THE ALIGNMENT OF BUSINESS WITH IT WITHIN A TERTIARY EDUCATION INSTITUTION THROUGH IT-GOVERNANCE: A STUDY CONDUCTED AT THE UNIVERSITY OF PRETORIA

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EXECUTIVE SUMMARY

Organizations grow and develop rapidly due to general demand and globalization, along with new technologies, regulations and business models. This leads to information systems becoming more intricate and complex. As a result, emphasis is placed on the standardization and integration of processes within organizations.

In determining how the standardization of certain processes influence the governance structure in a Higher Education Institution (HEI), a study needs to be conducted on how the institution aligns Business with IT through the use of IT Governance. A case study is performed at the University of Pretoria (UP), where the IT Service Department focuses on using the Enterprise Architecture (EA) 'light' version to direct IT practices during a System Renewal Project and the restructuring of the IT Service Department.

Enterprise Architecture is applied to support multiple business functions and business changes. EA also maintains the flow of data throughout different business sectors. Business Enterprises make use of governance mechanisms and IT Governance to define and obtain the desired behaviour when using IT and in determining decisions and decision rights. The governance framework offered by EA allows for correct development of information systems, ensures that value is added to the business and focuses on aligning Business and IT. However, Higher Education Institutions have a somewhat different approach to implementing Enterprise Architecture, than private and profit-seeking companies, with the aim of aligning Business and IT.

This document provides a theoretical background on what Business-IT alignment is, and how it contributes as a driver for doing EA. This leads to an evaluation on how Higher Education Institutions apply EA and as a result of this application a different approach to Business-IT alignment is investigated. The role of IT Governance within this new approach is identified, as well as stipulating the importance of EA maturity. An evaluation on EA, Business-IT alignment, IT Governance and EA maturity is completed and placed within the context of the University of Pretoria.

In the aim of determining how UP aligns Business and IT through IT Governance, a method is developed, with reference to The Open Group Architecture Framework's Architecture Development Method (TOGAF ADM), to determine and confirm the use of governance structures, governance mechanism and principles at UP. Selected tools include the use of guidelines provided by Ross, Weill and Robertson (2004, 2006), along with the selection of an EA Maturity Model for evaluation of EA maturity at UP.

Validation occurs through the application of the developed and selected tools from the research methodology. Project objectives thus far have all been met.

To conclude the research project, recommendations are made and constraints are identified, that where experienced throughout the duration of the project.

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ABBREVIATIONS

TERMINOLOGY	DESCRIPTION
ACMM	Architecture Capability Maturity Model. The US Department of Commerce has adapted the CMM as a means by which the Department can realize the benefits provided by EA. They developed the ACMM to assess business processes as well as understand the role of IT.
ADM	Architecture Development Method; a framework produced by TOGAF for the implementation of Enterprise Architecture in an organization.
CMM	Capability Maturity Model. In order to successfully manage change, organizations need to improve their IT-development processes. The CMM addresses this problem and has proven to be a great method for assessing and improving IT-related development processes.
CD	Core Diagram; derived from an operating model to help managers understand the enterprise architecture of their company.
CoBIT	Control objectives for Information and related Technology; a set of best practices for managing information systems.
CRM	Customer Relationship Management System.
CU	Cardiff University. Funded by JISC for an EA Pilot Program.
EA	Enterprise Architecture; a framework that among others provide a holistic view of an organization.
EAP	The Enterprise Architecture Planning methodology for an EA framework.
ERP	Enterprise Resource Planning; assists in organizing the resources of an enterprise for the best possible use.
FEAF	The Federal Enterprise Architecture Framework as a government EA framework.
FICA	Financial Intelligence Centre Act; a federal law requiring employers to withhold a portion of employee wages and pay them to the government trust.
HE/HEI	Reveres to Higher Education/Higher Education Institutions, i.e. Universities.
IAF	The Integrated Architecture Framework from Capgemini Worldwide, a French IT company.
IAS	International accounting standards; standards for the preparation and presentation of financial statements.
ICT	Information and Communication Technology; set of communication, hardware and software applications.
IT	Information Technology; the support, development and implementation of computer-based Information Systems, including hardware and software applications.

ITIL	Information Technology Infrastructure Library; a set of practices and concepts for managing IT, ITS, IT development and IT operations.

TERMINOLOGY	DESCRIPTION
IMSG	Information Management Steering Group. An established governance team at Liverpool John Moore's University
ITS	Information Technology Services; a department at UP responsible for the supporting ICT infrastructure and services.
JISC	Joint Information Systems Committee; a committee that supports universities and higher education institutions in the United Kingdom (UK), in the use of digital and innovative technology.
KCL	King's College London. University funded by JISC for an EA Pilot Program.
LJMU	Liverpool John Moore's University. A UK University that was established in 1825. Currently facilitating over 24 000 students and has six faculties. Funded by JISC.
OM	Operating Model; business model reflecting an organization's strategies and level of business process standardization and integration.
RU	Roehampton University. Funded by JISC for an EA Pilot Program.
SCM	Supply Chain Management system.
SRP	Systems Renewal Project; an improvement and development project embarked by UP in 2005.
TOGAF	The Open Group Architecture Framework; designed to assist enterprises in the development of enterprise architecture.
ADM	Architecture Development Method; a methodology created by TOGAF for implementing EA and develop Business-IT alignment.
TUC	Transvaal University College, today known as UP.
UK	United Kingdom; a state located off the Northwest coast of Europe.
UP	The University of Pretoria; a tertiary education institution situated in Gauteng.

1. INTRODUCTION – THEORETICAL CONTEXT

In any given business environment, Information Technology (IT) and Information Systems (IS) are an integral aspect. Large capital investments are required and enterprises face multiple shareholders in demand of business value creation (Van Grembergen, 2004). In order to reach this goal, Enterprise Architecture (EA) will be used as a management tool aiming to align business and technology initiatives within an enterprise. IT Governance will be used to specify the accountability framework and decision rights to encourage the desirable behaviour when IT is in use. (Ross *et al*., 2006; Ross & Weill, 2004).

In Section 1.1 Business-IT alignment is defined as well as a discussion to gain an understanding of its role in an enterprise. Business-IT alignment is one of the drivers for doing EA, as discussed in Section 1.2. This section provides multiple definitions of EA to gain understanding of why EA is used and its purpose for use. Included in this section, is insight to a previous study conducted by the Joint Information Systems Committee (JISC). This case study entailed a pilot program launched at three universities for determining the application and effectiveness of EA at Higher Education Institutions (HEIs). Results from this case study revealed that The Open Group Architecture Framework (TOGAF) approach was not completely effective and a new and lighter approached is required for the application of EA.

In Section 1.3 focus is placed on a different approach to Business-IT alignment using the 'foundation of execution' approach by Ross *et al* (2006). This approach consists of three components, namely an Operating Model, Enterprise Architecture and the IT Engagement model.

From the lessons learnt in Section 1.2 and the understanding of IT-Business alignment along with IT Governance, will the project rationale be revealed in Section 1.4.

1.1. BUSINESS-IT ALIGNMENT

In order to achieve cohesive goals and optimize communication across business units and IT infrastructures, alignment models have to be correctly implemented. Business has to align to IT to the same extend where IT has to align to Business (Buytendijk, 2009). The perceptions about value needs from Business strategies must match the perspectives of IT and vice versa.

According to MWD Advisors (Machiter & Ward-Dutton, 2005), IT and Business alignment is "a collaborative process that business people and IT organizations go through to create an environment in which investment in IT and delivery of IT services reflect business priorities, whether IT services are sourced internally or externally; and in which business priorities are influenced by the understanding of IT capabilities and limitations". Thus, a two-way dialogue has to exist between IT and Business.

BusinessDictionary.com (Murcko, 1999) defines alignment within the context of a corporation as the "Linking of organizational goals with the employees' personal goals" and that it requires "common understanding of purpose and goals of the organization and consistency between every objective and plan right down to the incentive offers." Replacing this view in the context of Business and IT alignment, states that the goals of Business and IT operations have to be connected and that the purpose and objectives of these goals be understood throughout an enterprise.

EA presents a unique way of aligning the organisation's functional aspects, people, activities, information, tools and data to work together effectively (JISC, 2008). Thus, Business-IT alignment is a driver for doing EA work. Making use of an EA framework, such as The Open Group Architecture Framework Architecture Development Method (TOGAF ADM) and the Zachman Framework, provide managers with the ability to administer change and manage and achieve long-term benefits (The Open Group Architecture Framework, 2007). It also supports the strategies of Business and IT along with providing value creation opportunities and ensuring alignment across various dimensions. EA provides guiding principles that create an aligned decision-making and planning framework for IT investment and services, in order to achieve Business, as well as IT objectives (Pretorius, 2006).

1.2. ENTERPRISE ARCHITECTURE

1.2.1. INTRODUCTION AND BACKGROUND

a) HISTORICAL PERSPECTIVE

Architecture in the physical world is still used today as a tool to comprehend, maintain and acquire insight into interrelationships between elements. Starting from the erection of pyramids and their complex relationships to the intricate confrontations IT started to face with the evolution of society.

IT structures was compared to the means by which construction industries maintained and structured these complex landscape systems, with the aim of applying these methods to the business world and to gain a better understanding of the integration of processes. Through the structuring of software and the need for better control over technology and the advancement of systems, Enterprise Architecture emerged (Op't Land *et al*., 2009; de Vries & Janse van Rensburg, 2008).

b) MULTIPLE DEFINITIONS

As the term suggest, EA has two components present when defining the concept. First to define 'an enterprise' and 'architecture';

According to The Open Group Architecture Framework (TOGAF) Version 9 (2009); "A good definition of "enterprise" in this context is any collection of organizations that has a common set of goals and/or a single bottom line". Also defining architecture as "a formal description of an information system, organized in a way that supports reasoning about the structural properties of the system" (The Open Group Architecture Framework, 2007; The Open Group Architecture Framework, 2009).

According to the Zachman Framework (1996) EA is defined as the "graphical detail of an organization's working and helps in planning and improving for optimizing business. It provides a comprehensive view of the policies, principles, services and solutions, standards and guidelines in an enterprise. It promotes and aligns IT initiatives throughout the enterprise."

From the view point of Chief Executive Officer of Real IRM Solutions Stuart McGregor; EA is a new coordinated approach of managing a business and not a project, aiming to reach short-term goals. The following was identified as typical triggers for EA to be initiated (McGregor, 2007):

- Concerns regarding regulatory compliance, including Sarbanes-Oxley, FICA, King II, Basel II and IAS 2005. Each playing a key role in organisational and system change, which leaves management more frustrated as the need for reinvention of the corporate wheel becomes more demanding.
- Government-driven regulations, including health, safety, quality and environment. These factors introduce non-negotiable checks and balances along with constant system change
- The need to bring business models together, brought on by mergers and acquisition.
- System implementation. With reference to components such as Enterprise Resource Planning, Business Performance Management, Business Intelligence or system conversion.

EA employs frameworks to present the current and future behaviour and structure of an organization for consistent strategic direction. It addresses problems such as poor business alignment and complex information systems. It will also play a key role in the evolution of an enterprise and a central part in any governance program (Ross *et al*., 2006).

Through addressing performance management, organizational structure, business and IT architecture, EA promotes business optimization. EA identifies the goals of an enterprise, as well as the critical components involved and their relationships with other components (Enterprise Architecture Center of Excellence, 1996; The Open Group Architecture Framework, 2009).

Many architecture methodologies and frameworks exist for doing EA, of which each brings forth its own advantages and challenges. These frameworks include the following (Sessions, 2009; The Open Group Architecture Framework, 1996; Robert Covington, 2009):

- The Zachman Framework based on the work of John Zachman.
- The Integrated Architecture Framework (IAF) from Capgemini Worldwide, a French IT company.
- The Open Group Architecture Framework (TOGAF) by the Open Group.
- The Federal Enterprise Architecture Framework (FEAF) as a government framework.
- The Enterprise Architecture Planning methodology (EAP).
- The Gartner methodology.
- The Oracle Enterprise Architecture Framework by the Oracle Corporation.

Even though the application of these frameworks and methodologies has proven to be successful in the public and commercial sector, it has been unknown in the education sector (JISC, 2008). Higher Education Institutions (HEIs) face a great number of challenges regarding the continuous development of technology and managing operations, changes and implementation of newly developed programs process.

A twelve-month Pilot program, funded by the Joint Information System Committee (JISC), was initiated in 2008 to investigate how useful EA is in the Higher Education sector and how suitable the TOGAF as a framework is for undertaking EA in the HE (JISC, 2008).

1.2.2. ENTERPRISE ARCHITECTURE PILOT - EARLY ADOPTER STUDY

The Joint Information Systems Committee (JISC) is a committee that supports universities and HEIs in the United Kingdom (UK), in the use of digital and innovative technology. Partnerships are developed for the main purpose of enabling the higher education in the UK to overcome challenges regarding ICT services and solutions (McCarthy, 2003).

The JISC realized the need for the HEIs to overcome at least of the following factors (JISC, 2008):

- Lack of information gathering.
- Insufficient integration of and value received by ICT systems and processes.
- Business process duplication.

In 2006 the JISC initiated an EA program for validating EA and evaluating Business-IT alignment in the Higher Education setting. They explored different methods and frameworks regarding the implementation of EA and the tight alignment of business and IT. Among these frameworks were the Federal Enterprise Architecture Framework and The Open Group Architectural Framework, also known as TOGAF (JISC, 2008).

The Open Group defined TOGAF ADM and this framework was adopted in the EA Pilot program initiated in 2008. Two main questions needed to be answered, firstly: how functional and useful would EA be in the HE sector? Secondly: How apt is the TOGAF for undertaking EA in the HE sector? (Anderson & Backhouse, 2009).

Initially ten projects were considered, but after evaluation, only four were funded. These four reported to be 'EA ready' according to the requirements of adopting the TOGAF ADM within an organization. Thus case studies at Liverpool John Moores

University (LJMU), King's College London (KCL) Cardiff University (CU) and Roehampton University (RU), have been undertaken in a twelve-month evaluation of EA in the context of each institution, funded by the JISC (JISC, 2008).

One case study will be discussed, namely the Pilot program done at Liverpool John Moore's University, as this Pilot program has more relation to the project at hand. This discussion will be followed by the overall conclusion, recommendations and lessons learnt at the end of the program as a whole.

a) LIVERPOOL JOHN MOORE'S UNIVERSITY ENTERPRISE ARCHITECTURE PILOT PROGRAM

Liverpool John Moore's University (LJMU) was established in 1825. Currently it facilitates over 24 000 students and has six faculties (Liverpool John Moores University, 2003).

In 2003 a development program was launched, namely the Systems Development Projects Program (SDPP). The aim was to base the current IS on an agreed architecture that will decrease the interface requirements that were built around an e-Business approach and decrease replication of data. LJMU adopted a Service-Orientated Architecture approach and even though investment in the Oracle e-Business Suit application proved to be capable, two concerns emerged. Firstly, management of information at service level was not effective as data and information were replicated and inaccessible. The second concern was that overlapping of functional areas existed across systems. A new integration project emerged, namely the Information System Architecture, to study how IS and processes operate across departments (JISC, 2008, pp.37-53).

Aware of their incomplete governance structure and with alignment projects in place a team was established, namely the Information Management Steering Group (IMSG). This group is known as the senior IT-Governance group and is chaired by Finance and Planning. Thus, senior management was initially driving the EA activities before the Pilot program came along. The university maintained a centralized structure and already had a good understanding in the field of IT Governance (JISC, 2008; Anderson & Backhouse, 2009).

The invitation included LJMU to pilot the Information System and Governance Toolkit, adapt to a new governance structure defined by Ross *et al* (2004) and make use of TOGAF as an added alignment tool (JISC, 2008, pp.37-53; Anderson & Backhouse, 2009). Thus, they participated in both the Governance and Program Management and had the need to align business and IT processes more effectively, including developing more agile systems (Anderson & Backhouse, 2009).

Governance regarding IT decisions/areas, as defined by Ross *et al* (2004), where divided among management groups for steering principles, architecture, business application, prioritization and investment decisions. Regarding responsibility of infrastructure decisions, the IMSG was already put into place. A standard approach was already imbedded to manage change initiatives, namely Managing Successful Programs (MSP). Another application, PRINCE 2, is also in use regarding project management (JISC, 2008, pp.37-53) and they made use of BiZZdesign, an EA tool.

