alignment approach compatibility. Since a common *frame of reference* was not available, this thesis presented the development of a contextualisation model, the Business-IT Alignment Model (BIAM).

One of the main goals of this thesis was to enhance the OM, due to its inherent deficiencies. The BIAM was instrumental in the process of demarcating the scope for enhancement, focusing only on the deficiencies related to the *identification of process reuse opportunities*. Therefore, the main research question of this thesis had to be answered:

> What constructs are required for a process reuse identification framework to enhance the operating model concept within the context of business-IT alignment?

The process of enhancing the OM, led to several scientific contributions, as presented in this chapter. The enhancement process, facilitated by the BIAM, led to the development of the main contribution, which is the Process Reuse Identification Framework (PRIF).

The PRIF answered the main research question, by providing the necessary constructs to enhance the operating model concept within the context of business-IT alignment.

11.5 CONCLUSION

This chapter presented five scientific contributions that resulted in answering the two secondary research questions, and thus the main research question of this thesis. In summary, the five contributions are:

- Contribution 1: A model for approach contextualisation
- Contribution 2: Classification categories for approach comparison
- Contribution 3: An Alignment Approach Enhancement Method (AAEM), using the BIAM
- Contribution 4: Requirements for enhancing the OM for process reuse identification
- Contribution 5: A *method, mechanisms and practices* to enhance the OM concept

The main research contribution is the *enhancement of the OM concept*, facilitated by a *business-IT alignment contextualisation model*.

The next chapter provides a conclusion to summarise the thesis.

Chapter 12. Conclusions

12.1 INTRODUCTION

The aim of this chapter is to provide an overview of the findings of this thesis. Since the research questions provided the propositions that were argued in this thesis, section 12.2 summarises the findings per research question, whereas section 12.3 presents opportunities for further research. The thesis concludes with final reflections in section 12.4.

12.2 SUMMARY OF FINDINGS

Three *emerging disciplines* currently contribute towards enterprise design and alignment, EE (enterprise engineering), EA (enterprise architecture) and EO (enterprise ontology). Although a number of publications exist for EE and EA, there is a lack of shared meaning in terms of the *theoretical foundations*, *definitions* and *business benefits*, that creates challenges in searching for relevant literature and advancing the EE and EA disciplines (Kappelman et al., 2010; Lapalme, 2011).

This study was initiated due to my own interest in the disciplines of EE, EA and EO, their complementary use and growth. During the EA practitioners' conferences of TOGAF (Capetown, March 2007; Glasgow, April 2008; Johannesburg, June 2008), I attended several presentations based on the OM. Although several presenters demonstrated their selected OMs and core diagrams as representations to guide enterprise evolution, the methods for constructing the OMs and core diagrams were not transparent. My own observation initiated a survey to assess the practicality of constructing an OM and core diagram, using the content presented by Ross et al. (2006).

The survey highlighted several deficiencies of the OM and core diagram, with the problem awareness that a well-explained *method* was required to obtain OM outputs. The problem awareness led to the initiation of a research design cycle for the development of a well-explained *method*. In search for literature that would contribute towards the development of a suitable *method*, another problem was identified. Although the disciplines of EE, EA and EO presented useful theory, there is still a lack of shared meaning in their definitions and business benefits (Lapalme, 2011). In addition, EA content was mostly embedded in a jungle of frameworks (Schekkerman, 2004). To circumvent the fragmentation that existed in theory, Chapter 4 of this thesis proposed the development of a business-IT contextualisation model (BIAM) to contextualise current alignment approaches and to provide a common understanding across alignment approaches. In addition, the thesis proposed the enhancement of the OM, using the BIAM as a contextualisation tool to select appropriate enhancement elements from existing literature.

The research questions addressed in this study were:

Primary Research Question:
What constructs are required for a process reuse identification framework to enhance the operating model concept within the context of business-IT alignment?
Secondary Research Questions:
1. What model is required to contextualise different business-IT alignment approaches?
2. What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

Since the contextualisation model was instrumental to the further development of a *method* to enhance the OM, a mixed methods research design was required. Chapter 2 motivated the use of a mixed methods research design, where Morse (2010) defined a mixed methods design as a complete method (i.e. the *core component*), plus one (or more) incomplete methods(s) (i.e., the *supplementary component*(s). In this thesis a mixed methods design incorporated a core component (*design research*), which was used to develop the PRIF (Process Reuse Identification Framework), and a supplementary component (*exploratory design*), which was used to develop the BIAM (Business-IT Alignment Model).

Part B (Chapters 3 to 5) and Part C (Chapters 6 to 10) delineated the development of the two main thesis outputs (BIAM and PRIF) by answering the secondary research questions and thereby answering the main research question. Sections 12.2.1 and 12.2.2 summarise the findings of this study pertaining to the two secondary research questions. Section 12.2.3 concludes with a summary of the main thesis contributions.

12.2.1 Summary: Research Question 1

The first research question focused on the contextualisation of alignment approaches in terms of a common business-IT alignment model. The research question was:

What model is required to contextualise different business-IT alignment approaches?

This study intended to reuse the knowledge embedded in existing alignment approaches to enhance the OM concept, associated with the *foundation for execution* approach of Ross et al. (2006). Although a number of publications existed within the disciplines of EE and EA, fragmentation in definition and the overlap between EE, EA and EO complicated the literature survey. Consequently, this study used the current knowledge base inductively to identify similar patterns between existing theoretical alignment approaches. An exploratory design approach was therefore used to identify similarities between alignment approaches inductively to develop a common Business-IT Alignment Model (BIAM).

The study consulted six alignment approaches during the development of the BIAM (section 3.3) and referred to *other alignment approaches* (section 3.4) for examples and explanation. Other theories that contributed towards the construction of the BIAM included the *three schools of thought* (discussed in section 3.2.3), the ISO/IEC/IEEE 42010 standard for architecture description (covered in section 3.2.4), systems theory (discussed in section 3.2.1), and systems engineering and the basic system design process (covered in section 3.2.2). The sample of six alignment approaches gravitated towards the *first school of thought* (enterprise IT architecting) as classified by Lapalme (2011); hence, the BIAM only claimed representation for business-IT alignment.

The study demonstrated the use of BIAM in contextualising four alignment approaches: (1) the Zachman approach, (2) the Open Group approach, (3) the *foundation for execution* approach, and (4) the *essence of operation* approach. The BIAM-contextualisation results not only highlighted the differences between various alignment approaches, but also demonstrated how BIAM was instrumental to enhance the OM (associated with *the foundation for execution* approach) with the interaction model (associated with the *essence of operation* approach). In addition, the BIAM-contextualisation of the *foundation for execution* approach also highlighted deficiencies inherent in using the OM.

Being the *supplementary component*, rather than the core component of this thesis, the results were adequate to confirm that the BIAM is useful to contextualise different business-IT alignment approaches. Section 12.3 suggests further research for additional model verification and scope extension.

12.2.2 Summary: Research Question 2

The second research question focused on the enhancement of the operating model concept by developing a Process Reuse Identification Framework (PRIF). The BIAM (the result of the first research question) was instrumental in the development of the PRIF. The second research question was:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

This thesis used a questionnaire (based on experimentation) to evaluate the practicality of the OM and subsequently motivated that the OM required a more rigorous *method* to guide the practitioner in selecting an appropriate OM for an enterprise. Since the study intended to develop a *method* as an artefact in support of the OM, addressing some of the OM deficiencies, *design research* was an appropriate research design. In accordance with the design cycle stipulated by Vaishnavi & Kuechler (2004/5), the main design research cycle consisted of five steps: (1) awareness of problem, (2) suggestion, (3) development, (4) evaluation, and (5) conclusion. Design research allowed for circumscription (learning by doing) and enabled an incremental development process (executing the third step of the design cycle in three increments).

12.2.2.1 Problem awareness and suggestion

The *awareness* of OM deficiencies and the *suggestion* that the OM was enhanced to address the *method* deficiency of the OM, led to the initial *development* of an OM-enhancing *method*.

The act of development however triggered *circumscription*, with the awareness that a basic system design process (Dietz, 2006) could be used to design the new *method*, initiating the first development increment/sub-cycle.

12.2.2.2 First development increment/sub-cycle

The *first development increment/sub-cycle* started with the *awareness* that the basic system design process required a constructional understanding of the using system (i.e. the construction of the OM), prior to determining requirements for the function of the object system (i.e. the new method). Since the OM is used within the context of the foundation for execution approach, which contributes towards the alignment of business with IT, it was *suggested* that the Business-IT Alignment Model (BIAM) was used to contextualise the foundation for execution approach. This entailed re-visiting the literature on the OM as to determine requirements for the OM-enhancing method.

As a result of the BIAM-contextualisation, the scope for enhancing the OM also changed. Instead of developing a *method* to address all OM deficiencies, the scope of the method was limited to address deficiencies pertaining to the identification of process reuse opportunities at an enterprise. Thus, a set of seven requirement categories was developed for a *method, mechanisms and practices* to identify process reuse opportunities at an enterprise. The identified requirements led to another *circumscription* process, with the awareness that an appropriate process representation language was required to address two of the seven requirement categories. A second development increment/sub-cycle was thus required.