As the University had no prior experience with EA, the Pilot Program gave them a more clear perspective regarding EA as a whole and equipped the university with tools and information to establish where they wanted to take the EA initiative (JISC, 2008, pp.37-53). They approached EA with a top-down perspective, driven senior management from the highest level and with support provided by the IMSG. With due regard to the twelve-month time limit, the university had to focus mainly on the 'Student Recruitment, Development and Support'. The project also included emphasis on the governance factors of EA (Anderson & Backhouse, 2009).

b) RECOMMENDATIONS AND LESSONS LEARNT

After the twelve-month Pilot program, each participating University presented feedback on their experiences and gave a few recommendations. The JISC prepared an overall conclusion on the lessons learnt, main debates and learning points that arose during the program and is based on the knowledge that was generated by the Pilot programs (Anderson & Backhouse, 2009). Each institute had a different:

- Foreknowledge of EA.
- Strategies and business context during evaluation.
- Experience of related issues regarding matters such as IT Governance.

Even though only four universities were involved, a variety of problems arose along with a few recommendations, as well as a few lessons learnt from the different perspectives. Some lessons learnt included the following (Anderson & Backhouse, 2009):

- The time scale was not sufficient for the evaluation of EA at the desired scale. Thus, project scopes had to be adjusted and reduced.
- Regarding the architectural work: senior management has to be involved.
- Regarding communication: emphasis should be given to the language used to give clear understanding of EA work, benefits and progress.

Applying and understanding the ADM was a struggle for each project team. This was due to a lack of examples provided, confusions over where to start and uncertainty of the order of the steps and number of iterations required by the ADM. Recommendations were made to concentrate only on certain phases of the ADM.

LJMU reported that they had a fairly good experience with the Pilot program and will continue with EA-related work. With support from the IMSG they are applying an architectural approach in IS strategy development and projects. Their focus on EA and governance already reduced duplications of services as well as cost and they will proceed with this work (Anderson & Backhouse, 2009).

In regards to communication, LJMU concluded that focus should be more on communicating in the business rather than the IT language proposed by TOGAF. They reported that conflict aroused regarding the development of EA and short term gains as projects realizing immediate benefits must have the ability of being executed outside the long-term view of EA (JISC, 2008).

Resources for LJMU were limited and with regard to the TOGAF ADM, only parts of it were used. They applied the ADM up to phase D, when implementation sets in, as they had existing applications for driving implementation and manage change (JISC, 2008; Anderson & Backhouse, 2009).

In conclusion, LJMU reported that the TOGAF approach to an EA initiative should be implemented in five conclusive steps. This was a two-year project that aimed in transforming student administration (JISC, 2008, pp.37-53):

1. Implement a governance structure that supports the Executive Board and develops principles.
2. Assimilate artifacts. (In LJMU's case, understanding TOGAF).
3. An EA tool must be selected, (where BiZZdesign Architect was the selected tool for LJMU).
4. EA must then be modeled at a high level across the organization.
5. Finally, a burning platform, for detailed EA and the demonstration of business value, must be selected. (LJMU chose the Student Recruitment, Development and Support profile).

A new approach towards Business-IT alignment can now be investigated, namely the 'foundation of execution'. This approach is provided by Ross *et al* (2006) and includes three disciplines that form a platform for governance and decision-making regarding the integration and standardisation of IT systems and business processes within an organisation.

1.3. A DIFFERENT APPROACH TO BUSINESS-IT ALIGNMENT

During 1995 to 2005, Ross, Weill and Robertson (2006) studied EA at more than 200 companies this included studying the implementation of new infrastructures, relations between business and IT strategies and IT Governance. Throughout their studies, they came to realize the importance of an effective foundation of execution and how organizations can build and manage their own foundation of execution.

Ross *et al* (2006), claims EA is "the organizing logic for business processes and IT infrastructure reflecting the integration and standardization of the company's operating model."

Defining EA in this context suggests that when an Operating Model has been defined within an enterprise, this model will represent part of the foundation of execution to direct decisions regarding business and IT Governance in the organisation. This will lead to the required level of process standardisation and integration throughout a business.

1.3.1. THE FOUNDATION OF EXECUTION APPROACH

The foundation of execution is the "IT infrastructure and digitized business processes automating a company's core capabilities." and it supports the strategy of the company (Ross *et al*., 2006, p.4). This will provide managers with the ability to focus on high-level processes, as processes become more predictable and reliable. The foundation of execution enables managers to apply and implement new systems and processes without obstructing the general daily operations. This not only includes focussing on business capabilities but also place focus on rationalizing and digitizing general, everyday processes in order to continue to do business (Ross *et al*., 2006, pp.7-9).

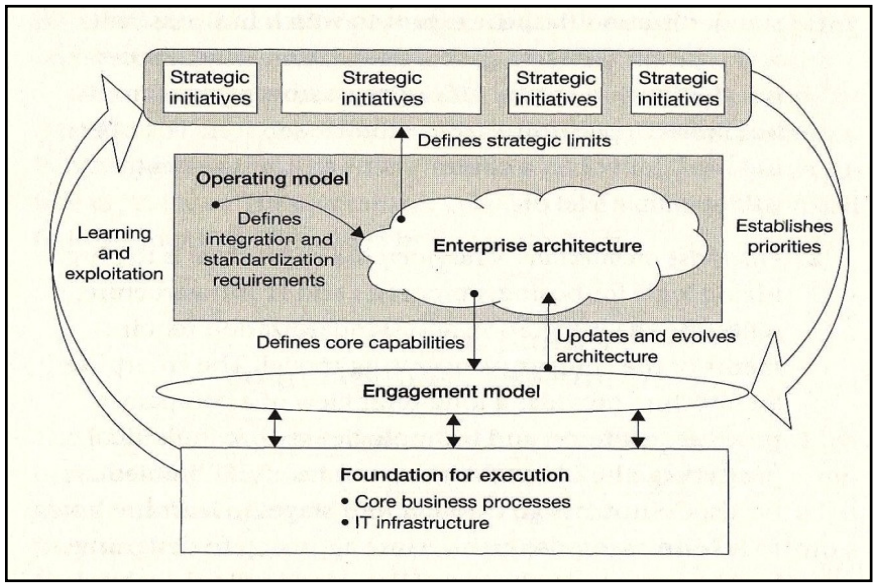

Figure 1: Creating and exploiting the foundation of execution described by Ross *et al* (2006:10).

In Figure 1 the application of the three elements (Operating Model, Enterprise Architecture and the IT Engagement Model) required for an effective foundation of execution is illustrated. The diagram also illustrates the creation and exploitation of an organization's foundation of execution (Ross *et al.*, 2006).

The Operating Model (OM) is the first of the three key elements that are required to build an effective foundation of execution. The OM drives the design of the foundation and will indicate the level of integration and standardization of business processes. It also provides insight into the commitment of the means by which a company operates (Ross *et al*., 2006, pp.8-9,26). Four types of OM have been identified by Ross *et al* (2006), namely the Diversification, Unification, Coordination and Replication model.

Implementation of the Operating Model can be done with the use of EA (which is the second element in the foundation of execution) where the key elements will differ according to the type of OM in use and demonstrated through a core diagram. The type of core diagram depends on the specific OM in use. Another manner of implementation can be done using IT Governance, where different IT Governance mechanisms are designed for the specific OM requirements (Ross *et al*., 2006, pp.45-51; Weill & Ross, 2008).

The second element required for the foundation of execution, Enterprise Architecture, is where the 'to-be' state of a company is viewed, the maturity of EA is established and developed and the standardization and integration requirements of the Operating Model are reflected. According to Ross *et al* (2006:9) enterprises follow a pattern when building their enterprise architectures. This pattern, namely the "four stages of architecture maturity", consists of four stages that enterprises go through in their quest for designing business processes with an enterprise architecture approach (Ross *et al*., 2006). These stages are as follow:

1. Business Silo architecture.
2. Standardized Technology architecture.
3. Optimized Core architecture.
4. Business Modularity architecture.

Advancement through these stages leads to a shift in focus on IT investments. Each stage helps identifying where greater value can be added through IT investments in data, infrastructure, local applications and enterprise systems.

The third element is an IT Engagement Model which depicts a system of governance mechanisms for ensuring that the business and IT projects achieve the organizational objectives. As mentioned earlier, different governance mechanisms will be designed for the type of OM in use when implementing the OM with the use of IT Governance. The model consists of three main disciplines (Ross *et al*., 2006, p.119):

- Company-wide IT Governance
- Project management
- Linking mechanisms

The IT Governance provides goals and incentives where as project management uses a set of the best practices for projects to ensure successful project outcomes. Linking mechanisms ensure the reflection of goals and priorities of the involved stakeholders. Solutions generated from the IT Engagement Model are guided by EA. Two main challenges that the model faces are coordination of business level groups and alignment of IT and Business activities and objectives. These can be overcome by linking IT Governance and project management (Ross *et al*., 2006).

The foundation of execution has to be effective and greatly depends on the alignment between IT capabilities and business objectives. (Ross *et al*., 2006). This brings forth another interest regarding business and IT alignment with the use of IT Governance. The alignment of business and IT is presented in the IT engagement model and is also an important element in EA. This will also be the main focus of the project at hand.

1.3.2. BUSINESS-IT ALIGNMENT AND IT GOVERNANCE

IT Governance is used in management areas, such as risk, governance, security, etc. for alignment of IT and Business through processes and policies. Even though some Business-IT alignment strategies are created to provide results for the moment, over a period of time they do not provide sustainable frameworks. Alignment frameworks based on the maturity life-cycle of an organization and methods on the allocation of assets, will provide a foundation for strategic IT and business alignment over a period of time (Samanta, 2007).

Ross *et al* (2004:8) defines IT Governance as "Specifying the decision rights and accountability framework to encourage desirable behaviour in the use of IT." Corporate governance, on the other hand, consists of a greater focus area and involves the enterprise as a whole. In Figure 3 the link between IT Governance and Corporate Governance is illustrated. At the top of the framework in Figure 3, the relationships of the board are shown with the agent of the board represented by the senior executive team (Ross & Weill, 2004, pp.5-6).

The agent defines strategies and desirable behaviours required to meet the board's directives. Where strategies identify a set of decisions, desirable behaviour supports the pre-defined culture and beliefs of an enterprise. The agent uses different mechanisms to govern the management of the six assets indicated by the lower half in Figure 3. The six assets are used in the enterprise for generating business value and meeting objectives (Ross & Weill, 2004).

IT Governance, as one of the governance mechanisms, plays a role in most of the organization's structure (Ross & Weill, 2004, pp.5-6). This illustration depicts the focus of this study regarding IT Governance; starting from the senior executive team through to the information and IT asset.

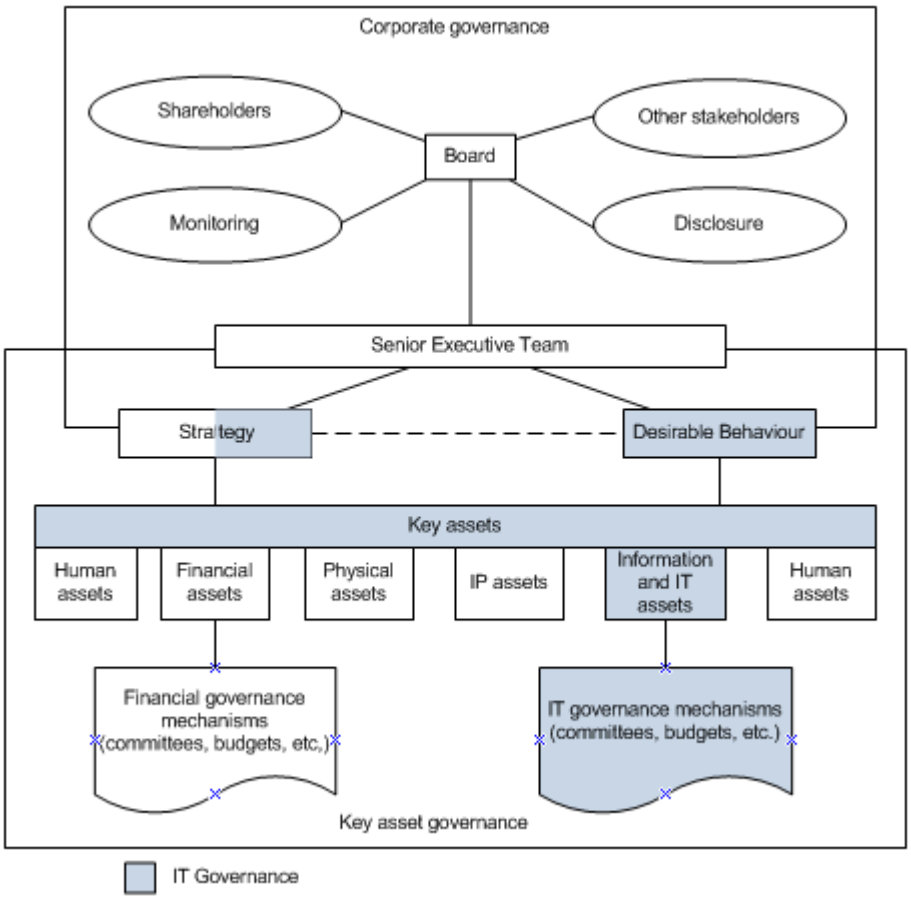

Figure 2: Corporate and key asset governance (Ross & Weill, 2004, p.5)

Ross *et al* (2004, 2006) emphasize five interrelated key decisions which are required for effective IT Governance (Ross & Weill, 2004, pp.27-49):

1. IT Principles.
2. IT Architecture.
3. IT Infrastructure.
4. Business Application Needs.
5. IT Investment and Prioritisation.

With the use of a Governance Arrangement Matrix combined with different governance mechanisms, can the governance at a particular organisation be demonstrated (Ross & Weill, 2004). The Arrangement Matrix will help define who is responsible for both the input and decision making regarding each decision.

In Figure 3, a Governance Arrangement Matrix is illustrated. The column headings present the five key decisions and the row headings specify archetypes for the decision rights. The types of people responsible for making IT decision are identified by an archetype.

The question mark represents, for each governance decision, the challenges for the applicable enterprise to determine the location of the input and decision making responsibility (Ross & Weill, 2004). EA provides a foundation for aligned decision-making and governance frameworks to meet business and IT objectives.

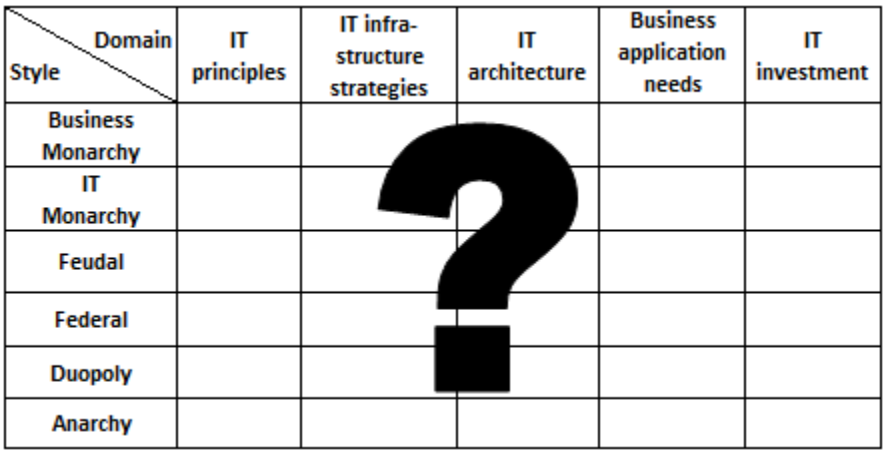

Figure 3: Governance Arrangement Matrix (Ross & Weill, 2004).

This study will focus on a governance framework that supports business-IT alignment with the use of IT Governance at the University of Pretoria.

1.4. RESEARCH PROBLEM AND RATIONALE

As seen in Section 1.2 that even though EA has been adopted in public and private sectors over the last 15 years in order to align business and IT as well as optimize business performance, it has been mostly unknown in the education sector. Higher Education institutions make considerable investments in networks, hardware and software and are still unable to demonstrate business process integration and standardization.

The opportunities offered by information and communication technologies (ICT) have been unsuccessfully exploited and ICT has not been used to support strategic educational and business objectives. Systems are struggling to communicate and a silo culture has been the means by which institutions operate. They are not seeing technology as the support for educational and strategic business objectives, but rather the solution to the problem (Watson, 2009; JISC, 2008, pp.7-10).

The standardization and integration of certain processes influence the governance structures and selection of business and IT alignment mechanisms in a tertiary education institution. EA will be used to gain a holistic view of the organization and define the relevant operating models (OM) and core diagrams (CD).

Previous studies were conducted by the Joint Information Systems Committee, as discussed in Section 1.2.2. This Pilot Program showed that the application of TOGAF at HEI was not completely successful. From lessons learnt and recommendations LJMU concluded a five step plan for implementing EA. The first step is to implement a governance structure that will, among others, develop principles. This research project will demonstrate Business-IT alignment and value by using the EA approach defined by Ross *et al* (2006) and only parts of the TOGAF defined by The Open Group (2009).

IT Governance in non-profit and profit seeking organisations are the same in many ways. The major difference is in the level of complexity of the value creation setting. There are little, if any, competition and no marketplace. Therefore different management frameworks, tools and mechanisms are required to strategically govern the enterprise (Ross & Weill, 2004).

Generating value in not-for-profit environments requires that the organization has an authorizing environment. The authorizing environment comprises of funding resources, potential customers and political influences that provide resources to create capabilities. It is complicated to measure value and performance of IT as it includes life-time value that is created by students in an educational environment (Ross & Weill, 2004).

Due to their greater dependency on partnerships, use of committees and joint decisions between IT and business leaders, non-profit firms are faced with value creation models that are more complex. Governance arrangements are not impossible, but are more important to change less often, as implementation of new processes and communications are more time consuming. Constraints that lie with IT Governance within a non-profit enterprise are as follow (Ross & Weill, 2004, pp.80-84, 214):

- Performance measurements. This is more challenging and less clear within non-profit sectors as it affects the culture of an organization as well as each individual working to provide service that is among others affordable rather than profitable.
- IT principles and IT decision-making relies on business monarchy models. This model reflects a decision-making process that is more centralised.
- Often multiple and conflicting objectives present themselves demanding strong direction from the centre. The attitudes regarding risk management and empowerment are effects the decision-making power of the senior executives.
- Business application needs and decision-making relies on federal models.

2. ORGANIZATIONAL CONTEXT – UNIVERSITY OF PRETORIA

2.1. HISTORY

In 1908 the Pretoria Centre of the Transvaal University College (TUC) opened its doors with 32 students, four professors and three lectures. In October of 1930 the establishment was the largest tertiary institution in the country with 900 students enrolled and became known as the University of Pretoria (UP).

Approximately 50 000 full-time and part time students are currently enrolled at UP of which 70% of the total contact student comprise of undergraduates. The University has become a multicultural and multiracial university, as well as one of the country's leading education institutions offering over 350 undergraduate study programs (Smit, 2008; Top Universities, 2009).

2.2. CULTURE

Many definitions regarding organizational culture exist, y*et al*l conclude with the focus on collective experience including values, beliefs, routine and systems. In the mission statement of the University of Pretoria, it states that a culture of excellence and honour must be brewed (University of Pretoria, 2008).

This demonstrates the existing student culture (external organization) which is affected by the internal organizational culture that includes the operational culture of information channels, information systems, as well as business and IT strategy. The information systems and information channels at UP are being hosted by the Department of Information Technology Services (ITS). They are also responsible for supporting ICT infrastructure and services, as well as managing the enterprise applications for teaching, learning and administration activities (Pretorius, 2008).

2.3. ENTERPRISE ARCHITECTURE – UNIVERSITY OF PRETORIA

EA serves as a strategic process at UP to align the business and IT strategy with the technology infrastructure (Pretorius, 2006).

Since 2002 proposals on the Systems Renewal commenced. In 2005 UP's strategy identified, among others, the Systems Renewal Project (SRP). This initiative aimed at overhauling the ICT infrastructure at UP.

The primary objectives are to provide a "comprehensive suite of business applications that delivers functionality which enables effective and efficient business processes relevant to UP's institutional needs" and the provision of a "modern, flexible IT platform and technology architecture that not only underpins these new applications, but also facilitates integration between both legacy, and future, applications and technologies" (Hudson, 2008).

In 2007 a new UP strategic Plan and Management Model was presented and the restructuring of the ITS commenced. The SRP's role in supporting the new strategic plan was also addressed (University of Pretoria, 2008).

As the current and future state of UP is identified and roadmaps generated to reach the future state, EA provides guiding principles and models among others to guide developments of IT capabilities. Choices made for the SRP shape the future-state architecture at UP (Pretorius, 2009). IT decisions are guided by a set of principles and plays a major role in the IT Governance at the UP.

2.4. IT GOVERNANCE – UNIVERSITY OF PRETORIA

IT Governance decisions are made by both the inside and outside structures of the Department of Information and Technology Service (ITS) (Pretorius, 2006).

The ITS have implemented various processes with the use of Accenture's IT Information Library (ITIL) V2 as guideline including a number of management process of which a few have been fully implemented. The ITIL V3 has also been used regarding the implementation of a Service Catalogue. The Service Catalogue is a document that contains information regarding all IT Services. It is part of ITIL Service Portfolio and information regarding deliverables, contact points and request processes are included in the catalogue (ITIL, 2002).

Processes implemented by Accenture; Incident, Change and Service Desk Management. Processes in progress include Problem Management, Release Management Configuration Management, Availability Management, Management and Service Continuity as well as implementation of the Service Catalogue with the use of ITIL 3 (Ferreira, 2010).

Matrixes defined from the Control Objectives and Information related Technology (CoBIT), as well as CoBIT maturity models are being used along with guidelines/practices for aligning ITIL and CoBIT (Ferreira, 2010). CoBIT is a trademark of the Information Systems Audit and Control Association and the IT Governance Institute (ISACA/ITGI, 2004). In its supporting IT Governance, CoBIT provides a framework that ensures (ITGI, 2007):

- The alignment of IT and business.
- Enabling business and maximizing benefits.

- Responsible utilization of IT resources.
- Appropriate management of IT risks.

King III, as part of the Companies Act no 71 of 2008, is also applied at UP. The code of governance includes effective leadership and good governance, as well as business corporate citizenship sustainability. The Act applies to all Public, Private and Non-Profit sectors, requiring that IT Governance becomes the responsibility of the board. UP has completed some of the requirements made by King III while other requirements are still in progress or not yet initiated (Kloppers, 2010).

2.5. PROBLEM CONTEXT AT THE UNIVERSITY OF PRETORIA

Currently the IT director at UP, Dr. Jakkie Pretorius, focuses on using EA to direct IT Practices during the execution of the Systems Renewal Project mentioned in the previous section. This is using the EA 'light' version of implementing practices as and when required.

Although the IT Department defined some of the governance mechanisms that includes IT and business principles, a Governance Arrangement Matrix and IT Governance mechanisms that are prescribed by Weill & Ross (2004:155-157), have not been based on a documented set of Operating Models as stipulated by Ross *et al* (2006:25-44). They may, on implicit knowledge have been based about the current operating models.

This study will attempt to reveal insights into the partial use of the 'foundation of execution' approach as defined by Ross *et al* (2006), combined with other IT Governance mechanisms. The study will conclude with a critical evaluation of IT Governance at UP.

2.6. PROJECT OBJECTIVES

In determining how the University of Pretoria aligns Business with IT through the use of IT Governance, the following main objectives will be delivered at the institution:

- An organizational structure analysis to be reviewed/defined and documented. This will include analyzing and verifying existing Enterprise Architecture models and teams. Including identification of current IT and Business principles and their applications. This will entail identification of gaps and constraints.
- To determine, confirm and asses IT Governance mechanisms and confirm governance support frameworks in use, as well as their effectiveness.
- To determine if other architecture mechanisms are in use such as project management, portfolio management, etc. And if so, reveal their effectiveness.
- To confirm and asses a Governance Arrangement Matrix as defined by Ross *et al* (2004) and its effectiveness.
- Evaluating Enterprise Architecture maturity with the aid of an EA Maturity Model.

Other deliverables include a documented set of the research findings, analysis and recommendations.

3. LITERATURE REVIEW

3.1. INTRODUCTION

As discussed in Section 1.1, Business and IT alignment is important when processes has to be optimized, standardized and integrated. IT capabilities have to be understood and business objectives must be achieved. In Section 1.2 multiple definitions for Enterprise Architecture were presented and defined. It was established, in Section 1.3, that when an Operating Model was defined, it represented the start of a foundation of execution to direct decisions regarding the governance of IT and Business. In this literature review, a thorough understanding of the 'foundation of execution' approach by Ross *et al* (2006) will be gained as well as an understanding of how IT Governance fits into the theoretical approach.

In order to apply and asses EA at an organization, requires the application of certain processes and frameworks. In Section 3.2 the TOGAF ADM approach is investigated to obtain insight regarding the initiation and preparation activities for EA at an organization with the aim of Business-IT Alignment. In Section 3.3 the Ross *et al* (2006) 'foundation of execution' approach to Business-IT Alignment is investigated. This includes a discussion of the four types of Operating Models and the implementation thereof via EA, the four stages of Architecture Maturity and the IT Engagement Model as defined by Ross *et al* (2006).

From the IT Engagement Model, it is shown that IT Governance plays a big role in Business-IT Alignment. This relationship will be addressed in Section 3.4 along with a discussion on applying the OM via IT Governance. This includes investigation of IT decisions and archetypes involved in the construction of a Governance Arrangement Matrix defined by Ross *et al* (2004).

In Section 3.5, two EA Maturity Models will be addressed to gain insight into the manners by which EA Maturity at an organization can be evaluated, controlled and measured.

The literature study will be concluded with a discussion on relevant tools and techniques that will be applied for the duration and completion of this project with the aim of reaching all objectives.

3.2. PREPARATION AND INITIATION ACTIVITIES FOR ENTERPRISE ARCHITECTURE AT AN ORGANIZATION

To identify EA principles, determine EA maturity and defining management frameworks relationships, a certain business directive has to be met (The Open Group Architecture Framework, 2009). The enterprise scope must be determined, including relevant stakeholders and people that can be held responsible and accountable for decision-making.

Developing Enterprise Architecture requires an EA framework/process that is among others, repeatable and able to govern change. The approach of architecting is not a one-size-fits-all approach (Ross *et al*., 2006). Assessment regarding the current EA framework needs to be done upfront in order to determine the level of maturity and initial structure of the organisation.

The Open Group Architecture Framework (TOGAF) provides a generic method, namely the Architecture Development Method (ADM), that serves as a framework for implementing EA in any given enterprise (The Open Group Architecture Framework, 2009). This process consists of nine phases of which the focus, with regard to this project, will be on fractions of the first/preliminary phase. Figure 2 provides an illustration of the nine phases. Pre-defined management frameworks have to be used in co-ordination with TOGAF to implement the ADM (The Open Group Architecture Framework, 2009).

During the first phase (the preliminary phase) of the ADM, the preparation and initiation activities required for the implementation of EA should be described, along with guidance on assessing the current available frameworks. The objectives of the preliminary phase will be to review the organizational context and among others, define people responsible for the execution of the architecture work. This also includes the classification of architectural principles and confirmation of any governance and supporting frameworks. This phase therefore involves doing the required work in order to initiate and adapt the ADM for the purpose of defining a specific framework for the organization (The Open Group Architecture Framework, 2009).

The initial step of the preliminary phase will be to identify the enterprise and/or the organizations impacted (The Open Group Architecture Framework, 2009).

The second step will involve the confirmation of existing governance and supporting frameworks. In order to understand the current organization, its shape and content, existing models will need to be assessed. This will assist in determining the government process that will control the architectural creation with the aim of defining a framework for architecture governance.

The third step is to define and establish the architecture team along with the organization. This step will require the identification of gaps within existing areas of the business, including but not limited to determining the capabilities of the business and constraints on the architecture work of the enterprise.

Finally, for the last step the architecture principles can be established and identified as soon as a customized framework is in place and the context of the organization is understood. This set of principles must be aligned with that of the business, as this is essential in the establishment of the architectural governance foundation and will form part of the constraints of the architecture work (The Open Group Architecture Framework, 2009).

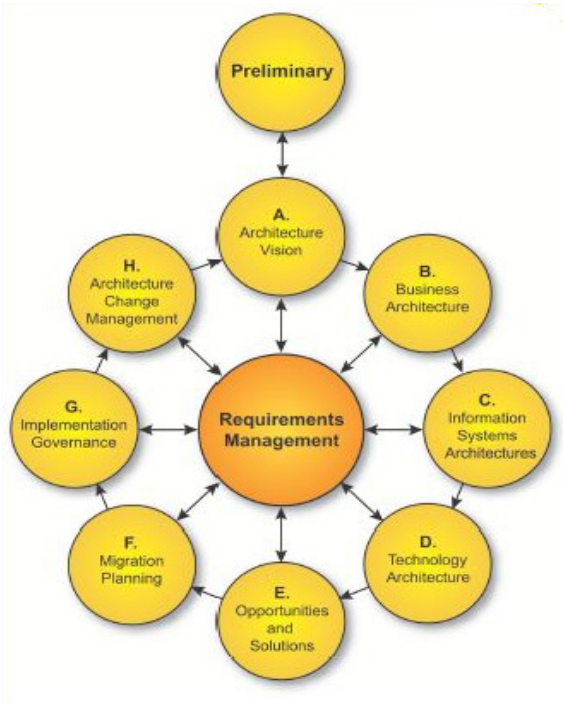

Figure 4: TOGAF Architecture Development Cycle (The Open Group Architecture Framework, 2009)

3.3. THE 'THE FOUNDATION OF EXECUTION' APPROACH

As discussed in Section 1.3, an Operating Model (OM), Enterprise Architecture and an IT Engagement Model are the three elements required for an effective foundation of execution as defined by Ross *et al* (2006).

3.3.1. THE OPERATING MODEL

Ross *et al* (2006) defines an OM as the "necessary level of business process integration and standardization for delivering goods and services to customers." An enterprise's OM amongst others (Ross *et al*., 2006; Weill & Ross, 2008):

- Supports the strategy of the enterprise and represents how the enterprise enables and executes strategies, i.e. the general vision of the enterprise.
- Provides a stable foundation for IT to identify future strategic initiatives by enabling IT not to be a reactive-, but become a proactive force.
- Has an impact on how the enterprise implements its IT infrastructure and business processes.
- Assists management in defining the role and level of business process standardization and integration in the decisions-making tasks on a daily basis.
- Reusable capabilities are created that leads to faster responses to customer and market demands and opportunities.

Four types of general OM's exist namely, diversification, coordination, replication and unification. Figure 5 illustrates the characteristics of each OM and indicates whether the business process integration and standardization is high or low for the specified operating model (Ross *et al*., 2006).

All the models function within two dimensions namely, standardization and integration of business processes. The standardization depicts how a process will be executed and integration links the business units of the enterprise through data sharing. Even though high standardized processes provide greater proficiency across the organization, local innovation is limited and existing systems has to be transitioned to a standardized system, causing great difficulty and added expenses. Integrated processes provide increased efficiency and improved customer services along with increasing the flow of data (Ross *et al*., 2006). However, challenges are present when data has to be shared; different units present the same data in different formats using different terms for the same definitions.

Different types of OMs can also exist within different business units, but if an OM has not been identified within an enterprise, new initiatives would require identification of new key capabilities, where an established OM will provide a committed way of how business is done (Ross *et al*., 2006).

According to Ross *et al* (2006), the OM can be implemented through EA. As mentioned in Section 1.3, the key elements of EA will differ according to the type of OM in use. Ross *et al* (2008) also established that the OM can be implemented through IT Governance. This subject matter will be discussed in Section 3.4.

To assist in the understanding of an organization's EA management makes use of Core Diagrams. The Core Diagrams present high-level views of data, technologies and processes forming the foundation of execution and it communicates the organization's vision (Ross *et al*., 2006).

Core Diagrams are not a necessity, but rather a luxury as it helps management understand the functioning of an organization. More over can visions be shared and developed without the use of Core Diagrams (Ross *et al*., 2006).

The foundation of execution needs to be flexible regarding the change in technologies and existing systems and processes that form obstacles to a new defined business vision. New and upgraded core processes and systems need to be implemented without general operations being disrupted (Ross *et al*., 2006).

Organizations go through four stages of Architecture Maturity as redesigning and implementation of new systems is required (Ross *et al.*, 2006).

Business process integration

High

Low

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 service; IT application decision made in business units	**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 • Centralized management often applying functional/process/business unit matrices • High-level process owners design standardized processes • Centrally mandated databases • IT decisions made centrally
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 • Centralized (or federal) control over business process design • Standardized data definitions but data locally owned with some aggregation at corporate • Centrally mandated IT services

Low High

Business process standardization

Figure 5: Characteristics of the four Operating Models defined by Ross *et al* (2006:29).

3.3.2. ENTERPRISE ARCHITECTURE – EA MATURITY

As mentioned in Section 1.2, an organization will go through four levels of Architecture Maturity, as defined by Ross *et al* (2006). Each stage differs regarding the role of IT, IT investments and benefits gained during each phase. The IT investments made in local applications, enterprise systems, shared infrastructure and shared data, change according to the growth and architecture maturity. This is not a model to evaluate EA maturity, an EA Maturity Model is required to establish the level of architecture maturity of an enterprise. This, however, will be discussed in Section 3.5. Ross *et al* (2006:71-78) defines their four stages of EA maturity as follows:

1. BUSINESS SILO STRUCTURE

A business silo culture focuses on delivering once-off solutions for immediate business needs and does not take the future state into consideration (Ross *et al*., 2006, pp.72 - 74).