12.2.2.3 Second development increment/sub-cycle

The *second development increment/sub-cycle* started with the *awareness* that two of the seven requirement categories, namely *process representation* and *replication identification*, necessitated the selection of a suitable process representation language. Since current process representation languages addressed similar requirements (pertaining to *process representation* and *replication identification*), the study had to select a process representation language that complied with *both* requirement categories.

Re-visitation of literature revealed that the ontological aspect models, used within the *essence of operation* approach, seemed to be promising in addressing the two requirement categories. To ensure compatibility with the *foundation for execution* approach and its associated OM, a *suggestion* was made to contextualise the *essence of operation* approach and more specifically one of its ontological aspect models (the interaction model) within a business-IT context. Using a common model for business-IT contextualisation, BIAM (Business-IT Alignment Model), would enable one to compare the two alignment approaches (*foundation for execution* approach and *essence of operation* approach) and their supporting models. The comparison results indicated compatibility between the *foundation for execution* approach and the *essence of operation* approach. In addition, an evaluation strategy was developed to ensure adherence to the requirements pertaining to *process representation* and *replication identification*. The interaction model had to enhance *ease of understanding* for *business users* and had to enable the *identification of operational similar organising entities* from a *practitioner's perspective*.

The *evaluation* strategy followed a participative and experimental approach, involving four research participants (industrial engineers) to develop interaction models for four engineering departments at a tertiary education institution. The interaction models were developed consecutively at the different departments, verifying the contents with the heads of the departments. The experimentation process required active involvement and use of open-ended questions. Positive results were obtained in terms of *ease of understanding* from the *business user* viewpoint (heads of departments). From a *practitioner's perspective*, the interaction model also enabled the *identification of operational similar organising entities*. Some of the interaction model limitations identified by the participants were due to a limited understanding of the combined use of the ontological aspect models and the purpose/use of each ontological aspect model. The feedback would be useful for future research to refine the method for constructing an interaction model and refining the constructs of the interaction model.

The positive results pertaining to the experimental evaluation substantiated the inclusion of the interaction model as part of the new *method, mechanisms and practices* to augment the OM concept. Further development of the *method, mechanisms and practices* however led to another *circumscription* process, with the awareness that a creative process was required in developing the *method, mechanisms and practices*, which initiated a third development increment/sub-cycle.

12.2.2.4 Third development increment/sub-cycle

The *third development increment/sub-cycle* started with the *awareness* that a creative process was required in developing the *method, mechanisms and practices*, whilst including the interaction model as part of the *method, mechanisms and practices*. With reference to the basic system design process, construction of the object system (i.e. the *method, mechanisms and practices*), required a process of devising specifications to translate functional requirements into constructional elements. According to Hoogervorst (2009) devising specifications may also be interpreted as devising constructional requirements. It was therefore *suggested* that a creative development process was used to incorporate both functional and constructional requirements into a constructed *method, mechanisms and practices*.

Construction resulted in a *method* that comprised of three phases and respective phase steps. In addition, applicable *mechanisms and practices* were provided for each phase step. As to guide the practitioner in the correct use of the *method, mechanisms and practices*, additional mechanisms and practices *motivations, considerations and implications* were also provided.

The third development increment/sub-cycle concluded the third step of the main design research cycle.

12.2.2.5 Evaluation and conclusion

The last two steps, *evaluation* and *conclusion*, required an evaluation of the newly developed artefact (PRIF *method, mechanisms and practices*) and interpretation of the evaluation results. Since the *method, mechanisms and practices* were already built/triangulated against requirements, external evaluation was confined to two measures, namely *usefulness* and *ease-of-use*. *Usefulness* measured the perceived value of the *method, mechanisms and practices* to all enterprises in identifying process re-use opportunities at the enterprise. Ease-of-use, on the contrary, measures the ease of using the *method, mechanisms and practices* to identify process re-use opportunities at an enterprise.

A questionnaire (based on experimentation) was used to evaluate the *method, mechanisms and practices*, involving twelve participants. The results indicated that research participants were positive towards the usefulness and ease-of-use of the *method, mechanisms and practices*. However, qualitative feedback suggested further improvement of the *method, mechanisms and practices*, which may be incorporated in future research.

12.2.3 Summary: Contributions

Sections 12.2.1 and 12.2.2 provided the findings related to the two secondary research questions. Two main artefacts were developed to address the two research questions: the Business-IT Alignment Model (BIAM) and, the Process Reuse Identification Framework (PRIF). Five scientific contributions resulted from this thesis (see Chapter 11):

- Contribution 1: A model for approach contextualisation
- Contribution 2: Classification categories for approach comparison
- Contribution 3: An Alignment Approach Enhancement Method (AAEM), using the BIAM
- Contribution 4: Requirements for enhancing the OM for process reuse identification
- Contribution 5: A *method, mechanisms and practices* to enhance the OM concept

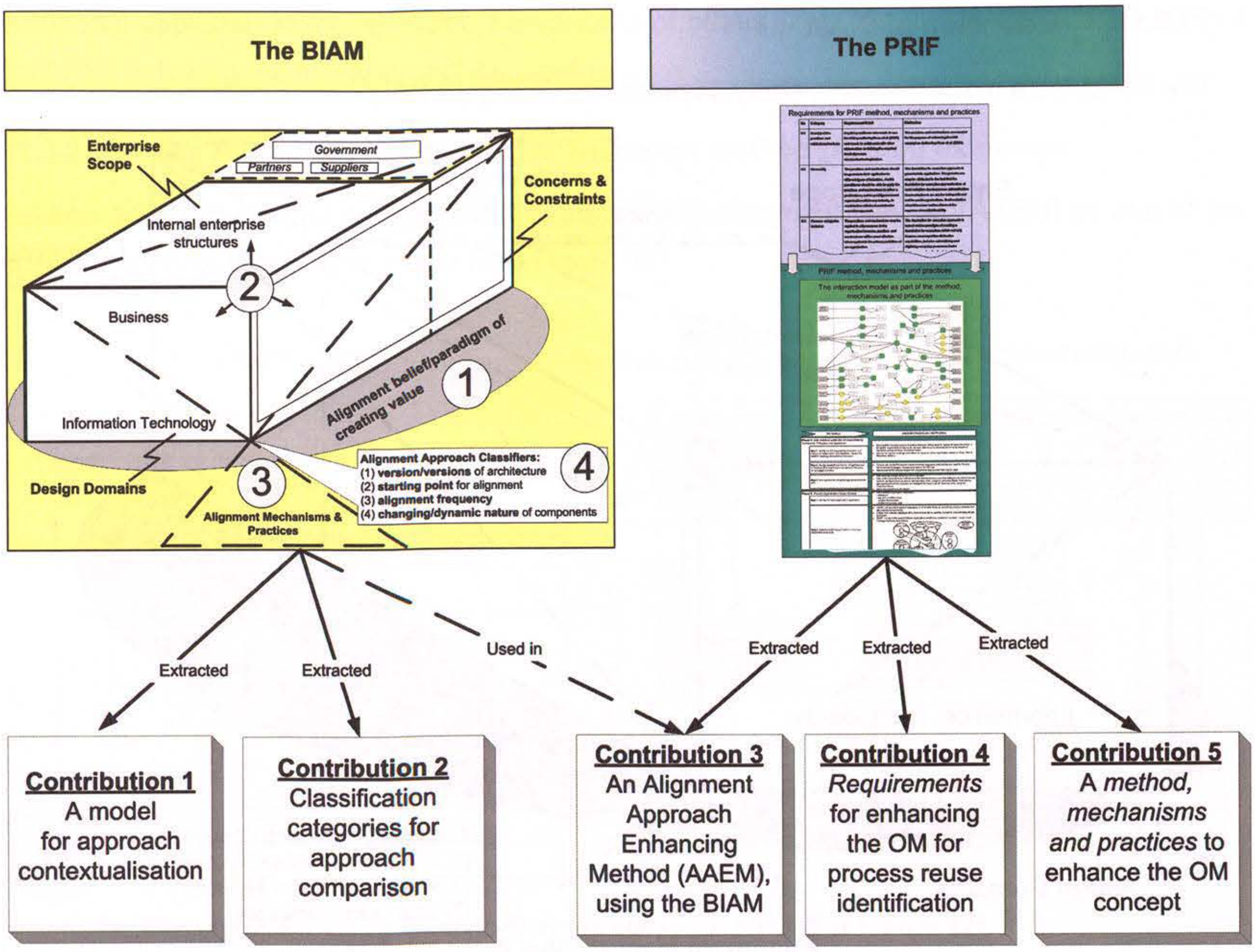


Figure 93: Thesis contributions (duplicate of Figure 90)

The next section accepts the contributions made in this thesis and suggest contribution extensions, based on further research.

12.3 FURTHER RESEARCH

This section suggests further research, based on the results obtained in this thesis. Section 12.3.1 presents ideas for extending the BIAM and the *approach comparison table*, whereas section 12.3.2 concludes with an agenda to expand the Alignment Approach Enhancement Method (AAEM).

12.3.1 Extension of BIAM

The BIAM, as a result from this study, is presented in Figure 94.