The role of IT is to automate the local business processes and is not focused on any standardization specifics. The system outcomes and benefits are predictable and measurable respectively.

The IT investments are focused to reduce costs; greater investments are made in local applications and shared infrastructures than enterprise systems and shared data. However, the solutions create a legacy of systems over a period of time that struggle to communicate with each other. This architecture encourages innovation and does not inflict on the constraints of business unit activities. Applications align to business units as well as functional and/or geographical structures.

Unfortunately, integration of business processes tends to become complex and standardization of business processes becomes obstructed. The need for a solid supporting platform for data and processes are required for IT operations. The enterprise is thus forced to move to the next stage (Ross *et al*., 2006, pp.72-74).

2. STANDARDIZED TECHNOLOGY ARCHITECTURE

During this stage the focus of IT investments are shifted and the role of IT differs slightly from that of a Business Silo stage. In the Standardized Technology stage technology becomes standardized and technology management becomes more centralized (Ross *et al*., 2006, pp.74-76).

The role of IT, as mentioned previously, is more or less the same as the role of IT in the Business Silo stage. The difference comes in when IT is used in shaping the business solutions. Solutions are not generated by providing best suited

technology, but by finding the best functionality given the current technology platforms. The focus of IT management is moved from application functionality to the cost effectiveness of the enterprise.

The focus of IT investments shifts to an increase in shared data and infrastructure and less in local applications and enterprise systems. The standardization of technology decreases the number of platforms that require decisions regarding IT solutions and management.

Benefits obtained from standardization during this stage are a reduction in risk, shared services and the reduction in the number of software applications performing similar tasks for optimal and faster functionality. Security is improved as well as the development time.

This stage prepares an enterprise for the next stage, where the standardization expands to more than standardization of technology, but moves to the standardized business processes and integrated data (Ross *et al*., 2006, pp.74-76).

3. OPTIMIZED CORE ARCHITECTURE

The Optimized Core stage facilitates the shift to an enterprise view from that of a local view regarding applications and data. Core processes become optimized, standardized as well as integrated (Ross *et al*., 2006, pp.76-77).

The role of IT entails the construction and building of business platforms. This includes building reusable data platforms and achieving the enterprise objectives along with providing business outcomes that are predictable. Data and processes become standardized and digitized, leading to better process innovation.

IT investments are more focused on the shared data and enterprise systems than in the previous stage. Core processes are optimized and better controlled. IT and business managers realize IT capabilities and understand the operating model of the enterprise.

Benefits include process standardization and integration as well as efficiency and better customer interaction. As the business' architecture matures, the need for modular architecture steps in. This moves the architecture maturity of the enterprise to the Business Modularity stage (Ross *et al*., 2006, pp.76-77).

4. BUSINESS MODULARITY ARCHITECTURE

With standardized and digitized processes in the Business Modularity stage, processes can now be refined and modularized by two individual approaches (Ross *et al*., 2006, pp.77-79).

The first approach entails that reusable modules be created and business units select customer-oriented processes. The second approach will lead to

management adding functionality to the optimized core. This entails that the managers of each business unit are involved in the design of the front-end processes which are bought or built as modules that are connected to the back-end and core processes.

IT investments are made with greater focus on enterprise systems and shared infrastructure. The role of IT ensures linkages between the business module processes. The benefits gained in the Optimized Core stage are extended, but not replaced, in the Business Modularity stage.

As EA matures in an enterprise, focus shifts to standardized and integrated IT-enabled processes. Transforming from one stage to the next involves the transformation of platforms and systems (Ross *et al*., 2006, pp.77-79).

In conclusion of the maturity stages; each stage demands change, companies learn to adapt and gain value from the stage they transition through. Two main, similar characteristics identified during the four stages are (Ross *et al*., 2006, pp.82-83):

1. The development of IT capabilities.
2. The strategic business implications of those capabilities.

In order to support these characteristics, organizations undergo learning in five areas during each Architecture stage. These areas are identified in Table 1 along with the strategic implications during each stage (Ross et al., 2006, p.83).

It is noticed that, with regard to the business objectives for IT, from stage one to stage four IT service reuse increases. Data, processes and business modules reuse also increases with transition through the stages. Taking a look at funding priorities specifies the focus of IT initiatives (Ross *et al*., 2006, pp.83-86).

Transforming from stage one to four, regarding management capabilities, requires management to shift focus beyond the local business process changes. Moving through the stages, the organization must reach a point where implementation, maintenance and gaining benefits from standards become the norm and effortless to execute. The focus from local business manager shifts to industry leaders taking into consideration who will define applications. Business leaders define applications to suit the business needs and industry leaders will define applications by setting industry standards (Ross *et al*., 2006, pp.83-86).

IT Governance puts focus on IT investments and accountability during the first Architecture stage. This is done through project management that is effective and business case development. Transitioning to the second stage requires the establishment of governance mechanisms. In stage three the focus is placed on a need for implementing business objectives and then governing business process modules in the last stage (Ross *et al*., 2006, pp.83-86).

	Business Silos	Standardized Technology	Optimized Core	Business Modularity
IT capability	Local IT applications	Shared technical platforms	Companywide standardized processes or data	Plug-and-play business process modules
Business objectives	ROI of local business initiatives	Reduced IT costs	Cost and quality of business operations	Speed to market; strategic agility
Funding priorities	Individual applications	Shared infrastructure services	Enterprise applications	Reusable business process components
Key management capability	Technology enabled change management	Design and update of standards; funding shared services	Core enterprise process definition and measurement	Management of reusable business processes
Who defines applications	Local business leaders	IT and business unit leaders	Senior management and process leaders	IT, business, and industry leaders
Key IT governance issues	Measuring and communicating value	Establishing local/regional/ global responsibilities	Aligning project priorities with architecture objectives	Defining, sourcing, and funding business modules
Strategic implications	Local/functional optimization	IT efficiency	Business operational efficiency	Strategic agility

Table 1 - Learning requirements of the architecture stages as defined by Ross *et al* (2006:83)

As extreme change is costly and risky to do all at once, the foundation can be built by individual projects meeting short term business goals and implementing the enterprise architecture one at a time. This requires that the stakeholders involved in the implementation, design and use of IT and business process capabilities make use of the IT Engagement Model (Ross *et al*., 2006).

3.3.3. IT ENGAGEMENT MODEL

To ensure that IT and business projects achieve organizational objectives, the IT Engagement Model will serve as a system of governance mechanisms that provides the alignment of IT and business objectives, regarding projects and project decisions. The Model will also coordinate the process decisions required at multiple organizational levels for business and IT (Ross *et al*., 2006).

Based on the Operating Model of an enterprise, the standardization, integration and architectural requirements can be defined by the EA of the organization. As business initiatives are identified, the benefits from and the contributions to the foundation of execution, are realized with the use of the IT Engagement Model (Ross *et al.*, 2006).

The IT engagement model, according to Ross *et al* (2006:119), consists of three main supports as illustrated in Figure 6:

- Companywide IT Governance.
- Project management.
- Linking mechanisms.

Three groups exist on both the IT and business sides of the enterprise. They represent the stakeholders present in the Model (Ross *et al.*, 2006):

- Company level.
- Business unit level.
- Project team level.

The IT Engagement Model aids in resolving differences that emerges between IT executives and business leaders regarding conflicting priorities. Due to the difference in opinion, view and incentives, these groups create two main challenges.

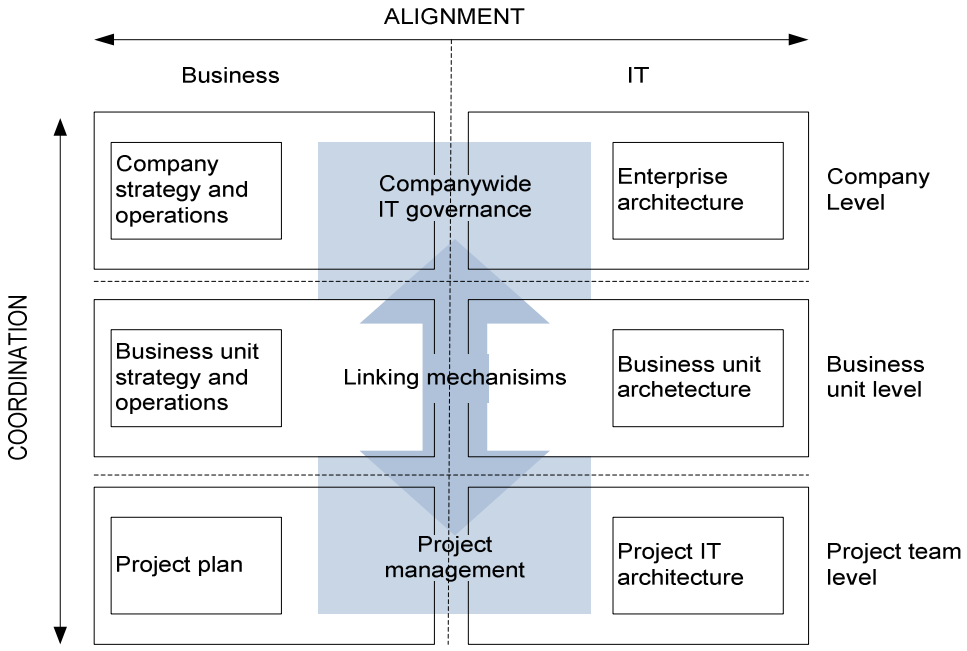

Figure 6: The IT Engagement Model (Ross et al., 2006, p.120)

The first challenge is coordination of the three different level groups (Ross *et al.*, 2006). The linking mechanisms will ensure that the goals and priorities of parties involved are reflected and informed as projects progress. To ensure the progression

of projects, project management will focus on applying the best practices of management tools and techniques specified by the company. As for the companywide IT Governance, high-level targets and motivations will be determined.

The second challenge is alignment of IT and business activities. IT Governance is used to determine who makes what decisions and provides a decision-making and accountability framework. It can also be linked to other company assets and the governance thereof as well as shared governance mechanisms, thus aligning decision-making processes companywide (Ross *et al*., 2006). This alignment ensures that the investments in IT will generate value where both IT and business objectives are achieved.

Solutions will be chosen to not only meet project goals, but also overall company goals as they are aligned and aimed at integrating and standardizing processes. Five decision areas included in IT Governance have been identified (Ross *et al*., 2006). These decisions relate to IT utilities and management and are driven by the OM. They will be discussed in the following section.

3.4. BUSINESS - IT ALIGNMENT AND IT GOVERNANCE

As discussed in Section 1.1, Business-IT alignment creates an environment where IT investments and services (including risk management, IT planning, etc.) reveal the business priorities within an enterprise. Aligning business and IT will ensure that communication is optimized regarding business decisions and technical operations, obtaining desired behavior when using IT. For the alignment of IT and business, IT Governance plays an enormous role. IT Governance provides a design framework for decision-making and accountability that support the alignment of strategies, IT Governance and performance. IT Governance arrangements will allocate the main IT decisions accordingly to those responsible for the outcomes (Ross & Weill, 2004).

A Governance Arrangement Matrix is used to address and map out decisions that have to be made in conjunction with archetypes required for making these decisions. Thus three main aspects will be addressed; what IT decisions must be made, who is responsible for making decisions (decision rights) and arrangements regarding each decision and archetype. These factors will shape the IT Governance mechanisms and arrangements required for the IT Governance design framework. This framework aids in the communication, design and understanding of an enterprise's overall governance (Ross *et al*., 2006). This study however, will focus on the Governance Arrangement Matrix as the governance design framework technique does not fall into the scope of the project. However, governance mechanisms and their effectiveness, at the institution under investigation, will be defined.

3.4.1. IT GOVERNANCE - IT DECISIONS

In Section 1.3, the five interrelated IT decisions for effective IT Governance were mentioned. In Figure 7 it is demonstrated how these key decisions are arranged and interconnect.

The lack of establishing proper IT principles will lead to other decisions being insufficient. IT principles are translated into integration and standardization requirements by IT architecture decisions. Infrastructure decisions flow top down from the IT principles and architecture decisions, defining the IT capabilities foundation for the enterprise. Business application needs specifies IT application requirements that translate back to IT infrastructure. Ultimately, decisions regarding IT investments influence the finding of the infrastructure as well as application initiatives. An architecture is implemented which represents the IT principles and in the end the business principles (Ross *et al.*, 2006).

<table>
<tr><td colspan="3">IT Principle decisions
High level statements about how IT is used in the business</td></tr>
<tr><td rowspan="2">IT Architecture decisions

Organizing logic for data application, and infrastructure captured in a set of policies, relationships, and choices to achieve desired business and technical standardisation and integration</td><td>IT Infrastructure decisions

Centrally coordinated, shared IT services that provide the foundation for the enterprise’s IT capability</td><td rowspan="2">IT investment and prioritisation decisions

Decisions about how much and where to invest in IT, including project approvals and justification techniques</td></tr>
<tr><td>Business application needs

Specify the business need for purchased or internally developed IT applications</td></tr>
</table>

Figure 7: Key IT Governance Decisions (Ross & Weill, 2004, p.27)

1. IT PRINCIPLES

Ross *et al* (2006) claims that enterprises containing a set of clearly defined IT principles will confidently gain business value from IT. These decisions are necessary to clarify the strategic role of IT in business and give direction for all IT decisions. They articulate the desirable behaviours expected from IT to support business strategy. The manner by which IT principles support business principles should be demonstrated. IT principles have to be based on the means of how a company operates, i.e. an OM for the organization will be a prerequisite for defining IT principles.

Expectations involve, first of all clarifying the desired OM of the enterprise and secondly, how this desired OM will be supported by IT. This includes indicating how products and services are delivered and developed as well as defining parameter boarders regarding infrastructure and application decisions for the future state of the enterprise (Ross *et al.*, 2006; Ross & Weill, 2004).

The third expectation is to elucidate which priorities take precedence regarding IT investment decisions by the use of a funding model. The principles communicate requirements regarding process standardization and integration, which will eventually form IT capabilities. Thus to control applications, infrastructure and data within an enterprise, an organizing logic is required (Ross & Weill, 2004, pp.27-30).

From the viewpoint of the TOGAF, during the ADM's preliminary phase, architecture principles are defined without an OM. These principles are based on business principles and include IT principles.

2. IT ARCHITECTURE

This decision is also defined as the "Enterprise Architecture" decision (Ross *et al.,* 2006). The definition of IT architecture differs slightly from that of EA. Ross *et al* (2006:9) define EA as "the organizing logic for business processes and IT infrastructure reflecting the integration and standardization of the company's operating model.", where IT architecture is defined as the "organizing logic for data, applications, and infrastructure, captured in a set of policies, relationships, and technical choices to achieve desired business and technical standardization and integration." (Ross & Weill, 2004, p.30).

Decisions regarding process, data and technical standardization will influence the design of an enterprise's IT architecture. Technical standardization will aid in meeting general objectives such as processing that is cost-effective. Process standardization requires adherence to one consistent manner of execution. Process integration on the other hand depends greatly on the standardization of data (Ross *et al*., 2006; Ross & Weill, 2004).

When data is standardized and a data element consists of set of characteristics and a single definition, process integration can take place. After a period of time applications that are shared and recurring within processes and among business units will be identified and transformed into components. The components twist these applications into services that are modular, reliable and specified. Component architectures emerge and another layer of standardization is provided (Ross & Weill, 2004, pp.30-34).

3. IT INFRASTRUCTURE

This includes among others provision and management of large scale computing and telecommunication network services. The IT infrastructure is a "centrally coordinated shared IT service that provides the foundation for enterprise's IT capability" (Ross & Weill, 2004), both technical and human capabilities which multiple applications make use of.

Planned IT capabilities that are shaped by integration and standardization are built on IT infrastructure where 55% of the IT investments comprise of this infrastructure. Incorrect investments in IT infrastructure can lead to unsolicited results including wasted and/or limited sharing of resources (Ross & Weill, 2004, pp.34-40).

An additional layer of standard and shared applications, known as infrastructure applications (ERP's, CRM's, SCM's) may also exist in the enterprise system. These applications change less than local applications, that sit atop the infrastructure, as business strategies evolve (Ross & Weill, 2004, p.37).

4. BUSINESS APPLICATION NEEDS

Value is directly created by the decisions regarding specific business needs. Identifying effective ways of delivering value to customers through IT and ensuring implementation of architectural integrity are two conflicting objectives that are addressed in identifying business needs for IT applications; creativity and discipline. Creative solutions also involve the identification of business applications required to support the enterprise objectives. Disciplined execution ensures EA is built out and controlled by applications as well as committing resources required to meet project and business goals (Ross & Weill, 2004; Ross *et al*., 2006).

Decisions has to be managed so that the outcome will lead to creative (applications supporting objectives and experiments of the business), disciplined (commit resources to achieve business goals) applications (Ross & Weill, 2004).

5. IT INVESTMENT AND PRIORITIZATION

Decision makers for investments must focus on priorities that are essential and vital, rather on priorities that are optional and not necessary. Three factors are present in making IT investment decisions, namely the amount of time and money to be spent, on what to spend it and finally how the needs of different areas will be resolved. Appropriate spending levels have to be determined, along with allocating this amount to the right and most important areas whilst ensuring

minimum risks and maximum value as the outcome (Ross & Weill, 2004; Ross *et al.,* 2006).

Projects that will be approved or declined are determined by their priorities and presentable risks. Projects that do not fall within any of the two categories would have to be redone (Ross & Weill, 2004).

3.4.2. IT GOVERNANCE - DECISION RIGHTS

Decision rights analysis and representation thereof play a vital role in IT Governance. Ross *et al* (2004) provides a set of choices for decision rights regarding IT. This set comprises of archetypes that each describes the different groups of people who make and/or have inputs into decisions within an enterprise. Refer to Figure 8 for a clear understanding of the archetypes and the key entities involved, namely executive teams, corporate/business unit IT teams and business unit leaders.

	C-level executives	Corporate IT and/or business unit IT	Business unit leaders or key business process owners
Business monarchy	✓		
IT monarchy		✓	
Feudal			✓
Federal	✓	✓	✓
	✓		✓
IT duopoly	✓	✓	
		✓	✓
Anarchy			

Figure 8: Key players in IT Governance archetypes (Ross & Weill, 2004, p.60)

The first political archetype is business monarchy. Decision makers include individual or groups of senior business executives, not including IT executives that act independently. Enterprise-wide decisions are made by relying on many sources for business information, e.g. reports from CIO's and IT leaders, agreements, etc (Ross & Weill, 2004, pp.58-59).

The IT monarchy arrangement involves decision-making by individual IT executives or groups thereof. The third archetype is known as a feudal model. This arrangement facilitates business units and regional decisions for optimizing local business needs. It does not however support decision-making for the whole enterprise (Ross & Weill, 2004, pp.59-60).

The forth archetype is a federal model. Federal entities include business unit leaders, such as executive committees and management teams, business process owners and in addition, business unit IT leaders. As different business units bring different concerns to the table, unique responsibilities are presented (Ross & Weill, 2004).

Business units share resources and it is inevitable that bigger business units with most influence will leave smaller business units pulling on the short end of the stick. Thus, to resolve conflicts, executive teams must intervene and responsibilities must be balanced along with accountability (Ross & Weill, 2004, pp.60-61).

IT duopoly arrangements consist of two decision-making parties. One of the groups represents IT executives and the other represents either a group of executives or business unit leaders/process owners. The two setting of groups can be illustrated by two structures; the bicycle wheel and T-shaped duopolies (Ross & Weill, 2004, pp.61-63).

The bicycle wheel can be seen in Figure 9**.** The structure comprises of the IT group that is central and the group of business unit leaders/business process owners. The business units are set around the rim; relationships of a bilateral nature are presented by the spokes and the hub represents the central IT group. Individual attention is given to business units by the same hub supporting the enterprise as a whole (Ross & Weill, 2004, p.62).

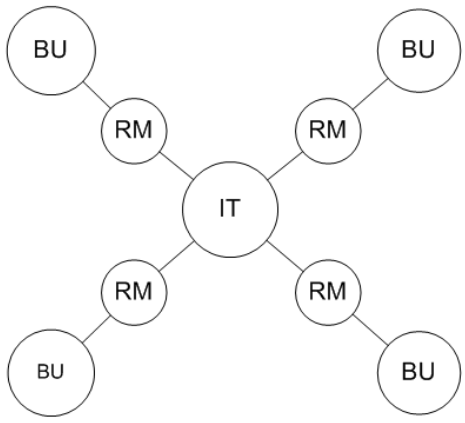

Figure 9: Bicycle Wheel format taken by the IT Duopoly arrangement (Ross & Weill, 2004, p.62).

The T-shaped structure comprises of the IT group and team of executives. In Figure 10, the horizontal part of the T presents the executive/senior management committee. A number of people will participate on this committee as well as the IT committee consisting of technical managers.

The IT group is presented by the vertical part of the T. Overlapping occurs where the two groups meet and is presented by the number of people in both committees (Ross & Weill, 2004, p.62).

Compared to other archetypes, the duopoly model has an advantage over the feudal model; The IT group tends to seek out opportunities to share and reuse and can also observe the enterprise as a whole. In comparison to the federal model, the duopoly works with a more straightforward management structure with either local or corporate representations along with IT professionals (Ross & Weill, 2004).

The last archetype, the anarchy model speaks for itself. Decisions are made by individuals/small groups based on their own their own local needs.

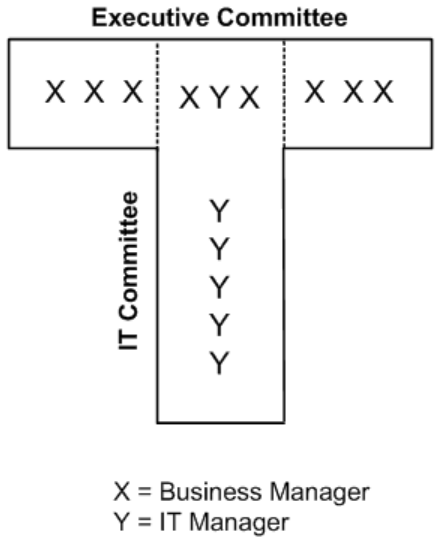

Figure 10 : T-Shaped format taken by the IT Duopoly arrangement (Ross & Weill, 2004, p.62)

After defining the different IT decisions and different arrangements enterprises have available for decision-making, the two factors need to be combined. Variations regarding different governance arrangement for each of the five IT decisions can now be established and a Governance Arrangement Matrix (GAM) can be generated (Ross & Weill, 2004).

3.4.3. IT GOVERNANCE - ARRANGEMENTS

The Governance Arrangement Matrix can be seen in Figure 11. As discussed in Section 1.3, the column and row headings represent, respectively, the five interrelated IT decisions and decision rights specified by the set of archetypes, discussed in the previous section. IT decisions are divided into two main functions; who makes the decisions and who provides input.

These answers are summarized in the Governance Arrangement Matrix by indicating, in the relevant blocks, the persons responsible for the input/decision making in accordance to the arrangement/style used (Ross & Weill, 2004).

GOVERNANCE ARCHETYPES

DECISIONS

Style \ Domain	IT principles		IT infra-structure strategies		IT architecture		Business application needs		IT investment	
	Input	Decision	Input	Decision	Input	Decision	Input	Decision	Input	Decision
Business Monarchy										
IT Monarchy										
Feudal										
Federal										
Duopoly										
Anarchy										

Figure 11: Detailed Governance Arrangement Matrix – Indicating who has input and responsibility regarding IT decisions (Ross & Weill, 2004).

3.4.4. IT GOVERNANCE – MECHANISMS

Ross *et al* (2004) claims the existence of three types of IT Governance mechanisms and five principles for designing effective governance mechanisms. The three types have different objectives and are as follow (Ross & Weill, 2004, pp.110-16):

- **Decision-making**: Determining who makes what decisions with the help of a Governance Arrangement Matrix.
- **Alignment Processes**: Ensuring the necessary balance of integration and standardization across operating units.
- **Communication Approach**: Where committees and management ensure correct communication across operating units regarding announcements and decisions.

These three mechanisms must exhibit the following characteristics (Ross & Weill, 2004, pp.114-15):

- **Simple**. Mechanisms define the responsibilities of groups or persons.
- **Transparent**. Processes are relied upon by the mechanisms and are clearly understood.
- **Suitable**. In making decisions, mechanisms aid in the best position for making a formal decision.

Mechanisms interact with each other and five designing principles for mechanisms have been created by Ross *et al* (2004:15):

- **Choose mechanisms from all three types.** These three types were discussed previously.
- **Limit decision-making structures.** Instead of making use of multiple decision-making structures, an organization must implement alignment mechanisms. This will lead to decision-making to be disseminated and less opportunities for contradictions and disconnections.
- **Provide for overlapping membership in decision-making structures.** By providing decision-making bodies that overlap in membership areas, will lead to IT and business decisions not being disconnected. All perspectives should be considered in IT Governance decisions.
- **Implement mechanisms at multiple levels in the enterprise.** Connections between business unit and the organizational mechanism should exist. This entails implementation of mechanisms at multiple levels that will be aligned throughout the enterprise.
- **Clarify accountability.** Governance mechanisms should clearly state the roles and responsibilities of decision-making bodies to avoid confusion and uncertainties.

3.4.5. APPLYING THE OM VIA IT GOVERNANCE

As mentioned in Section 1.3, the OM can also be implemented through IT Governance. Effective IT Governance is required in order to reuse the platform built from the OM to grow the enterprise.

Ross *et al* (2008) researched the IT Governance mechanism that firms design to comply with their OM. Analysis where done at 640 firms and it was found that the IT Governance mechanisms will differ according to the OM in use (Weill & Ross, 2008).

The Diversification OM has among others an IT Governance mechanism that will define the services and standard technology utilized for a shared infrastructure. The IT Governance mechanism for a Coordination OM will help to enable process integration, where the Replication OM's IT Governance mechanisms require to aid in the standardization of business processes. Regarding the Unification OM, the IT Governance mechanisms aid in a tightly integrated and standardized structure, thus focusing not only on business units, but company-wide performance and reward (Weill & Ross, 2008). In Figure 12 the different IT Governance mechanisms in accordance with the different Operating Models can be seen.

3.5. EA MATURITY MODELS

Making use of maturity models provide insight to an organization's development processes. Applying this to EA is necessary as the development of EA is required for guiding the integration of IT and business. EA development should be managed and maintained to ensure its usefulness and that business value is obtained. As the maturity of EA increases, as will the predictability, process controls and effectiveness (Schekkerman, 2006).

There is a lack of maturity in the discipline of EA, however, two EA maturity models will be discussed. The first model will be the Extended Enterprise Architecture Maturity Model Version 2.0 (E2AMM), defined by the Institute for Enterprise Architecture Development (IFEAD). The second model is a modification/customization of the Capability Maturity Model (CMM) that was originally defined by the Software Engineering Institute (SEI). TOGAF provides insight to this modified model which is known as the Architecture Capability Maturity Model (ACMM) as defined and adapted by the United States' Department of Commerce (US DoC).

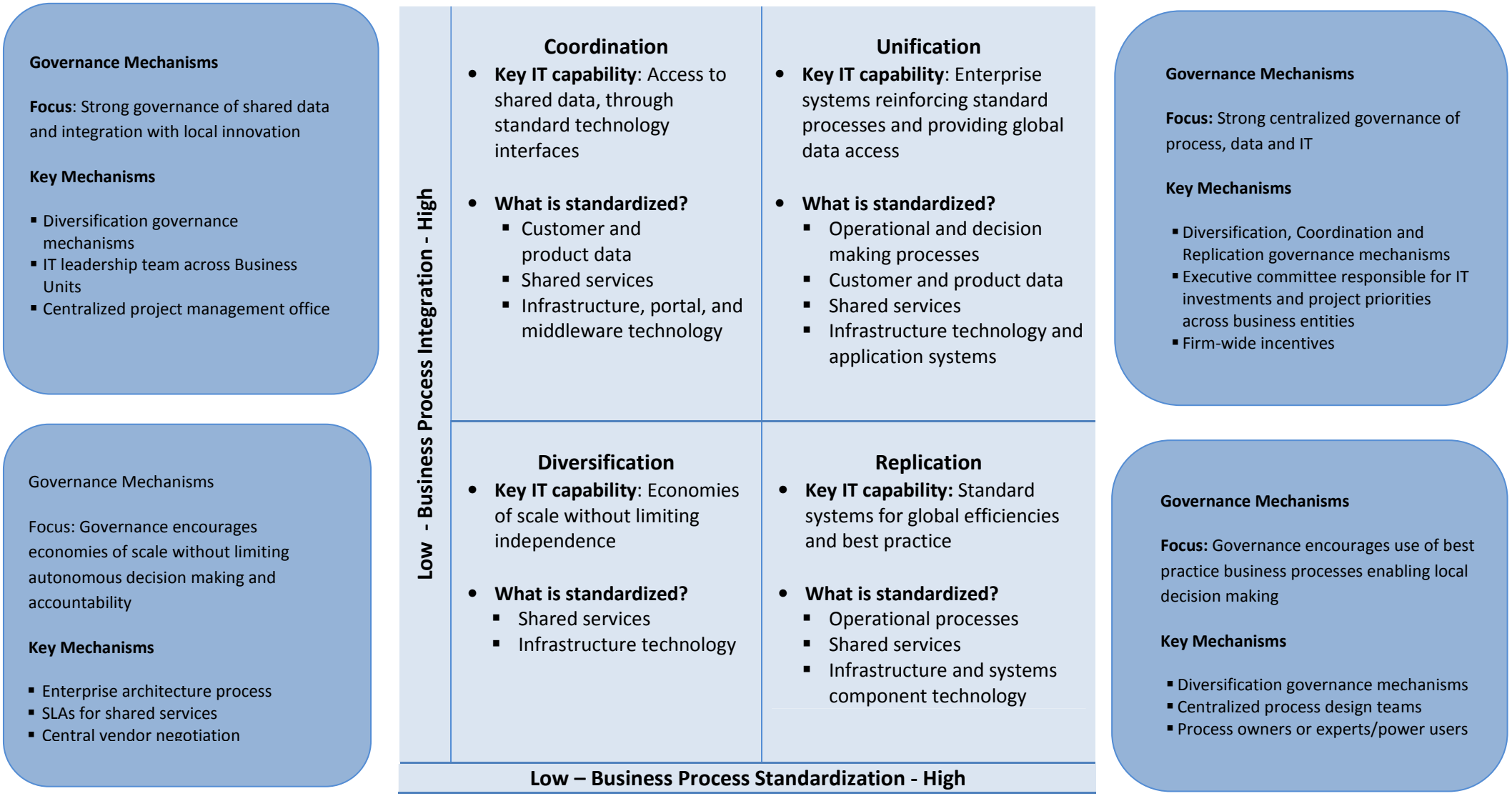

Figure 12: IT Governance Mechanisms and the four corresponding Operating Models (Weill & Ross, 2008)

3.5.1. THE EXTENDED ENTERPRISE ARCHITECTURE MATURITY MODEL

The IFEAD (2006) defines EA as the 'organization-wide roadmap' for achieving the mission of the organization within an IT environment. This is done through the optimal functioning of the core business processes. This roadmap defines the current and desired state. When EA is at its fullest maturity, it becomes an extended EA. In this context, 'extended' is defined as all elements and influences that are touching the enterprise's boundaries (Schekkerman, 2006).

The E2AMM consists of six levels and eleven 'areas'. The five levels are defined as follows (Schekkerman, 2006):

0. No Extended Enterprise Architecture.
1. Initial.
2. Under Development.
3. Defined.
4. Managed.
5. Optimized.

The eleven areas are as follows:

- Business and Technology Strategy Management.
- Extended Enterprise Involvement.
- Executive Management Involvement.
- Business Unit Involvement.
- Extended Enterprise Architecture Program Office.
- Extended Enterprise Architecture Developments.
- Extended Enterprise Architecture Results.
- Strategic Governance.
- Enterprise Program Management.
- Holistic Extended Enterprise Architecture.
- Enterprise Budget and Procurement Strategy.

The model can be seen in Appendix A. Even though it has clear defined concepts and levels of maturity, it provides no scoring criteria or EA characteristics for validation of the score that can correspond to each maturity level. No method of use is presented or previous case examples available.

3.5.2. THE ARCHITECTURE CAPABILITY MATURITY MODEL

In order to successfully manage change, organizations need to improve their IT-development processes. The CMM addresses this problem and has proven to be a great method for assessing the maturity and improving these processes (The Open Group Architecture Framework, 2009).

The US Department of Commerce has adapted the CMM as a means by which the Department can realize the benefits provided by EA. They developed the ACMM to assess business processes as well as understand the role of IT. According to the Department, CMMs are currently the means by which organizations should manage, assess and evaluate their EAs (United States Department of Commerce, 2004).