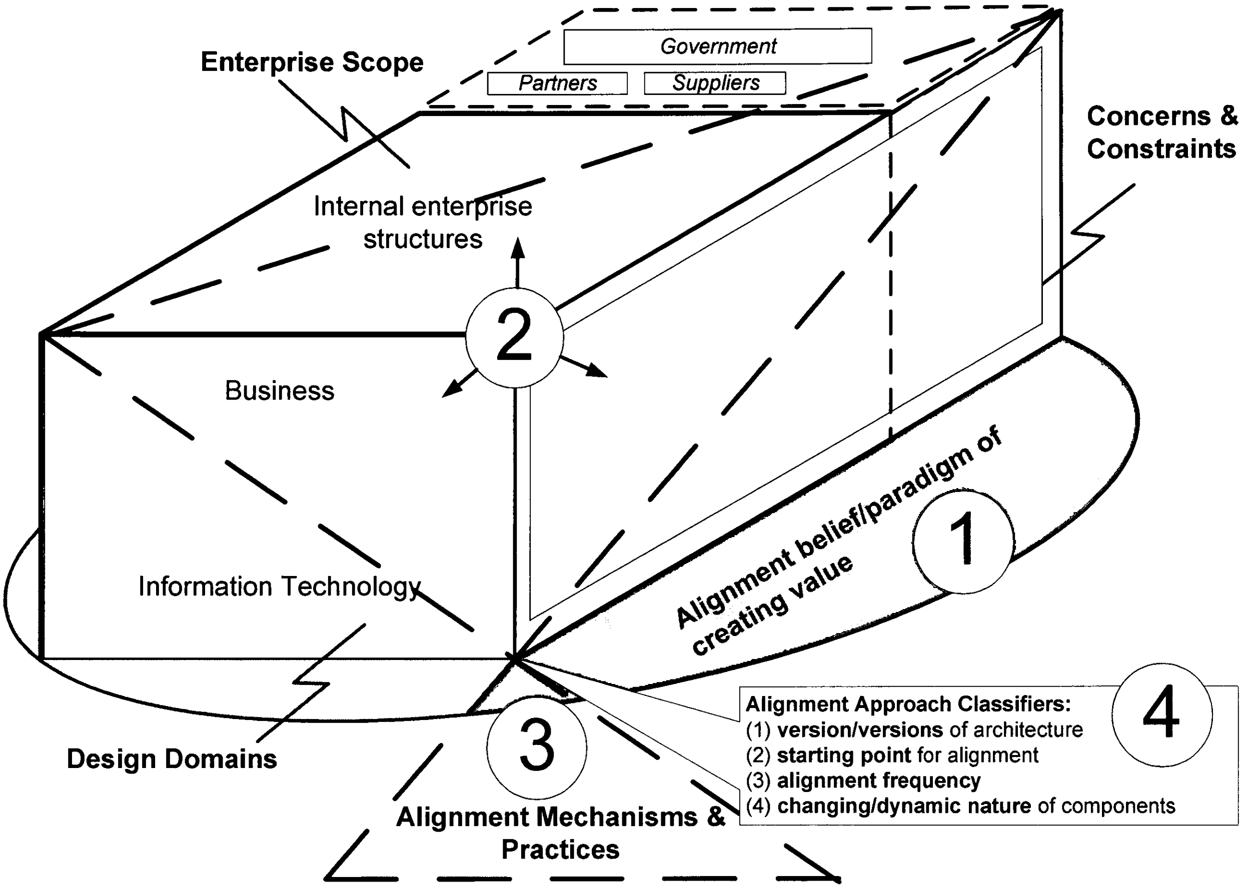


Figure 94: The BIAM (duplicate of Figure 45)

This section presents opportunities for extending the BIAM in terms of two facets: component extension, and scope extension.

In terms of *component extension*, the current *alignment belief/paradigm of value creation* component relates to the philosophical dimension of a paradigm, providing the *why* of the approach and the grounds for the type of activities included in the alignment *mechanisms and practices.* However, the component does not delve deeper into the worldviews of the authors (i.e. the paradigmatic assumptions of the authors). An application of paradigmatic analysis tools is proposed to extend the paradigmatic analysis of the BIAM.

Regarding *scope extension*, the development process of the BIAM took cognisance of the three different schools of thought on alignment approaches, as defined by Lapalme (2011), and the differences in design and alignment scope. Although most of the alignment approaches that were consulted gravitate towards the third school of thought (enterprise IT architecting), one could investigate the use of the BIAM within a wider scope.

Section 11.2.2 presented an approach comparison table (see Table 24), based on the four components of the BIAM, to compare different alignment approaches for compatibility.

Additional approach mapping, using frameworks of others (e.g. Mingers & Brocklesby (1997)) could aid in linking the two approaches together.

12.3.2 The Alignment Approach Enhancement Method (AAEM) extension

Section 11.3.1 presented an Alignment Approach Enhancement Method (AAEM) as one of the scientific contributions of this thesis (see Figure 95).

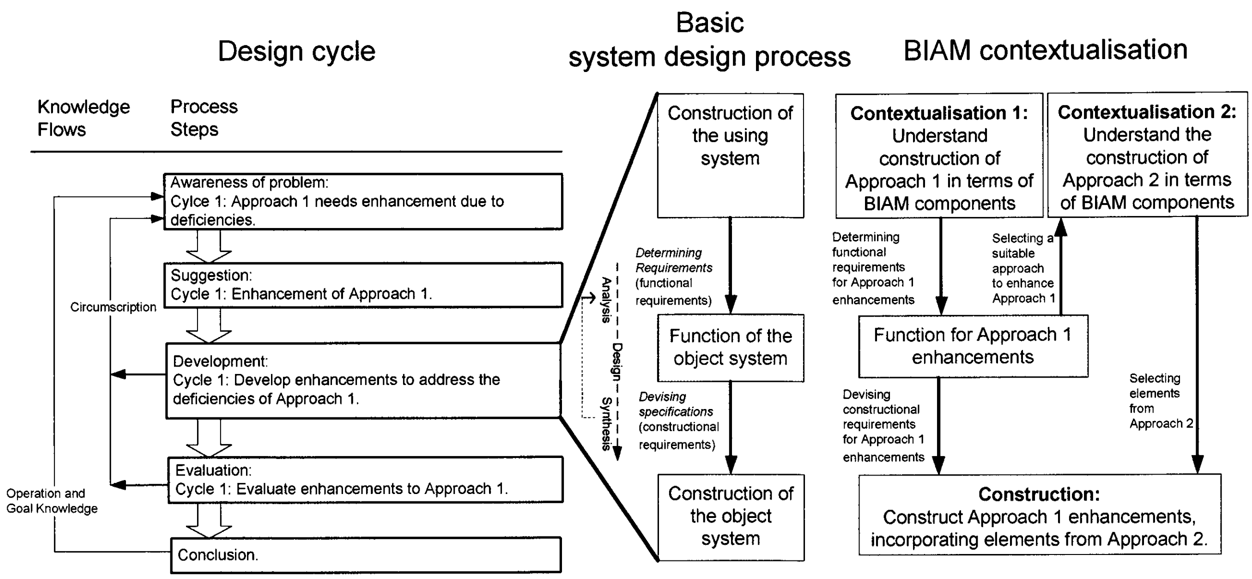


Figure 95: Alignment approach enhancement process (duplicate of Figure 92)

The AAEM provides a single example of enhancing one alignment approach (the *foundation for execution* approach) with an element (the interaction model) from another approach (the *essence of operation* approach). To increase rigidity, more cases would be required to verify the use of the AAEM.

The AAEM is useful if one needs to enhance an existing alignment approach with elements from another alignment approach. However, there is also the need to combine elements from multiple approaches (Dumay et al., 2005). Further research would however be required to combine/mix elements from multiple approaches.

12.4 REFLECTIONS

This study is primarily qualitative in nature and concerned with interpretation. An interpretive understanding assumes that meaning is context-specific and constructive. There is no single 'correct' meaning. Thus, there is a possibility that two different researchers may apply sound, but similar research methods, yet arrive at different answers/solutions.

Qualitative research requires a different concept of reliability than quantitative research. In making qualitative research reliable, Steinke (2004) suggests a systematic and transparent research process, which includes motivations for every conclusion and every step in the research process. Due to their active involvement, the supervisors of this thesis provided multiple perspectives on the research process to increase the reliability of the study.

The following sections present reflections and lessons learnt, in terms of both methodology and scientific contribution. Section 12.4.1.1 reflects on the use of a mixed methods design in answering the main research questions of this thesis. Section 12.4.1.2 reflects on the scientific contributions that resulted from this study.

12.4.1 Methodological reflection

This section reflects on the mixed methods design that was used in answering the main research question.

A mixed methods design, as prescribed by Morse (2010), was appropriate to answer the main research question of this thesis, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept within the context of business-IT alignment?

The mixed methods design, as defined by Morse (2010), requires two design components to answer the main research question. According to Morse (2010), the two design components (a *core component* and *supplementary component*) may be used sequentially or simultaneously. The *supplementary component* continues until the researcher is certain enough that the sub-question (pertaining to the *supplementary component*) is answered.

This study started with the *core component* (*design research*) in answering *Research Question 2*, namely:

What constructs are required for a process reuse identification framework to enhance the operating model concept, using the business-IT contextualisation model?

Since an appropriate business-IT contextualisation model could not be found, the study also initiated a *supplementary component* (*exploratory design*), to develop a business-IT contextualisation model, thus answering the Research Question 1, namely:

What model is required to contextualise different business-IT alignment approaches?

Thus, the *supplementary component* (*exploratory design*) was used *simultaneously* with the *core component* (*design research*) to answer the main research question. As suggested by Morse (2010), the *supplementary component* (*exploratory design*) only continued until the sub-question (related to the *supplementary component*) was answered.

Using a mixed methods design (see Figure 13), the core component (*design research*), developed the PRIF (Process Reuse Identification Framework), and a supplementary component (*exploratory design*), developed the BIAM (Business-IT Alignment Model). Even though Morse (2010) states the *supplementary component* may not be publishable within a single study, the result of the supplementary component (initially called the Business-IT Alignment Framework (BIAF)) was published as a single study (De Vries, 2010). Yet, the result of the *supplementary component* (BIAM) was a prerequisite in providing *business-IT alignment insight* for the *core component*.

Reflecting on the mixed methods design, one could have reasoned that the entire study used *design research* as the primary method, rather than a mixed methods design. Using the single method approach implies that the first iteration of the design cycle would have created the awareness that a business-IT alignment model for contextualising current alignment approaches, *did not exist*. Rather than treating the development of the Business-IT Alignment Model (BIAM) as a supplementary component within a mixed methods design, one could have incorporated the BIAM as the development of another artefact within the *design research* paradigm. Using *design research* as the primary method would thus have created another development sub-cycle (Figure 96, column 2, *Sub-cycle 0*).

Although feasible in terms of the *design research* paradigm, the mixed methods approach was suitable to highlight the two separate contributions (BIAM and PRIF) that were made in this study, but also to emphasise that the supplementary component (*exploratory design*) was an incomplete design (e.g. using literature review alone as data collection instrument) for developing the BIAM. The core component (*design research*), however, required a complete design (e.g. adhering to the guidelines of Hevner et al. (2004) in doing design research, and using questionnaires and interviews as appropriate). The mixed methods design also highlighted that the *supplementary component* provided *business-IT alignment insight* for the *core component.*

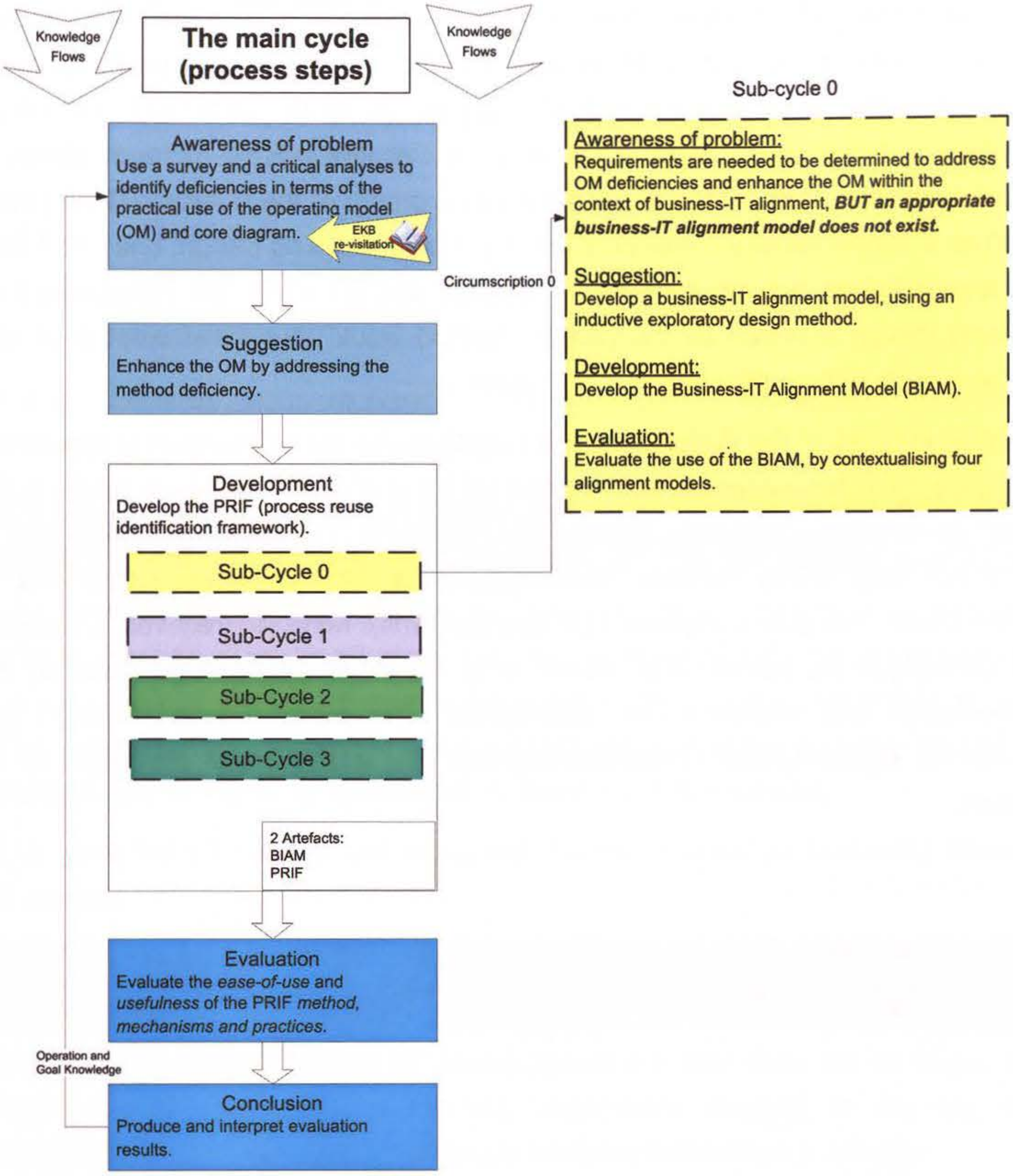


Figure 96: Using only design research, rather than a mixed methods design

The next two sections (12.4.1.1 and 12.4.1.2) reflect on the two separate designs (*exploratory design* and *design research*), and their associated data-collection methods in answering the two research questions.

12.4.1.1 Methodological reflection: Research Question 1

In answering the first research question, the study used *exploratory design* as a supplementary component within a mixed methods design, to develop the BIAM. Since an incomplete design is sufficient for the supplementary component (Morse, 2010), a *literature review* was sufficient for extracting themes/patterns inductively from existing alignment approaches. Morse (2010) also states that an inadequate sample size is sufficient for a supplementary component. The study used a sample of four alignment approaches as the primary data source for building the BIAM and evaluated the use of BIAM, by doing four contextualisations. Increasing the reliability of the BIAM to reflect different facets of business-IT alignment, would require a larger sample size.

Another technique that would increase the reliability of the BIAM components, is content analysis. A content analysis has the advantage of limiting the analysis to aspects that are relevant in terms of a specific research question. However, content analysis requires that the coding frame is at a higher level of abstraction than the more concrete information in the analysed material (Schreier, 2012). Thus, by classifying the concrete information according to a coding frame, results in losing information.

Schreier (2012) also differentiates between *quantitative* and *qualitative* content analysis. *Quantitative* content analysis determines the frequency of themes in the analysed material. A pure *quantitative* type of content analysis disregards the fact that meaning is often complex, holistic, and context-dependent. In addition, some aspects of meaning may only appear once in a text, which does not necessarily imply insignificance (Schreier, 2012). *Qualitative* content analysis, also called *thematic coding* (Saldana, 2009), focuses on latent meaning (meaning that is not immediately obvious), whereas *quantitative* content analysis focuses on literal meaning (Schreier, 2012).

Although time-consuming, *qualitative* context analysis would be useful to arrive at a comprehensive set of themes/patterns. Qualitative context analysis would allow one to consider context, when analysing the different alignment approaches.

12.4.1.2 Methodological reflection: Research Question 2

In answering the second research question, *design research* was used as the core component within a mixed methods design, to develop the PRIF. Since an complete design is required for the core component (Morse, 2010), *design research* was used according to the design research guidelines of Hevner et al. (2004).

Design research facilitated the incremental process of developing a new artefact. The process of circumscription (gaining new knowledge via the act of doing) also allowed for incremental learning, continuously engaging and interacting with current theory. An alternative research design that was also considered, is a model- or method-building approach. According to Mouton (2001), this approach consists of a set of postulates that are taken to be true. Theoretical propositions are then deducted from the postulates and finally tested against empirical data. Although the model-building approach captures part of the design cycle pattern (awareness of problem, suggestion, development, and evaluation), the model-building approach does not reveal the process of circumscription that lead to additional design research sub-cycles. Avenier (2010) emphasises *explicitness* as a prerequisite for doing constructivist research, i.e. providing sufficient grounding for the knowledge claims that are made. Design research enables explicitness and transparency by allowing an iterative design process and the concurrent creation/explication of knowledge. In addition, design research also allows for future extension of this study via additional design cycles.

Data-collection methods included *questionnaires* and *interviews*.

Questionnaires were used as part of two separate evaluations within the research design:

- Evaluating the *practicality of the operating model (OM)* and core diagram (see section 6.3).
- Evaluating the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices* (see section 10.2)

Both questionnaires included close-ended and open-ended questions, allowing the participants to express their experiences with current or new theoretical models.

Since the study did not aim to generalise findings scientifically (i.e. with a known degree of accuracy), *nonprobability sampling* (using convenience samples) was adequate for both evaluations. Both evaluations used a convenience sample of graduate participants. The participants were willing to take part in the questionnaires (based on experimentation), and were educated on business-IT alignment theory to increase the validity of the evaluation results.