The ACMM offers a framework representing the main components of an EA process. The CMM provides a way to improve the overall processes starting from an ad hoc state and transforming through six stages to a fully measured mature state (United States Department of Commerce, 2004).

The ACMM consist of three sections of which the first two explain the Architecture Capability Maturity (ACM) levels and the EA characteristics for each maturity level. These will be used in the assessment process as measures for assessment. From the third section the ACM level is derived and reported to the CIO (United States Department of Commerce, 2004).

Like the E2AMM, the ACMM consist of six maturity levels, but nine EA characteristics. The maturity levels are as follow:

0. None.
1. Initial.
2. Under Development.
3. Defined.
4. Managed.
5. Measured.

The EA characteristics are as follow :

1. Architecture Process.
2. Architecture Development.
3. Business Linkage.
4. Senior Management Involvement.
5. Operating Unit Participation.
6. Architecture Communication.
7. IT Security.

8. Governance.
9. IT Investment and Acquisition Strategy.

The DoC defined two methods for determining an Operating Unit's maturity level. The two methods complement each other and can both be applied (United States Department of Commerce, 2004).

METHOD 1: THE WEIGHTED MEAN EA MATURITY LEVEL

In Appendix B, Table B.1 defines the scoring criteria for each of the nine EA characteristics. Table B.2 defines the EA characteristics that validate the score for each level of the Maturity Model. Table B.3 defines an Evaluation Scorecard. These tables along with the following steps aid in determining the mean ACM level as defined by the DoC:

1. Map the EA characteristics with each of the six Maturity Levels. See Tables B.1,B.2 and B.3 in Appendix B.
2. Sum the occurrence of each maturity level. See Table 2.
3. Divide the total by nine EA characteristics.

Architecture Characteristic	Score
1.	
2.	
3.	
4.	
5. = (5A+5B)/2	
6. = (6A+6B+6C)/3	
7.	
8.	
9.	
Score = (1...9)/9	

Table 2: The evaluation scorecard for measuring EA maturity (United States Department of Commerce, 2004).

METHOD 2: THE PERCENTAGE FOR EACH MATURITY LEVEL

The second method is used to obtain the percentage achieved at each Maturity Level for the nine EA elements. This method is dependent on the outcomes of the first method. Table 3 with the following steps can be used for obtaining the percentage (United States Department of Commerce, 2004):

1. The number of times that a Maturity Level has occurred at the nine EA elements must be counted. This is cumulative, thus if Level 4 has been achieved x number of times, so has Levels 3, 2 and 1.
2. Divide the number of occurrences with nine and multiply by 100 to obtain the percentage.

Maturity Level	Occurrences at each level	Percentage (out of 9)
5		
4		
3		
2		
1		
0		

Table 3: The evaluation table for determining the percentage of each maturity level (United States Department of Commerce, 2004).

Two parameters can be measured using the Enterprise ACMM. The first is the Enterprise ACM Level. The second is to calculate the Enterprise ACM score using the two methods.

The ACMM, unlike the E2AMM, has a clear defined methodology for applying the model and determining the EA maturity of an organization. This model can be applied to any enterprise with or without an OM. It can also be taken to an IT Architecture level and be modified as long as the core and basic elements remain the same. This model consists of clearly defined concepts and levels of Architecture Maturity, providing an unambiguous view of the difference in maturity levels.

3.6. TOOLS AND TECHNIQUES

In 2005 UP initiated a project known as the Systems Renewal project, as discussed in Section 2 and a new strategic Plan and Management Model were presented in 2007. The ITS started a restructuring process in 2007 and has also implemented various process and governance mechanisms with guidelines from tools and techniques provided by ITIL and CoBIT, as well as the regulatory compliance of KING III as mentioned in Section 2.

Documents regarding UP's EA, IT Governance, planning and strategic structures, have been set in place in 2005. However, these documents have been outdated and since the restructuring, some of these documents have been updated. Analysis of the updated material will be done and interviews with relevant candidates will be conducted.

The ACMM will be used to determine the level of EA maturity. Guidelines from Ross *et al* (2004, 2006) and the preliminary phase of the TOGAF ADM will be used to achieve the objectives set out to complete the project at hand.

3.7. CONCLUSION OF LITERATURE REVIEW

Enterprise Architecture provides a foundation for aligned decision making and governance frameworks. It can be used as a management tool to provide a comprehensive view of a company's principles and aid in the Business-IT alignment. In order to implement and asses the EA at any organization, the TOGAF ADM can be applied.

For a different view of Business-IT alignment, the 'foundation of execution' approach by Ross *et al* (2006) can be taken into account. This approach can be determined by three disciplines. First, an Operating Model, that establishes the level of process standardization and integration across business units. Second, Enterprise Architecture, that reflects the standardization and integration requirements through organization of business processes and the IT infrastructure. Thirdly, the IT Engagement Model, that ensures business objectives and IT principles are met through the use of IT Governance.

Aligning Business and IT through IT Governance, requires an accountability framework and corresponding archetypes. IT Governance is used to identify desired behaviors (principles) for the use of IT. In conjunction with the archetypes defined regarding decision rights, can the principles be applied to generate a Governance Arrangement Matrix to map out decisions and archetypes responsible for making decisions.

Two approaches for implementing an enterprise's OM exist. The first is through EA, where the key elements will differ for the different OM in use. The second approach is through IT Governance, where different IT Governance mechanisms are defined for the OM in use.

Determining the maturity level of EA at an organization requires a Maturity Model. Even though this subject area has not been widely known, a few models exist and can be applied at an enterprise like the E2AMM and the ACMM as discussed in Section 3.5.

Guidelines from Ross *et al* (2004, 2006) and parts from the preliminary phase described by TOGAF will be used to execute the research project at hand and attain the defined objectives. This will be discussed in Section 5.

4. IN CONTEXT OF THE UNIVERSITY OF PRETORIA

In 2007 the Department of Information and Technology Services (ITS) was restructured. Reasons for restructuring included, among others, the inability of the IT process to handle the current demand, the current 'silo' structure caused limitations and a better coordinated planning capacity was required. A governance committee was established which included the Executive Director, the IT Director and a representative from HR. The main objectives of restructuring included the following (Hudson, 2008):

- Meeting requirements of the IT strategic plan.
- Execute large scale projects while maintaining a stable production and infrastructure.
- Create a culture of measurement and improvement.
- Accommodate the Systems Renewal Project.

As discussed in Section 2, UP launched the Systems Renewal Project (SRP) in 2005 with the aim of minimizing long term risks, decreasing system maintenance of legacy systems and improving services, among others.

This overhauling project included various business areas, including Student Management, Financial Management, Facilities Management Systems, etc. As well as implementation of various suites of software provided by Oracle, including Oracle's PeopleSoft, Enterprise Content Manager, Business Intelligence and Middleware technologies. In 2007 the SRP was reviewed as part of the priorities, regarding the ICT, for the strategic plan (2007-2011) for UP (Hudson, 2008).

4.1. ENTERPRISE ARCHITECTURE - UP

Decisions made for the SRP, structure the future state of UP, where EA provides deliverables, such as roadmaps, that create decision-making frameworks for projects to cooperate and support business strategies. The current and future states are linked through a roadmap that outlines the sequence and timing of the SRP with the aim of reaching the future state architecture which is shown in Appendix C.1 (Pretorius, 2009). The elements of EA at UP can be illustrated in Appendix C.2, which was adapted from Gartner Inc. This depiction of EA elements from the adapted framework, with regard to EA at UP, are expanded in Appendix C.3 (Pretorius, 2010).

According to Hudson (2008), the PeopleSoft application will provide an integrated and comprehensive set of ERP business applications that will incorporate workflows and self services.

Data analysis from various sources will develop business insights with the help of a set of tools provided by Oracle's Business Intelligence application. Generated data will be available on the Web. The Enterprise Content Management application will provide a management toolset for aiding in the management of unstructured data, images, etc. (Hudson, 2008).

Through Middleware and the Oracle Web-center, a middleware stack will be available for managing applications and technologies. This will aid in the coordination of business processes and integration of applications by providing SOA tools (Hudson, 2008).

As part of the objectives regarding the ITS restructuring process, system efficiency and reliability will be ensured by the implementation and design of IT projects and processes. This will be guided by the future state architecture. The newly defined architecture will ensure a flexible, more adaptable architecture, but a more complex infrastructure (Pretorius, 2009).

4.2. IT GOVERNANCE - UP

As discussed in Section 2, the ITS makes use of ITIL and CoBIT for implementing processes and systems, including the completion of various requirements enforced by KING III for effective governance. UP has defined a set of high-level IT decision-making principles that can be seen in the table in Appendix D (Pretorius, 2009). The alignment between the IT principles and drivers identified in UP's strategic plan are illustrated, with the use of an alignment matrix that can be seen in Appendix D (Pretorius, 2009). Enterprise Business Services (EBS) is used to identify the principles in the alignment matrix.

A set of defined archetypes have been identified in 2005 (Pretorius, 2005):

- Business Monarchy: Top Managers (Executive Level).
- IT Monarchy: IT Management (Director and deputy Directors).
- Feudal: Each Faculty or Support Service making independent decisions.
- IT Duopoly: IT group in conjunction with a management or business unit leader group
- Anarchy: Isolated small decision-making groups

These archetypes along with the IT decision-making principles were used to generate a Governance Arrangement Matrix and a Governance Design Framework, as defined by Ross *et al* (2004), that can be seen in Appendix E (Pretorius, 2005). The Governance Design Framework represents the alignment between the enterprise strategy with IT Governance arrangements and business performance goals.

However, these structures have been outdated and a completed updated Governance Arrangement Matrix will be verified, but it is not based on an existing operating model defined by Ross *et al* (2006). Currently IT decisions are guided by a set of defined principles as stated by Ross *et al* (2004). This set of principles entails the five IT decisions discussed in Section 3.4 and illustrated in Figure 7 (Pretorius, 2010).

Enterprise Architecture must be improved continuously and developed further at UP. EA will aid in producing value from IT investments made in new systems. Duplication and obstruction of process data will be avoided and setbacks from 'data silos' created by the different systems will be prevented (Pretorius, 2009).

4.3. EA MATURITY - UP

The ITS have used the CoBIT maturity model to measure the EA maturity of a few implemented ITIL processes mentioned in Section2. Making use of the generic maturity model as defined by CoBIT, the ITS has measured the EA maturity of the following process and will in due time measure the processes that are shown:

Process	Date of assessment	Maturity level	CoBIT generic Model Characterization
Availability Management			
Capacity Management			
Change Management	28/06/2010	3.5	Defined Process moving to a Managed and Measurable Process.
Configuration Management	22/07/2010	2.0	Repeatable, but intuitive process.
Incident Management	05/08/2010	3.0	Defined Process
Portfolio Management			
Problem Management	05/08/2010	1.8	Initial moving to a Repeatable, but intuitive process
Release Management	22/07/2010	1.5	Initial moving to a Repeatable, but intuitive process
Service Continuity	10/09/2009	1.0	Initial
Service Level Management			

Table 4: The EA maturity level for ITIL processes as measured by the ITS with the CoBIT Generic Model (Ferreira, 2010).

The average Maturity Level for processes already measured is 2.13. According to the CoBIT generic model seen in Table 5, this is characterized as a Repeatable, but intuitive process moving to a Defined maturity.

Level		Description
0	**Non-existent**	Complete lack of any recognisable processes. The enterprise has not even recognised that there is an issue to be addressed.
1	**Initial**	There is evidence that the enterprise has recognised that the issues exist and need to be addressed. There are, however, no standardised processes; instead, there are ad hoc approaches that tend to be applied on an individual or case-by-case basis. The overall approach to management is disorganised.
2	**Repeatable but Intuitive**	Processes have developed to the stage where similar procedures are followed by different people undertaking the same task. There is no formal training or communication of standard procedures, and responsibility is left to the individual. There is a high degree of reliance on the knowledge of individuals and, therefore, errors are likely.
3	**Defined Process**	Procedures have been standardised and documented, and communicated through training. It is mandated that these processes should be followed; however, it is unlikely that deviations will be detected. The procedures themselves are not sophisticated but are the formalisation of existing practices.
4	**Managed and Measurable**	Management monitors and measures compliance with procedures and takes action where processes appear not to be working effectively. Processes are under constant improvement and provide good practice. Automation and tools are used in a limited or fragmented way.
5	**Optimised**	Processes have been refined to a level of good practice, based on the results of continuous improvement and maturity modelling with other enterprises. IT is used in an integrated way to automate the workflow, providing tools to improve quality and effectiveness, making the enterprise quick to adapt.

Table 5: The CoBIT Generic Maturity Model (ITGI, 2007)

5. RESEARCH DESIGN

During this section a research plan will be discussed that will include a discussion on how and why intended work is to be done.

5.1. RESEARCH PLAN

A study on how the standardization of certain processes will influence the governance structures in a tertiary education institution (in this case the University of Pretoria), is being conducted by Ms Marné de Vries. This study includes two parts. The first part entails the input of another student, to investigate and develop a method for identifying standardization opportunities within a process, which is executed within different business units at UP. The second part entails this research project, to investigate the alignment of Business and IT through the use of IT Governance.

In order to conduct the research required to meet this research project goals, the following model was used as guideline:

- **Research Planning**
  This involved the completion of a literature study (see Section 3) to provide the scope of the research project and gain a better understanding of EA concepts and IT Governance. Throughout the literature review section, insight was gained on alignment of business and IT and IT Governance concepts. Research showed that implementation and assessment of EA could be done by applying TOGAF ADM, however, more focus was placed on the preliminary phase. The Ross *et al* (2006) approach to business-IT alignment as well as models for assessing EA maturity was investigated.
- **Research Methodology**
  After the required research has been conducted relevant tools, methods and techniques are selected. The literature study provided a clear background of available tools, methodologies and techniques. This section will also reveal motivation for selective tools, methods and techniques to be used in order to investigate how a Higher Education Institution (in this case the University of Pretoria) aligns business and IT through IT Governance. This section will also reveal how the selected tools, methods and techniques will be applied.
- **Validation**
  From the research methodology where selection for tools, methods and techniques were motivated, can they now be applied to gain insight and understanding of how IT Governance is applied for business and IT alignment at UP.

- **Recommendations, Constraints and Conclusion**
  Enclosing the research project will be a few recommendations, constraints and a conclusion.

6. RESEARCH METHODOLOGY

As discussed in Section 2, the IT director aims in using the EA 'light' version of implementing practices during the execution of the Systems Renewal project. Even though the University has operating models in place, these are not based on the OM defined by Ross *et al* (2006).

This section will discuss selected and developed tools, guidelines, methods and techniques for completing the project at hand. The literature review provides insight into relevant tools, methods and techniques that could be applied to attain the objectives of this project.

6.1. SELECTED AND DEVELOPED TOOLS, METHODS AND TECHNIQUES

Research, including interviews and investigations have been be undertaken to acquire the relevant documentation required to execute this research project.

Guidelines provided by Ross *et al* (2004, 2006) in conjunction with guidelines and methods from the preliminary phase provided by TOGAF ADM (2009), will be altered to achieve objectives of this research project. From this conjunction, the Modified Model will emerge. The Modified Method (MM) will be as follows:

- **Step MM1: Confirm governance and support frameworks**. In order to understand the current organization, assessment and confirmation of existing models must be undertaken at UP. This will assist in determining the government process that will control the architectural creation with the aim of defining a framework for architecture governance. This is part of the second step of the ADM and will be adapted to include the confirmation and assessment of any existing IT Governance and EA models and frameworks at UP. Guidelines provided by Ross *et al* (2004), as discussed in Section 3, will also be used.
- **Step MM2: Define and establish mechanisms**. During the step in the Modified Model, the architecture team at UP will be defined, upholding the third step of the ADM. IT Governance and EA mechanisms will also be identified with the aid of guidelines provided by Ross *et al* (2004) as discussed in Section 3. This includes characterizing the type of mechanism in use. Gaps will be identified within business areas as well as determining business capabilities and architecture constraints at UP. This step extends the MM1 step, gaining a more detailed view at what the frameworks at UP actually consist of and who/what forms part of these structures.

- **Step MM3: Identify and establish Architecture principles.** Architecture principles will be identified, investigating if their alignment with the business principles at UP. This will include identifying any IT principles. This forms part of the fourth step of the ADM.
- **Step MM4:** Conclusion of the findings of the three MM steps. This includes assessment on the effectiveness of the Governance and Support Frameworks and their mechanisms as well as the effectiveness of other mechanisms identified.

Selected techniques, methods and guidelines to achieve project objectives will include the following:

- **The Operating Model as defined by Ross *et al* (2006).** Guidelines provided by Ross *et al* (2006) will assist in identifying the existence, if any, of an Operating Model as defined by Ross *et al* (2006), at UP. This will include determining the current level of standardization.
- **The Governance Arrangement Matrix**. This technique shall asses IT Governance, as discussed in the literature review. It entails the identification of IT decisions and archetypes as defined by Ross *et al* (2004).
- **The four levels of Architecture Maturity**. This technique, as discussed in the literature review, entails defined levels of maturity based on IT investment, the focus of key IT Governance issues and benefits gained during each stage as defined by Ross *et al* (2006).
- **The Architecture Capability Maturity Model (ACMM).** This model, as discussed in the literature review, includes two methods of determining the EA maturity of an organization. This model is well explained and defined by the US Department of Commerce (2007) and will be selected over the E2AMM defined by the IFEAD (2006).

7. VALIDATION

Applying EA at Higher Education Institutions has been an unknown subject area, as discussed in previous sections. Attempts revealed to be unsuccessful, however, it showed the complexities present in a HEI and that partial use of TOGAF can be sufficient for initial implementations and evaluation of EA.

The objective of this section is to apply the selected/developed methods, tools and techniques identified in the previous section. This will lead to reaching all project objectives and determine the overall project initiative; Determining how UP aligns Business and IT through the use of IT Governance.

The Modified Method (MM) will first be validated, followed by implementing the selected tools, methods and techniques.

7.1. THE MODIFIED MODEL

7.1.1. STEP MM1: CONFIRM GOVERNANCE AND SUPPORT FRAMEWORKS

Governance and support frameworks identified at UP:

1. **A Committee Structure as defined by the IT Director at UP (Pretorius, 2010).**

The committee structure that can be seen in Appendix F.1 was constructed by the IT Director. The majority of the committees play a big role in the steering of the SRP. As mentioned in Section 2, the architecture is shaped by the choices made for the SRP.

2. **The IT Governance Framework Version 3 (Pretorius, 2010).**

The IT Governance Framework that can be seen in Appendix F.2 has been updated on 22 April, 2010. This framework was constructed by the IT Director and describes the input rights, decision rights and ratification rights of the committees/leaders that make decisions regarding six defined governance areas. These governance areas are as follow (Pretorius, 2010):

1. IT Principles.
2. IT Architecture.
3. IT Infrastructure.
4. Business Application Functionality (Systems Renewal).
5. Investment and Prioritization: Purchase or development of systems within approved budget.
6. Investment and Prioritization: Approval of customization (Systems Renewal).

The committees/leaders have influence on three types of decision areas. The type of decision area can be characterized as one of the following, corresponding to the colors indicated on the framework in Appendix F.2:

1. Normal process (blue)
2. System Renewal (red)
3. Both of the above (green)

The framework also defines when a committee/leader can be held responsible, accountable, is consulted or informed, regarding each governance area (Pretorius, 2010).

3. The major IT Functions Model (Pretorius, 2009).

The three IT functions and their relationships are depicted in Figure 13. Two management sides form part of the model. The first is the IT Supply Side Management that comprises of the IT Operations function. All IT services are produced at the IT Operations function according to a service level agreement. The software and hardware infrastructure, as well as IT processes and services are owned by the IT Operations function with the exception of projects and governance (Pretorius, 2009).

The other management side is the IT Demand Side Management that comprise of the Capability Development function and Governance, EA & Planning function. New projects that add to the IT capability are managed by the Capability Development function. Projects could take up to days or years to be completed by the project office and technical capability development teams that the Capability Development function comprises of. Capabilities of completed projects are sent to production. These capabilities are maintained and managed by the IT Operations function in production (Pretorius, 2009).

The Governance, EA & Planning function serves as the main oversight function. The Governance function allocates budgets and takes responsibility for program and portfolio management. The funding and prioritization is separated as fully funded projects are sent to the Capability Development function for execution (Pretorius, 2009).

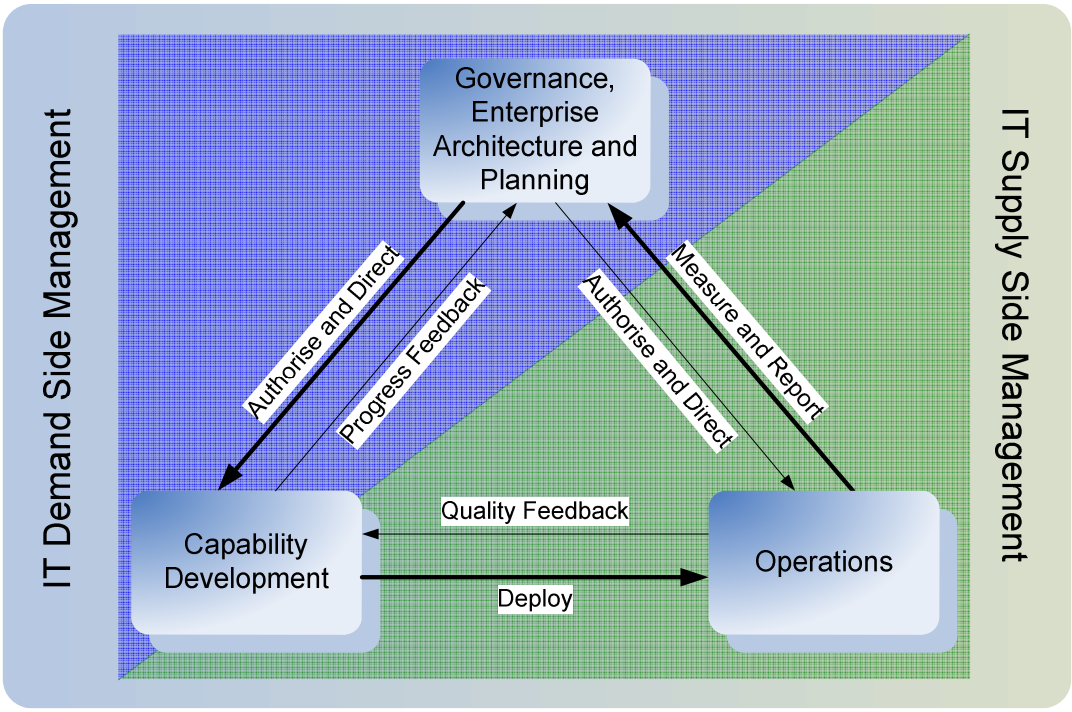

Figure 13: The Major IT Functions (Pretorius, 2009, p.4).

4. Future state description (Pretorius, 2009).

As mentioned in Section 2, the ITS started restructuring in 2007. They consulted with Accenture, and defined a new organizational structure and operating model for the ITS. The restructuring lead to defining a planned future state model that overlays the new IT organization structure. The planned future state can be seen in Figure 14 and can now be viewed as the 'almost-current' state of the ITS. The objectives of the structure are illustrated along with its key features such as customer focus, broken down silos and roles of cross-functional end-to-end processes and teams. The new IT organization structure can be seen in Figure 15 (Pretorius, 2009).

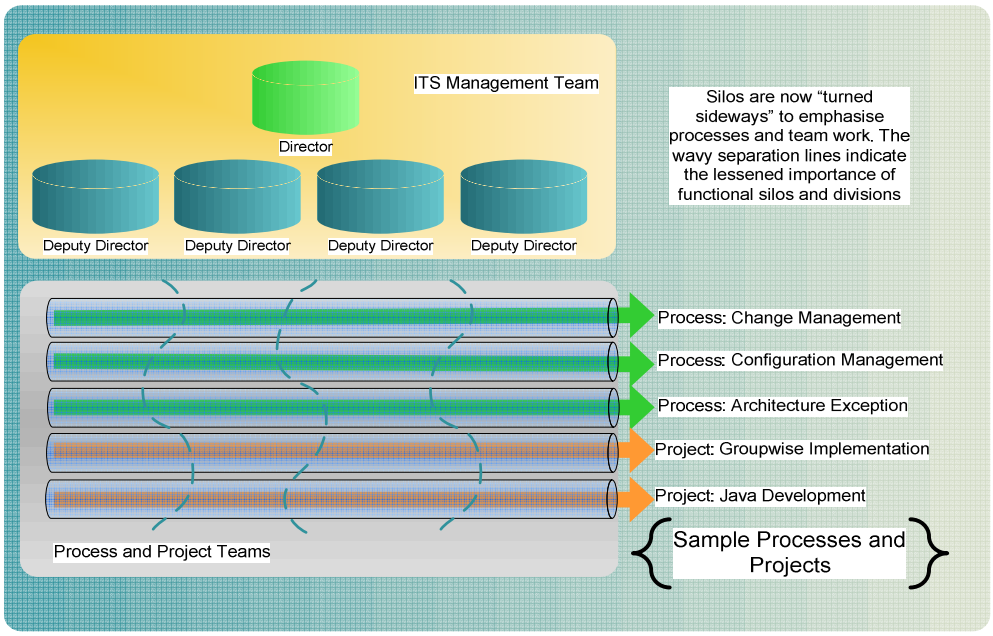

Figure 14: The ITS planned future state (Pretorius, 2009)

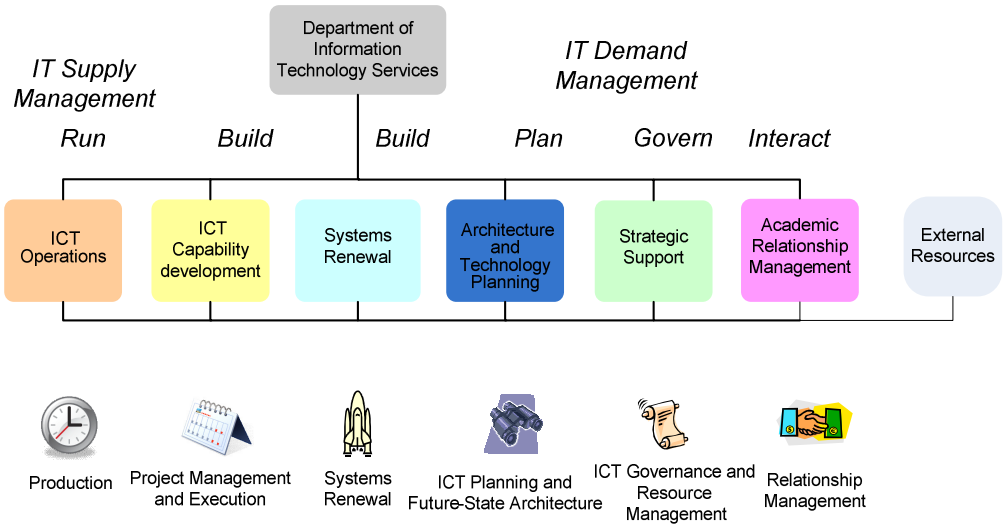

Figure 15: The new IT organizational structure (Pretorius, 2009)

5. IT Operating Model (Pretorius, 2009).

From the ITS restructuring, this model is adapted from the IT model of Accenture, namely the Industrialized IT Capability Model (IITCM). The combination of the IITCM and the ITS requirements lead to defining the IT Operating Model that can be seen in Appendix F.3. This model serves as the bases on which the IT strategy is built. The model illustrates the IT Supply Service and IT Demand interactions with the users, Support Service and faculties via the Service Catalogue discussed in Section 2. The phases for IT projects and functions are also illustrated on the far right of the model (Pretorius, 2009).

6. IT Demand Management framework (Pretorius, 2009).

In addition to the restructuring of the ITS, focus has been placed on the management of IT demand. This framework was adapted from Gartner and can be seen in Appendix F.4. The mechanisms in the framework correspond to their counterparts in the new IT organization structure of which the mechanisms will be discussed in the MM2. The total number of arrow points on the arrows, indicate the speed at which the mechanisms operate. The divisions where the functions will be performed are indicated by the rounded rectangles (Pretorius, 2009).

7. Information Management and Governance Framework (Pretorius, 2009).

A governance framework with defined accountabilities has been constructed to improve the Information Management and Information Governance's effectiveness. The main objective is so that guidance can be provided with regard to implementation of systems that utilize structured and unstructured

data during the SRP. The figure in Appendix F.5 illustrates a conceptual architecture for Information Management. In correspondence to the purchased suites from Oracle and PeopleSoft, information gets stored in one of two data repositories; structured and unstructured (Pretorius, 2009).

On the left side of the figure the flow of particular types of information is illustrated. The information that needs to be stored enters the top vertical, segments and gets filtered, or gains attributes, through the layers until it reaches a data repository where all the information enters the Information Management life cycle. Information that needs to be retrieved from the repository goes vertically up the layers (Pretorius, 2009). The right side of the figure provides governance suggestions, decision requirements for each layer and guidelines with regards to assign roles for Information Management Governance (Pretorius, 2009).

8. The future state architecture for UP (Pretorius, 2009).

As mentioned in Section 4, the future state architecture for UP can be seen in Appendix C along with the EA elements adapted from Gartner Inc. Decisions made by the SRP shape the future state where EA delineates roadmaps for decision-making frameworks at UP to reach the future state. Open standards, which are based on a common enterprise model, will make optimization of processes possible along with enabling information channels that is consistent by integrating systems. Flexibility, and unfortunately complexity, will increase. IT operational process implementations and designs will be guided by the future-state architecture (Pretorius, 2006; Pretorius, 2010).

7.1.2. STEP MM2: DEFINE AND ESTABLISH MECHANISMS

As discussed in Section3.4, Ross *et al* (2004) have delineated three types of governance mechanisms. The first is Decision-Making Structures, secondly Alignment Processes and thirdly, Communication Approaches. The focus will be on the mechanisms that the first six structures and frameworks, discussed and confirmed in MM1, comprise of. The last four mechanisms (mechanism 5 – 8), mentioned in the MM2 are IT metrics and external resources utilized by the ITS. The mechanisms are as follow:

1. **Established mechanisms for the IT Governance Framework v3 and Committee Structure**.

In the Committee Structure and IT Governance Framework (v3) confirmed in the MM1, the committees identified serve as mechanisms. With reference to Ross *et al* (2006), these mechanisms can be characterized as Decision-

Making mechanisms, where responsibility roles are identified for making IT decisions. The mechanisms identified are as follow:

1. IT Director (ITD).
2. Systems Renewal Executive Steering Committee (SRESC).
    i. Systems Renewal Operational Steering Committee (SROSC).
    ii. Systems Renewal Extended Steering Committee (SRXSC).
    iii. Systems Renewal Workstream Leader (SRWL).
    iv. Systems Renewal Workstream Team (SRWT).
3. Functional Unit (FU).
4. Project Director (PD).

5. ITS Senior Management Committee (ITSM).
    i. Change Advisory Board (CAB).
    ii. EA Review Board (EARB).
    iii. IT Standards Committee (ITSC).
6. IT Committee (ITC)
    i. Committee for online strategic matters.
    ii. Research computing Committee (RCC).
    iii. IT Budget Prioritization Committee (ITBPC).
    iv. Virtual Campus Committee (VCC).

With regard only to decisions for the SRP, as indicated by the Governance Framework (v3); the ITD has decision rights over IT Principles, IT Architecture and IT Infrastructure. The Project Director has decision rights over Investment & Prioritization. Table 6 outlines a more simplistic view of understanding the rights and roles of each mechanism regarding decisions about the SRP:

	Input Rights	**Decision Rights**	**Ratification Rights**
IT Principles	• EARB • SROSC • PD • ITD	• ITD	• EARB
IT Architecture	• EARB • SROSC • ITD • PD • ITSM	• ITD	• EARB
IT Infrastructure	• SROSC • ITD • PD • ITSM	• ITD • PD • ITSM	• ITD
Business Applications functionality (Systems Renewal)	• SRXSC • SRWL • FU	• SRWL • PD	• SROSC
Investment and Prioritization: Purchase or development of systems within approved budget	•	•	•
Investment and prioritisation: Approval of customisation (Systems Renewal)	• SRXSC • SRWL • SRWT • FU	• PD	• SRESC • SROSC

Table 6: Decision rights regarding decisions about the SRP

2. Future -state mechanisms.

The future-state structures confirmed in MM1 consists of functions/mechanisms that can be seen in Appendix G.1 (Pretorius, 2009). These can be characterized as Alignment Processes by which input is provided back to decision-making. These are functions that are consistent with the IT policies. The mechanisms can also be classified as Communication Approaches where channels exist that distribute IT principles and policies and the effects of decisions that have been made (Ross *et al*., 2006).

3. The IT Operating Model mechanisms.

The IT Operating Model, as discussed in the MM1, has mechanisms that can be characterized as Alignment Processes (Ross et al., 2006). The Academic & Relationship Management and Architecture & Technology Planning are responsible for the interactions and planning phases to produce business cases that are used for finding prioritization through their interactions with the Strategic Support function (Pretorius, 2009).