The second questionnaire (evaluating the PRIF *method, mechanisms and practices*) also included descriptive statistics (*average* and *standard deviation*) to measure the *usefulness* and *ease-of-use* of the PRIF *method, mechanisms and practices*. The descriptive statistics were only used to highlight areas that required further research and was not used to confirm or reject a hypothesis. If *probability sampling* was used, it would be possible to state the levels of *usefulness* and *ease-of-use* with a quantifiable level of confidence. Increasing the certainty of the exact levels of *usefulness* and *ease-of-use* would, however, not contribute significantly for the purpose of this study.

Semistructured interviews were used to request feedback from the heads-of-departments (HODs) of a tertiary education institution to obtain feedback on the ease of understanding of the interaction model. An alternative to interviews would be questionnaires, using open-ended questions. One of the disadvantages of a questionnaire is that the number of respondents are low. In addition, a questionnaire disallows interpretation based on body language and facial expression, which may require additional probing. In guaranteeing feedback from the small sample of four HODs, an interview was more appropriate.

12.4.2 Scientific reflection

The scientific contribution of this study can be depicted graphically (see Figure 97) to emphasise the two main contributions, namely the BIAM and the PRIF. The development of BIAM and PRIF resulted in five scientific contributions. The purpose of this section is to reflect on the five scientific contributions within a broader context, i.e. relating the contributions to the *scientific body of knowledge*.

The section starts with a summary of the five scientific contributions (section 12.4.2.1) and reflects on the scientific contributions of BIAM (section 12.4.2.2), and PRIF (section 12.4.2.3).

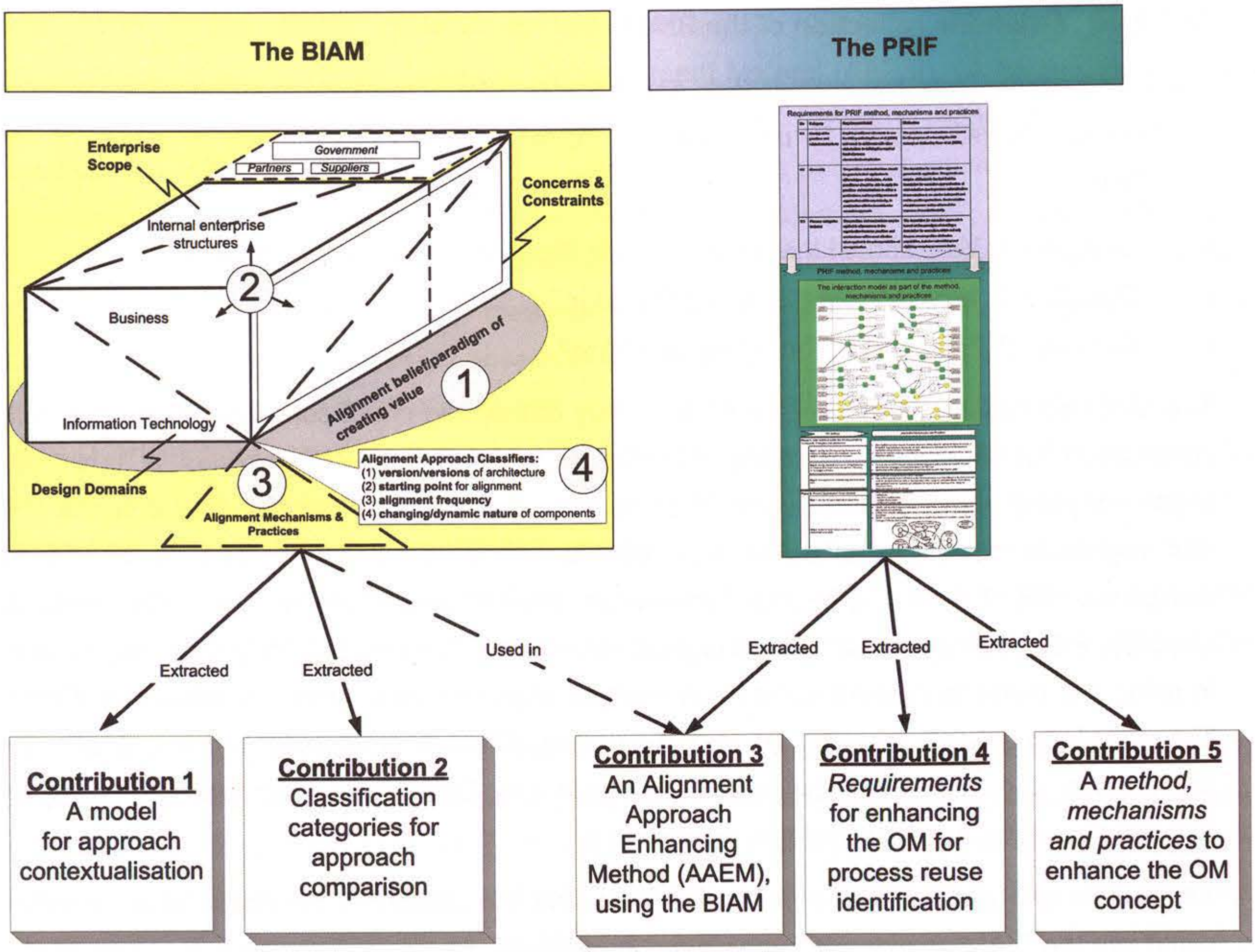


Figure 97: Thesis contributions (duplicate of Figure 90)

12.4.2.1 Contribution summary

Initially, the aim was to develop an artefact that would address the OM deficiencies. However, the fragmentation that existed within the emerging disciplines of EE, EA and EO, made it difficult to reuse the existing body of knowledge to address the deficiencies related to the OM. The fragmentation problem led to the development of a contextualisation model, the BIAM.

Although the BIAM was initially used as a supporting tool to assist with the development of the PRIF, the BIAM has more potential. This thesis demonstrates the BIAM potential in terms of two contributions:

- Contribution 1: A model for approach contextualisation
- Contribution 2: Classification categories for approach comparison

BIAM was instrumental in developing the PRIF and used as part of the PRIF design process. The PRIF design process delivered three contributions:

- Contribution 3: An Alignment Approach Enhancement Method (EEAM), using the BIAM
- Contribution 4: Requirements for enhancing the OM for process reuse identification
- Contribution 5: A *method, mechanisms and practices* to enhance the OM concept

12.4.2.2 Scientific reflection of the BIAM

The BIAM circumvents the irregularities and fragmentation that exists in literature, by providing a common analysis model to *understand* a current alignment approach in terms of *three questions*:

- Question 1: *Why* should the enterprise use the proposed approach to align?
- Question 2: *What* should the enterprise align?
- Question 3: *How* should the enterprise align?

The BIAM addresses the three questions by way of four alignment components. As a scientific contribution (*extending the existing knowledge base*), the BIAM provides a business-IT alignment perspective to analyse and understand current alignment approaches in terms of the four alignment components. BIAM thus recognizes the knowledge embedded in emerging disciplines (EE, EA and EO), but circumvents the fragmentation that currently exists and suggests their combined use. The pedagogic value of the BIAM has already been demonstrated in using the BIAM to present content on multiple alignment approaches to several audiences. The BIAM provides a vehicle for discussing the different emphases of current alignment approaches (e.g. the Zachman approach versus The Open Group approach) and highlight deficiencies within current alignment approaches.

Academics and *practitioners* that are involved with the design or re-design of an enterprise could use the BIAM as *extended knowledge* in various ways.

The *academic* may need to generalise on the combined use of current alignment approaches within a specific type of industry. The BIAM provides a common contextualisation tool for the separate alignment approaches to highlight their similarities and differences, which could enact their combined use and adaptation. The act of contextualisation (e.g. using the BIAM) is also called *knowledge-activation*, which is a complex process that implies reflection and re-interpretation (Avenier, 2010). *Knowledge-activation* of the BIAM may lead to other applications, which were not initially intended. As an example, a Masters student already considers using the BIAM to contextualise and compare diverse *enterprise alignment* approaches (not necessarily business-IT alignment approaches) within a telecommunications enterprise.

The *practitioner* may also need to combine different alignment approaches at an enterprise. Post-graduates (of 2010, 2011 and 2012) have already used the BIAM to contextualise alignment approaches at their employer-enterprises. Additional qualitative feedback on the interpretation and use of the BIAM would be an agenda for further research.

12.4.2.3 Scientific reflection of the PRIF

The initial aim of this thesis was to enhance the OM, addressing the OM deficiencies. The development of the PRIF contributed in several ways to the *scientific body of knowledge*.

The research design (*design research*) facilitated the incremental process that was required to enhance the OM, by developing the PRIF. Although not the initial purpose of this thesis, an application of the *design cycle* (Vaishnavi & Kuechler, 2004/5) contributed towards the development of an Alignment Approach Enhancement Method (AAEM), which incorporates the BIAM. Although *design research* (especially IT-based design) received attention and development within the IS discipline, some also indicated its potential within organisation theory development and improvement of professional practice (Mohrman, 2007; Romme, 2003; Van Aken, 2005). Keuchler & Vaishnavi (2008) also favoured a broader scope for *design science research* than its current focus on creating low level artefacts (IT mechanisms). This thesis demonstrates the use of *design research* to create an artefact (AAEM) to enhance one alignment approach with another. The use of *design research* in creating the AAEM (not a low level IT artefact), opens up new opportunities for research within the emerging discipline of EE, EA and EO. The AAEM encourages application of existing knowledge in new ways (i.e. enhancing one alignment approach with another). The underlying *design research* structure (sequential steps and iterative cycles due to circumscription) and *basic system design process* (based on Dietz (2006)) embedded in the AAEM, provide transparency and explication of the research process.

Two research projects within the Industrial Engineering department (University of Pretoria) already embarked on the re-use of existing alignment methods, methodologies and frameworks within different industries. The AAEM is useful during the initiation phase of these research projects, providing a blueprint research design, which encourages the simultaneous development of the emerging disciplines of EE, EA and EO.

This thesis demonstrated the AAEM by enhancing the OM with a Process Reuse Identification Framework (PRIF). The PRIF extends the current knowledge base (OM and associated *foundation for execution* approach of Ross et al. (2006)). Although restricted to the *practitioner* who intends using the *foundation for execution* approach and its associated OM, *knowledge-activation* may lead to other applications of the PRIF, which were not initially intended. As an example, a presentation at the ISEM 2011 (Industrial and Systems Engineering and Management) conference demonstrated the effective use of the Interaction Model (IAM) to identify replication opportunities at an enterprise. The presentation led to collaboration between the Department of Industrial Engineering (University of Pretoria) and the CSIR (Council of Scientific and Industrial Research) to apply part of the PRIF within an enterprise re-design initiative.

Thus, the process of enhancing the OM, facilitated by the BIAM, led to several scientific contributions, of which the main contribution is the development of the Process Reuse Identification Framework (PRIF).

The PRIF answered the main research question, by providing the necessary constructs for a process reuse identification framework to enhance the operating model concept within the context of business-IT alignment.

12.5 CLOSURE

Thus, based on the findings of this thesis, it can be stated that this study supports the thesis statement that *the operating model concept, as part of a business-IT alignment approach, can be enhanced with a process reuse identification framework, when a business-IT alignment contextualisation is used.*

Aveiro, D., Silva, A. R., & Tribolet, J. (2011). Control organisation: a DEMO based specification and extension. In A. Albani, J. L. G. Dietz & J. Verelst (Eds.), *Advances in Enterprise Engineering V* (pp. 16-30). Berlin: Heidelberg: Springer-Verlag.

Avenier, M. (2010). Shaping a constructivist view of organisational design science. *Organisation studies, 31*(9-10), 1229-1255.

Avolution. (2012). ABACUS. Retrieved 7 May, 2012, from http://www.avolution.eu/

Ballengee, B. V. (2010). Why enterprise architecture matters: surfing the waves. In L. A. Kappelman (Ed.), *The SIM guide to enterprise architecture* (pp. 46-51). Boca Raton: CRC Press.

Bernard, S. A. (2005). *An Introduction to Enterprise Architecture EA3* (2nd ed.). Bloomington: Authorhouse.

Bertalanffy, L. (1968). *General systems theory: foundation, development, applications.* Middlesex: Penguin Books.

Bespoke Systems. (2012). Timeline of Enterprise Architectures. Retrieved 20 February, 2012, from http://www.bespokesystems.net/ea/timeline/

Bittler, R. S., & Kreizman, G. (2005). *Gartner Enterprise Architecture Process: Evolution 2005* (No. G00130849). USA: Gartner Group.

Blowers, M. (2012). Hybrid enterprise architecture frameworks are in the majority. Retrieved 12 April, 2012, from http://ovum.com/2012/03/22/hybrid-enterprise-architecture-frameworks-are-in-the-majority/

Boar, B. H. (1999). *Constructing blueprints for enterprise IT architecture*. New York: J. Wiley.

Boardman, J., & Sauser, B. (2008). *Systems thinking: coping with 21st century problems*. Boca Raton: CRC Press.

Booth, A., Papaionnou, D., & Sutton, A. (2012). *Systematic approaches to a successful literature review*. California: Sage Publications.

Buchanan, R. D., & Soley, R. M. (2002). *Aligning Enterprise Architecture and IT Investments with Corporate Goals*. Needham: OMG and Meta Group.

Bunge, M. A. (1979). *Treatise on basic philosophy, Vol. 4: a world of systems.* Dortrecht: Reidel Publishing Company.

Burrel, G., & Morgan, G. (1979). *Sociological paradigms and organisational analysis.* London: Heineman.

Cambridge Dictionary. (n.d.-a). Cambridge Dictionaries Online: Framework. Retrieved 20 February, 2012, from http://dictionary.cambridge.org/dictionary/british/framework?q=framework

Cambridge Dictionary. (n.d.-b). Cambridge Dictionaries Online: Model. Retrieved 20 February, 2012, from http://dictionary.cambridge.org/dictionary/british/model_4

Capgemini. (2007). Enterprise, business and IT architecture and the integrated architecture framework. Retrieved 18 November, 2008, from http://www.capgemini.com/insights-and-resources/by-publication/enterprise_business_and_it_architecture_and_the_integrated_architecture_framework/

Chamaz, K. (2006). *Constructing grounded theory: a practical guide through qualitative analysis*. California: Sage.

Ciborra, C. (2002). *The labyrinths of information*. Oxford: Oxford University Press.

Creswell, J. W. (2007). *Qualitative inquiry and research design: choosing among five approaches* (2nd ed.). California: Sage.

Creswell, J. W., & Plano Clark, V. L. (2006). *Designing and conducting mixed methods research* (2nd ed.). California: Sage Publications.

Czaja, R., & Blair, J. (2005). *Designing surveys*. London: Sage Publications.

Damschroder, L. J., Aron, D. C., Keith, R. E., Kirsh, S. R., Alexander, J. A., & Lowery, J. (2009). Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation Science, 4*(50).

Davenport, T. H. (2005). The coming commoditisation of processes. *Journal, 83*(6). Retrieved from http://hbr.org/2005/06/the-coming-commoditization-of-processes/ar/1

De Vries, M. (2010). A framework for understanding and comparing enterprise architecture models. *Management Dynamics, 19*(2), 17-29.

De Vries, M., Van der Merwe, A., Gerber, A., & Kotzé, P. (2010). Refining the operating model concept to enable systematic growth in operating maturity. In C. Schutte (Ed.), *Proc. 24th SAIIE Conference* (pp. 32-46). Glenburn Lodge, Gauteng: SAIIE.

De Vries, M., & Van Rensburg, A. C. (2009). Evaluating and refining the 'Enterprise Architecture as Strategy' approach and artefacts. *South African Journal of Industrial Engineering, 20*(1), 31-43.

DeBoever, L. R., Paras, G. S., & Westbrock, T. (2010). A pragmatic approach to a highly effective enterprise architecture program. In L. A. Kappelman (Ed.), *The SIM guide to enterprise architecture* (pp. 156-161). Boca Raton: CRC Press.

Dictionary.com. (n.d.). Dictionary.com's 21st century lexicon: Metamodel. Retrieved 22 February, 2012, from http://dictionary.reference.com/browse/metamodel

Dietz, J. L. G. (2006). *Enterprise ontology*. Berlin: Springer.

Dietz, J. L. G. (2009). DEMO-3 Models and Representations. Retrieved 4 May, 2011

Dietz, J. L. G., & Hoogervorst, J. (2011). An enterprise engineering based examination of TOGAF. Retrieved 20 February, 2012, from http://www.sapio.nl/sapio2010/pdf/jd236_togaf.pdf

Dietz, J. L. G., & Hoogervorst, J. A. P. (2010). An enterprise engineering based examination of TOGAF. Retrieved 26 March, 2012, from http://www.sapio.nl/sapio2010/pdf/jd236_togaf.pdf

Dumay, M., Dietz, J. L. G., & Mulder, J. B. F. (2005). Evaluation of DEMO and the Language-Action Perspective after 10 years of experience. In G. Goldhuhl, M. Lind & S. Haraldson (Eds.), *The Lanaguage Action Perspective on*

Communication Modelling, 10th International Working Conference. (pp. 77-106). Kiruna.

Dunshire, K., O'Neill, T., Denford, M., & Leaney, J. (2005). The ABACUS architectural approach to computer-based system and enterprise evolution. In *Proceedings of the 12th IEEE International Conference and Workshops on the Engineering of Computer-Based Systems* (pp. 662-669). USA: IEEE.

EA Research Forum. (2009). Enterprise architecture definition. Enterprise Architecture Research Forum.

Engelbrecht, R. (2010). An enterprise architecture approach: towards a method for standardising processes across different business units at a tertiary education institution. Retrieved 2 June, 2011, from http://repository.up.ac.za/upspace/bitstream/2263/16174/1/Engelbrecht_Enterprise%282010%29.pdf

Forrester, J. W. (1968). Industrial dynamics - a response to Ansoff and Slevin. *Management Science, 14*, 601-618.

GAO. (2006). Enterprise architecture: leadership remains key to establishing and leveraging architectures for organisational transformation. Retrieved 1 February, 2008, from http://www.gao.gov/new.items/d06831.pdf

Gartner. (2008a). Develop solution architectures and the enterprise solution architecture. In *Gartner Summit, November 2008 4*. USA: Gartner Group.

Gartner. (2008b). Develop the business context. In *Gartner Summit, November 2008 4*. USA: Gartner Group.

GERAM. (1999). Generalised Enterprise Reference Architecture and Methodology, Version 1.6.3. Retrieved 30 November, 2009, from http://hobbit.ict.griffith.edu.au/~bernus/taskforce/geram/versions/geram1-6-3/v1.6.3.html

Gharajedaghi, J. (2006). *Systems thinking - managing chaos and complexity: a platform for designing business architecture* (2nd ed.). New York: Elsevier Inc.

Giachetti, R. E. (2010). *Design of enterprise systems*. Boca Raton: CRC Press.

Gibbs, G. (2007). *Analysing qualitative data*. London: Sage Publications.

Gregg, D., Kulkarni, U., & Vinze, A. (2001). Understanding the philosophical underpinnings of software engineering research in Information Systems. *Information Systems Frontiers, 3*(2), 169-183.

Gregor, S., Hart, D., & Martin, N. (2007). Enterprise architectures: enablers of business strategy and IS/IT alignment in government. *Information technology and people, 20*(2), 96-120.

Habermas, J. (1981). *Theorie des Kumminikatives Handelns*. Frankfurt: Suhrkamp Verlag.

Hammer, M., & Champy, J. (1993). *Reengineering the corporation*. London: Nicholas Brealey Publishing.

Handler, R. (2004). Enterprise Architecture is Dead - Long Live Enterprise Architecture. Retrieved 5 January, 2007, from http://itmanagement.earthweb.com/columns/article.php/11079_3347711_1

Haunert, T. (2008). Want your own FREE subscription? *Oracle Magazine, June/July*, 64.

Heinrich, B., Henneberger, M., Leist, S., & Zeller, G. (2009). The process map as an instrument to standardise processes: design and application at a financial service provider. *Information Systems and E-Business Management, 7*(1), 81-102.

Henver, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly, 28*(1), 75-105.

Hesse-Biber, S. N., & Leavy, P. (2011). *The practice of qualitative research* (2nd ed.). California: Sage Publications.

Hilliard, R. (2007). All about IEEE Std 1471. Retrieved 23 June, 2010, from http://www.iso-architecture.org/ieee-1471/docs/all-about-ieee-1471.pdf

Hitchins, D. K. (2003). *Advanced systems thinking, engineering and management*. Boston: London: Artech House.

Hofstee, E. (2006). *Constructing a good dissertation: a practical guide to finishing a master's, MBA or PhD on schedule*. Sandton: EPE.

Hoogervorst, J. A. P. (2009). *Enterprise governance and enterprise engineering*: Springer.

Iivari, J. (1991). A paradigmatic analysis of contemporary schools of IS development. *European Journal of Information Systems, 1*(4), 249-272.

Iivari, J., & Venable, J. (2009). *Action research and design science research - seemingly similar but decisively dissimilar.* Paper presented at the 17th European Conference on Information Systems, Verona.

INCOSE. (2004). What is systems engineering? Retrieved 29 February, 2012, from http://www.incose.org/practice/whatissystemseng.aspx

ISO/IEC JTC 1/SC 7 committee. (2011). ISO/IEC/IEEE 42010 Systems and software engineering - architecture description. Retrieved 22 February, 2012, from http://www.iso-architecture.org/42010/docs/ISO-IEC-FDIS-42010.pdf

Jackson, M. C. (2003). *Systems thinking*. Chichester: Wiley.

James, G. A., & Burke, B. (2005). *Understand the maturity of your enterprise architecture program* (No. ID G00136105). Stamford.

James, G. A., Hander, R. A., Lapkin, A., & Gall, N. (2005). *Gartner Enterprise Architecture Framework: Evolution 2005* (No. G00130855). USA: Gartner Group.

Johansson, H. J., McHugh, P., Pendelbury, A. J., & Wheeler, W. A. (1993). *Business process reengineering.* Chichester: Wiley.

Kappelman, L. A. (2007). Enterprise architecture: Not just another management fad. *Align journal*(March/April), 24-27.

Kappelman, L. A. (2010). *The SIM guide to enterprise architecture*. Boca Raton: CRC Press.

Kappelman, L. A., McGinnis, T., Pettit, A., Salmans, B., & Sidorova, A. (2010). Enterprise architecture: charting the territory for academic research. In L. A. Kappelman (Ed.), *The SIM guide to enterprise architecture* (pp. 96-110). Boca Raton: CRC Press.

Kindler, E. (2006). On the semantics of EPCs: resolving the vicious circle. *Data & Knowledge Engineering, 56*(1), 23-40.

Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly, 23*(1), 67-94.

Kuechler, W., & Vaishnavi, V. (2008). The emergence of design research in information systems in North America. *Journal of Design Research, 7*(1), 1-16.

Kvale, S. (2007). *Doing interviews*. London: Sage Publications.

La Rosa, M., & Dumas, M. (2008). Configurable process models: how to adapt standard practices in your own way? Retrieved 2 June, 2011, from http://www.bptrends.com/publicationfiles/11-08-ART-Configurable%20Process%20Models-LaRosaDumas.doc-final.pdf

Lapalme, J. (2011). 3 Schools of enterprise architecture. *IT Professional, 13*(6), 1-7.

Lapkin, A. (2005). *Business Strategy Defines Enterprise Architecture Value* (No. G00129604). USA: Gartner Research.

Lapkin, A. (2008). *Gartner Clarifies the Definition of the Term 'Enterprise Architecture'* (No. G00156559). USA: Gartner Research.

Laudon, K. C., & Laudon, J. P. (1998). *Management information systems*. Upper Saddle River: Prentice-Hall.

Leech, N. (2010). Interviews with the early developers of mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Mixed methodology: Combining qualitative and quantitative approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Liles, D. H., Johnson, M. E., & Meade, L. (1995). The enterprise engineering discipline. In *Proc. of the Society for Enterprise Engineering*. Orlando, FL.

Locke, S. (2009a). *Z102 Master Class: Implementation Strategy Examples.* Canada: Zachman International.

Locke, S. (2009b). *Z103 Pragmatics: Enterprise modeling workshop*. Canada: Zachman International.

Luftman, J., & Ben-Zvi, T. (2010). Key issues for IT executives 2010: Judicious IT investments continue post-recession. Retrieved 6 March, 2012, from http://blog.cionet.com/wp-content/uploads/2010/12/MISQE-2010-Key-Issues-for-IT-Executives-2.pdf

Luftman, J., & Kempaia, R. (2007). An update on Business-IT alignment: 'A line' has been drawn. *MIS Quarterly Executive, 6*(3), 165-177.

Luftman, J., & Kempaia, R. (2008). Key issues for IT executives 2007. *MIS Quarterly Executive, 7*(2), 99-112.

Maier, M. W., & Rechtin, E. (2002). *The art of systems architecting*. Boca Renton: CRC Press.

March, S. T., & Smith, G. (1995). Design and natural science research on Information Technology. *Decision Support Systems, 15*(4), 251-266.

Marshall, C., & Rossman, G. B. (2011). *Designing qualitative research* (5th ed.). California: Sage Publications.

Marshall, G. (1998). Ideographic versus Nomothetic Approaches. A Dictionary of Sociology. Retrieved 14 February, 2011, from http://www.encyclopedia.com/doc/1O88-ideogrphcvrssnmthtcpprchs.html

Martin, J. (1995). *The great transition: using the seven disciplines of enterprise engineering to align people, technology, and strategy.* New York: American Management Association.

McWhorter, N. (2008). Business architecture and accountability to business intent. *Cutter IT Journal, 21*(3), 11-16.

Mingers, J., & Brocklesby, J. (1997). Multimethodology: towards a framework for mixing methodologies. *Omega, 25*(5), 489-509.

Mohrman, S. A. (2007). Having relevance and impact. The benefits of integrating the perspectives of design science and organizational development. *Journal of Applied Behavioral Science, 43*(1), 12-22.

Morse, J. M. (2010). Simultaneous and sequential qualitative mixed method designs. *Qualitative Inquiry, 16*(6), 483-491.

Morse, J. M., & Niehaus, L. (2009). *Mixed methods design: principles and procedures.* Walnut Creek, CA: Left Coast Press.

Mouton, J. (2001). *How to succeed in your master's and doctoral studies: a South African guide and resource book*: Van Schaik.

Nadler, D., & Tushman, M. L. (1980). A congruence model for diagnosing organisational behaviour. In R. Miles (Ed.), *Resource Book in Macro Organisational Behaviour* (pp. 30-49). Santa Clara CA: Goodyear.

Nadler, D. A., & Tushman, M. L. (1997). *Competing by design: the power of organisational architecture*. New York: Oxford University Press.

Niehaves, B. (2007). *On Epistemological Diversity in Design Science - New Vistas for Design-Oriented IS Research?* Paper presented at the 28th International Conference on Infomration Systems, Montreal.

O'Kane, B., Radcliffe, J., & White, A. (2012). *Hype cycle for master data management* (No. G00227133). USA: Gartner Group.

O'Rourke, C., Fishman, N., & Selkow, W. (2003). *Enterprise architecture using the Zachman Framework*. Boston: Thomson Course Technology.

Object Management Group. (2009). Business Process Model and Notation (BPMN) Specification. Version 2.0 - Beta1. Retrieved 1 June, 2012, from http://www.omg.org/spec/BPMN/2.0/

OMB. (2005). Federal Enterprise Architecture Program EA Assessment Framework 2.0. Retrieved 8 June, 2009, from http://www.cio.gov/documents/OMB_EA_Assessment_Framework_2.pdf

OMB. (2007a). FEA Consolidated Reference Model Document Version 2.3. Retrieved 9 June, 2009, from http://www.whitehouse.gov/omb/assets/fea_docs/FEA_CRM_v23_Final_Oct_2007_Revised.pdf

OMB. (2007b). FEA practice guidance. Retrieved 17 February, 2012, from http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_Practice_Guidance_Nov_2007.pdf

Owen, C. (1997). Design research: building the knowledge base. *Journal of the Japanese Society for the Science of Design, 5*(2), 36-45.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). California: Sage.

Purao, S. (2002). Design Research in the Technology of Information Systems: Truth or Dare. GSU Department of CIS Working Paper.

Rea, L. M., & Parker, R. A. (2005). *Designing and conducting survey research: a comprehensive guide* (3rd ed.). San Francisco: John Wiley & Sons.

Robertson, B. (2005). *Architecting the Technology Viewpoint Requires Defining a Service-Oriented Infrastructure Strategy* (No. G00134007). USA: Gartner Research.

Romme, A. G. (2003). Making a difference: organisation as design. *Organisation Science: A Journal of the Institute of Management Sciences, 14*, 448-573.

Ross, J. W. (2003). Creating a strategic IT architecture competency: learning in stages. *MISQ Executive, 2*(1), 1-18.

Ross, J. W. (2010). A need for a OM method. In M. De Vries (Ed.): E-mail.

Ross, J. W., Weill, P., & Robertson, D. C. (2006). *Enterprise architecture as strategy: creating a foundation for business execution*. Boston: Harvard Business School Press.

Rosser, B. (2004). *Sell the Value of Architecture to the Business* (No. G00123412). USA: Gartner Research.

Rossi, M., & Sein, M. (2003). Design Research Workshop: A Proactive Research Approach. Presentation delivered at IRIS 26, August 9 – 12, 2003. Retrieved 16 January, 2004, from http://tiesrv.hkkk.fi/iris26/presentation/workshop_designRes.pdf

Rouse, W. B. (2004). Embracing the enterprise. *Industrial Engineer, 36*(3), 31-35.

Saldana, J. (2009). *The coding manual for qualitative researchers*. London: Sage Publications.

Sauer, C., & Willcocks, L. (2004). Strategic alignment revisited: Connecting organisational architecture and IT infrastructure. In *Proc. of the 37th annual Hawaii international converence on systems software* (pp. 232-241): Washington, DC: IEEE Computer Society Press.

Schekkerman, J. (2004). *How to survive in the jungle of enterprise architecture frameworks* (2nd ed.). Victoria: Trafford Publishing.

Schekkerman, J. (2006). Enterprise Architecture Survey 2006. Retrieved 6 November, 2007, from http://enterprise-architecture.info/EA_Survey_2006.htm

Schekkerman, J. (2011). Enterprise architecture tools. Retrieved 27 February, 2012, from http://www.enterprise-architecture.info/EA_Tools.htm#EAT

Schreier, M. (2012). *Qualitative content analysis in practice*. London: Sage Publications.

Searle, J. R. (1995). *The construction of social reality*. London: The Penguin Press.

Sessions, R. (2007). A Comparison of the Top Four Enterprise Architecture Methodologies. Retrieved 9 June, 2009, from http://www.objectwatch.com/whitepapers/4EAComparison.pdf

Sidorova, A., & Kappelman, L. A. (2010). Enterprise architecture as politics: an actor-network theory perspective. In L. A. Kappelman (Ed.), *The SIM guide to enterprise architecture* (pp. 70-88). Boca Raton: CRC press.

Simon, H. A. (1996). *The sciences of the artificial* (3rd ed.). Cambridge: MIT Press.

Simons, G. F., Kappelman, L. A., & Zachman, J. A. (2010). Using language to gain control of enterprise architecture: on the verge of major business reengineering.

In L. A. Kappelman (Ed.), *The SIM guide to enterprise architecture* (pp. 127-146). Boca Raton: CRC Press.

Smith, H., & Fingar, P. (2003). *Business process management: the third wave*. Florida: Meghan-Kiffer Press.

Steinke, I. (2004). Quality criteria in qualitative research. In F. Uwe, E. Von Kardorff & I. Steinke (Eds.), *A companion to qualitative research* (pp. 184-190). London: Sage Publications.

Symons, C. (2005). *IT governance framework*: Forrester Research.

The Open Group. (2009). TOGAF Version 9.0, Enterprise Edition. Retrieved 1 June, 2009, from https://www.opengroup.org/online-pubs

The Open Group SOA Working Group. (2007). Service Oriented Architecture (SOA). Retrieved 1 June, 2009, from http://www.opengroup.org/onlinepubs/7699929599/toc.pdf

Theuerkorn, F. (2005). *Lightweight enterprise architectures*. New York: Auerbach Publications.

Towill, D. R. (1997). Successful business systems engineering part i: The systems approach to business processes. *Engineering Management Journal, 7*(1), 55-64.

Trochim, W. M. K. (2006). Deduction and Induction. Retrieved 11 February, 2012, from http://www.socialresearchmethods.net/kb/dedind.php

Ulrich, W. (2008). The role of collaborative governance in Business Architecture. *Cutter IT Journal, 21*(3), 38-46.

University of Pretoria committee for research ethics and integrity. (2007). policy and procedures for responsible research. Retrieved 1 February, 2012, from http://web.up.ac.za/sitefiles/file/40/Guidelines_ethical_research_senate.pdf

Vaishnavi, V., & Kuechler, W. (2004/5). Design Research in Information Systems. Retrieved 11 December, 2009, from http://desrist.org/design-research-in-information-systems

Van Aken, J. E. (2005). Management research as a design science: Articulating the research products of Mode 2 knowledge production in management. *British Journal of Management Studies, 41*, 219-246.

Van der Aalst, W. M. P. (1999). Formalisation and verification of event-driven process chains. *Information and Software Technology, 41*(10), 639-650.

van der Raadt, B., Hoorn, J., & van Vliet, H. (2005). Alignment and maturity are siblings in architecture assessment. In *Proc. of advanced information systems engineering: 17th international conference, CAiSE 2005* (pp. 357-371): Berlin: Springer-Verlag.

Van Nuffel, D., Mulder, H., & Van Kervel, S. (2009). Enhancing the formal foundations of BPMN by enterprise ontology. *Lecture notes in business information processing, 34*(3), 115-129.

Van Reijswoud, V. E., & Dietz, J. L. G. (1999). Business process re-design with DEMO. Retrieved 29 March, 2012, from http://www.demo.nl/publications/cat_view/20-scientific-publications?limitstart=40

Wagter, R., van den Berg, M., Luijpers, J., & van Steenbergen, M. (2005). *Dynamic enterprise architecture: how to make it work*. New Jersey: John Wiley & Sons Inc.

Webster, J., & Watson, R. T. (2002). Analysing the past to prepare for the future: writing a literature review. *MIS Quarterly, 26*(2), 13-23.

Wegmann, A., Regev, G., & Loison, B. (2005). Business and IT alignment with SEAM. *REBNITA Workshop, 14th International Requirement Engineering Conference* Retrieved 2 July, 2009, from http://lamswww.epfl.ch

Weill, P., & Broadbent, M. (1998). *Leveraging the new instrastructure*. Boston: Harvard Business School Press.

Weill, P., & Ross, J. W. (2004). *IT Governance: how top performers manage IT decision rights for superior results*. Boston: Harvard Business School Press.

Weill, P., & Ross, J. W. (2008). *Implementing your Operating Model via IT Governance* (Center for Information Systems Research Briefing No. 8(1D)). USA: CISR.

Whitten, J. L., & Bentley, L. D. (2007). *Systems analysis and design for the global enterprise* (7th ed.). New York: McGraw-Hill/Irwin.

Whittle, R., & Myrick, C. B. (2007). *Enterprise business architecture: the formal link between strategy and results*. USA: Auerbach Publications.

Willis, T. (2009). Enterprise Architecture Workshop Notes. Gartner Research.

Winter, R. (2008). Design science research in Europe. *European Journal of Information Systems, 17*, 470–475.

Winter, R., & Fischer, R. (2007). Essential layers, artefacts, and dependencies of Enterprise Architecture. *Journal of Enterprise Architecture, 3*(2), 7-18.

Zachman, J. A. (1987). A framework for information systems architecture. *IBM Systems Journal, 26*(3), 276-292.

Zachman, J. A. (1996). The Framework for Enterprise Architecture: Background, Description and Utility. Retrieved 9 June, 2009, from http://www.aeablogs.org/eakd/files/The_Framwork_for_EA_Background_Description_and_Utility.pdf

Zachman, J. A. (2009a). *Z101 Master Class: Framework Foundations*: Zachman International.

Zachman, J. A. (2009b). The Zachman Framework for Enterprise Architecture™: A Primer for Enterprise Engineering and Manufacturing. Retrieved 19 November, 2009, from http://zachmaninternational.com/index.php/home-article/15#maincol

Zachman, J. A. (2012). John Zachman's concise defintion of the Zachman Framework. Retrieved 17 February, 2012, from http://www.zachman.com/about-the-zachman-framework