During the governance phase, the Strategic Support function makes use of Project Portfolio Management processes to allocate funds to the Capability Development function. The Capability Development function plays a role in the building phase. This function takes responsibility for project management and delivering the new capability to the Operations function that enters the Run phase. The Operations function takes responsibility for management of the IT asset portfolio and uses this portfolio to deliver IT services to the end used, faculties and Support Service. The IT portfolio comprise of all the hardware and software that are in production (Pretorius, 2009).

4. IT Demand Management Mechanisms.

This framework, as discussed in the MM1, has mechanisms that can be characterized as Alignment Processes (Ross *et al*., 2006). They include (Pretorius, 2009):

- IT requirements that also entails relationship management along with architecture and technology planning.
- IT Funding Prioritization that serves as an IT demand governance component.

- Program and Project Management that entails protect execution prioritization.

5. Alignment matrix for determining how well the alignment between the strategic thrusts of UP is with the defined IT principles (Pretorius, 2009).

This matrix, as discussed in Section 4, can be seen in Appendix D and can be characterized as a Decision-Making, Alignment Process and Communication Approach mechanism. The matrix provides a clear view on what areas require better alignment and where improvements can be made, while also aiding in keeping the focus on strategic goals and objectives that need to be achieved.

6. Guidelines provided by CoBIT and ITIL

The University has implemented a few CoBIT and ITIL processes and models as mentioned in Section 4. The ITTL v2 has been used for the implementation of various processes and ITIL v3 for the implementation of a Service Catalogue. CoBIT is used for filling the ITIL processes in areas such as the RACI-table, utilization of the CoBIT Maturity Model, alignment of CoBIT with ITIL and CoBIT defined metrics (Ferreira, 2010).

7. ITS Balanced Scorecard and Strategy Map (Pretorius, 2009).

An ITS Balanced Scorecard and Strategy Map has been defined to guide performance management, especially during the execution of the SRP. These mechanisms are characterized as Alignment Processes as they serve as part of IT metrics procedures (Pretorius, 2006). The IT Strategy Map starts at the bottom from the Learning and Growth Perspective, moving up to the Internal Process perspective. This perspective is followed by the Financial Performance and Resource Optimization Perspective to the Customer Perspective. The mechanisms can be seen in Appendix G.2.

8. IT Metrics

A three-tiered IT metrics have been developed for the ITS and realization of benefits. The metrics have been divided into the following tiers (Pretorius, 2008):

- Scorecard metrics which were developed at strategic level
- Project metrics that provides indicators on project execution and value realization.
- Operational metrics – a 'dashboard' indicating operational metrics and SLA measurements.

7.1.3. STEP MM3: ARCHITECTURE PRINCIPLES

The ITS have defined a detailed set of governance principles that is mostly aligned to UP's objective and strategy (see Appendix D) as well as the SRP and all activities regarding IT. The principles are established with guidance from the five IT decisions as defined by Ross *et al* (2004). Thus, the IT principles are delineated within the following areas. The descriptions thereof can be seen in Appendix H (Pretorius, 2010):

- IT Principles, as mentioned in Section 4. (See Appendix D)
- Business Application
- IT Architecture
- Investment and Prioritization
- IT Infrastructure

7.1.4. STEP MM4: THE MODIFIED MODEL CONCLUSION

In conclusion to the Modified Model, the Governance and Support Frameworks are conceptually supported by their defined mechanisms and designed structures:

- The Committee Structure and IT Governance Framework supported by the appropriate committees of which each role and responsibility regarding decisions have been defined.
- With the IT Function model it is noticed that execution is well separated from prioritization. This includes separation of accountabilities and required management styles.
- The future-state description requires that the backbone of the new ITS organization structure includes cross-functional management, process and project teams. In both frameworks depicted in the future state, the IT Demand and IT Supply Management functions is realized as well as providing an illustration on where and how the three major IT functions fit into the new IT Organization structure as a whole.
- The IT Operating Model defines the organization on an operational level and also depicts the role of each function as defined in the new IT Organization Structure.
- The Information Management and Governance framework, as defined by the IT Director, serves as a guideline of what is needed to utilize the renewed system effectively.
- The future-state architecture of UP is a high-level description of the technical architecture at UP, whereas the planned future-state architecture for the ITS focuses more in the operational and functional architecture.

The adoption of certain CoBIT and ITIL processes has been a significant boost in the ITS regarding management assessment of processes as well as choosing the right processes to utilize.

Implementation of new structures has been difficult considering that the ITS restructuring has only been an ongoing project for three years. This required a major culture shift and adaption to new processes and structures.

Actual alignment of principles has not reached the desired level. Even though the implementation of the structures and governance frameworks has been done recently, improvement can be noticed; the Budget and Priority system has improved, along with information flow, performance management, effectiveness of campus support teams and project management.

However, the ITS requires more support, tenacity and willingness from lower level employees to top management, for ensuring the effectiveness of the conceptual structures and frameworks.

7.2. THE OPERATING MODEL DEFINED BY ROSS *ET AL* (2006)

The application of this tool, will be completed for the next due date.

7.3. GOVERNANCE ARRANGEMENT MATRIX

The application of this tool, will be completed by the next due date.

7.4. MATURITY MEASUREMENT

As mentioned in Section 2, UP has implemented maturity models for internal control, as defined by CoBIT. However, for a different perspective and point of view, the EA maturity from Ross *et al* and the ACMM from the DoC, will be applied to determine the EA maturity at UP.

7.4.1. FOUR LEVELS OF ARCHITECTURE MATURITY

The application of this method, will be completed by the next due date.

7.4.2. ARCHITECTURE CAPABILITY MATURITY MODEL

As discussed in Section 3.5, the ACMM consists of two steps.

Method 1 entails the mapping of the EA characteristics and six maturity levels and completion of the evaluation scorecard. These can be seen in Appendix B. The objective is to obtain the weighted mean EA maturity level. The evaluation scorecard was completed with the input and authorization of the IT Director. The following results were achieved:

Architecture Characteristics	Score
1. The Architecture Process	1
2. Architecture Development	1
3. Business Linkage	2
4. UP Senior Management Involvement	2
5. 5a. Operating Unit Participation A - 1 5b. Operating Unit Participation B - 1	1
6. 6a. Architecture Communication A - 1 6b. Architecture Communication B - 0 6c. Architecture Communication C - 0	0.33
7. IT Security	1
8. Governance	2
9. IT Investment and Acquisition Strategy	2
Mean Weighted Average	**1.37**

Table 7: A completed ACMM evaluation scorecard

The mean weighted average for EA at UP, according to the ACMM, is 1.37. This means the maturity is at an initial stage and that informal EA processes are underway.

The next stage, to which UP is already moving to, is where EA processes are under development. Method 2 entails determining the percentage of each maturity level. The following was derived:

Maturity Level	Occurrences at each level	Percentage (out of 9)
5. Measured	0	0
4. Managed	0	0
3. Defined	0	0
2. Under Development	4	44.4%
1. Initial	4+4	88.89%
0. None	4+4+1	100%

Table 8: Evaluation on the utilization of Maturity Levels defined by the ACMM

In comparison to the CoBIT evaluation, the ACMM was applied to the operating unit as a whole and not to specific process. The results of the ACMM show that the second maturity stage has reached utilization of 44.4 %, and that this is not far off from the obtained results from CoBIT. Thus, the evaluation is valid. It is noticed that EA at UP still requires much more attention and development for its objectives to take effect.

8. RECOMMENDATION

The following recommendations can be made:

- With regard to the current EA maturity level, the ITS can focus on distributing and communicating the EA initiatives across its own and the different UP departments, as well as high-level management. This will ensure better understanding and raise more awareness of EA, as well as effort and interest in EA, across UP.
- Methods for attaining better involvement of senior management, and also lower-level employees need to be implemented.
- Awareness sessions should be considered to enlighten and assist employees with regard to culture changes and adaption to new structures and systems.

9. PROJECT CONSTRAINTS

The following constraints were identified throughout the duration of the project:

- Limited knowledge on certain subject fields prior to the project.
- Limited knowledge on process operations and functions at the University of Pretoria.
- Appointments made with high-level management ahead of time.
- Other subjects' interference on schedules and working sessions.
- Time.

10. CONCLUSION

The research project entailed intense investigation into the use of EA, Business-IT alignment, IT Governance and EA maturity. It was found that EA can provide a valid governance framework for Business-IT alignment and that IT Governance plays a big role in the success and effectiveness of this alignment.

Applying EA to HEIs, on the other hand, is a much more difficult task than implementing it within a Business Enterprise. Systems and processes are more complex and do not hold up to an Operating Model as stipulated by Ross *et al* (2006). However, with the partial use of the TOGAF ADM, this task is made easier.

Objectives were achieved with the selected and developed set of tools, techniques and methods, gaining a clear understanding on UP's approach to EA and IT Governance.

UP aligns its IT and Business with various frameworks, principles and structures, however, their effectiveness rests heavily upon the practical application of these defined frameworks, as well as the support and acceptance of the developed structures, by employees.

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12. APPENDICES

APPENDIX A
THE EXTENDED ENTERPRISE ARCHITECTURE MATURITY MODEL (SCHEKKERMAN, 2006)

E2AMM	Level 0: No Extended Enterprise Architecture	Level 1: Initial	Level 2: Under Development	Level 3: Defined	Level 4: Managed	Level 5: Optimized
1. Business & Technology Strategy Alignment	No awareness of aligning business strategies, business drivers & principles and IT strategies, drivers & principles.	Initial alignment of business strategies, business drivers & principles and IT strategies, drivers &principles.	First activities to align business strategies, business drivers & principles and IT strategies, drivers &principles.	Formal alignment of business strategies, drivers, principles & functional/ non-functional Requirements and IT strategies, drivers, principles & functional/ non-functional.	Frequently reconsideration of business strategies, drivers, principles & functional/ non-functional Requirements and IT strategies, drivers, principles & functional/ non-functional.	Business-Technology cost/benefits validation metrics for end-to-end value chain examination.
2.Extended Enterprise Involvement	No involvement of Extended parties; No collaboration agreements.	Incidental involvement of extended parties.	Awareness of collaboration with extended parties. First initiatives to involve extended parties in the E2A program.	Extended parties involved in E2A program. Definition of collaboration levels and information exchange standards.	Extended Enterprise management & governance structure in place.	Measurement structure in place to manage Extended Enterprise environment.
3.Executive-Management Involvement	E2A is not for us. We don't need to be involved. We know how to do our jobs. Don't tell me about it.	What is Extended Enterprise Architecture about? I have heard something about E2A.	Little awareness by management of E2A possibilities. Spread scepticism to adopt E2A	Executive management aware of e2A benefits. Executive management supports pro-active E2A program.	Executive management evaluates periodic the E2A program and results.	Executive management participating in the E2A optimization process.
4.Business Unit's Involvement	E2A is not recognized by any business unit.	Some BU supports the E2A program and will deliver some added value to the Business-IT alignment process.	Identification that it is hard to maintain too many different business processes and supporting technologies in a dynamic business world.	Identification that an E2A program can reduce complexity and can enhance business flexibility. Adaptive Business-IT alignment is the answer to business dynamics.	Enterprise wide BUs are actively involved in the E2A program.	E2A is established in all BUs and part of their decision making process.

E2AMM	Level 0: No Extended Enterprise Architecture	Level 1: Initial	Level 2: Under Development	Level 3: Defined	Level 4: Managed	Level 5: Optimized
5.Extended Enterprise Architecture Program Office	E2A program does not exist.	First cut of E2A program in place. E2A architects identified.	E2A program being actively defined. E2A program office established.	E2A program established. E2A program office actively working together with business and IT units in defining E2A value.	E2A program office is involved in the line of business and the Enterprise budget process.	Continuously measurement of E2A program activities and results. E2A measurement process of the overall Enterprise improvement activities.
6.Extended Enterprise Architecture Developments	No E2A recognition.	Some E2A activities are started. Recognition about focusing on business value and IT standards + cost reduction activities. Ad-hoc alignment of Business and IT.	E2A program is set up. Business and IT strategy and standards are developed and linked. EA framework and methodology are chosen but not yet widely spread.	E2A program established. Business and IT principles, drivers and strategies are defined and communicated. E2A and Solution Architecture areas are defined and aligned.	E2A program managed by E2A steering committee. Reference models are rolled out and accepted by BUs. E2A program office involved in the definition of new projects. E2a reflects current and future state.	E2A program office manages projects portfolio landscape and aligns continuously the overall activities and initiatives.
7.Extended Enterprise Architecture Results	None.	E2A results are documented in a single way. No access to the results for other.	E2A are shared with others. Most results are documented using traditional office tools. Access to the results is limited. Sharing of information in a traditional way. Modelling and visualization techniques are developed.	E2A results are updated frequently. Standards, modelling methods and visualization techniques are used. E2A repository is set-up.	E2A results are controlled and managed regularly. BUs are using E2A results in their planning business. E2A results are accessible in an electronic way for all participants.	E2A results are mandatory used in the Enterprise wide strategic planning and governance activities. Continuous improvement of strategic planning and decision making cycle based on E2A results.

E2AMM	Level 0: No Extended Enterprise Architecture	Level 1: Initial	Level 2: Under Development	Level 3: Defined	Level 4: Managed	Level 5: Optimized
8.Strategic Governance	Strategic Governance not in place.	Strategic Governance is in place and the first activities are set up to link the E2A program and Strategic Governance.	E2A results are part of the Strategic Governance process. The Enterprise Program management office and the E2A office are working together on an incident base.	Strategic decision making and governance are based on the E2A results. The E2A program office is involved in the formal governance processes.	Formalized strategic governance of all business and IT investments based on E2A results.	Value measurement techniques are adopted to continuously measure the business and IT value of investments based on the E2A results and in line with the Governance strategy.
9.Enterprise Program Management	Enterprise Program management not recognized.	Project management upgrade to program management. Recognition of the added value of Enterprise Program management, Program management executed almost in isolation.	Enterprise Program management and E2A linked together. Enterprise Program management office responsible for the transformation part, E2A office responsible for the Content part.	Enterprise Program management office and E2a office, officially working together. Program management approach and E2A program aligned. Accountability and responsibility of activities defined.	Project and program initiatives under auspices of the enterprise program management office with participation of the E2A office Procedures, standards and methods are aligned.	Enterprise Program Management Office and E2A Office are participating in the enterprise strategic planning process. Measurement techniques are in place to determining the added value to the business of all initiatives.

E2AMM	Level 0: No Extended Enterprise Architecture	Level 1: Initial	Level 2: Under Development	Level 3: Defined	Level 4: Managed	Level 5: Optimized
10.Holistic Extended Enterprise Architecture	Awareness of aligning business and technology not present.	Awareness of aligning business and technology present. First initiatives set up to align business and technology activities, based on the Enterprise its mission, vision strategies and business drivers.	Activities are set up to continuously align business and technology initiatives. Alignment of business and information modelling methods with the technology modelling methods.	E2A framework is used to define the business IT alignment areas. Results of business and IT modelling methods are stored in a repository. Traceability of business and IT alignment.	Every project or program initiative is measured against the added value to the business and the cost of investments. The current and future state. E2A are used as a management tool to plan transformation initiatives. Business and Technology are operating on the same level of maturity.	The holistic E2A approach is part of the organization's culture. Business initiatives are continuously reflected to the technology impact and IT possibilities are driving new business activities.
11.Enterprise Budget & Procurement Strategy	Separated Business & IT budget & procurement strategy.	Almost no awareness about aligning and managing the Enterprise business & IT budget and procurement strategies.	First awareness about the alignment and management of the Enterprise business & IT budget and procurement processes.	The E2A office is participating in the enterprise budget and procurement strategy. Request for information or proposals are defined in cooperation with the EA office.	The future state E2A acts as a blueprint for investments, is formalized and part of the enterprise budget process.	All investment plans and initiatives are related to the E2A results, the budgets and procurement strategy.

APPENDIX B
TABLES REQUIRED FOR THE ARCHITECTURE CAPABILITY MATURITY MODEL (UNITED STATES DEPARTMENT OF COMMERCE, 2004)

Table B.1: Scoring criteria for each of the nine EA characteristics.
Table B.2: The EA characteristics that validate the score for each level of the Maturity Model
Table B.3: The Evaluation Scorecard.

Table B.1: Scoring criteria for each of the nine EA characteristics.

Score	Element 1. Architecture Process
0 No EA	Not established or does not exist.
1 Initial	Exists in ad-hoc or localized form or early draft form may exist. Some Enterprise Architecture processes are defined. There is no unified architecture process across technologies or business processes. Success depends on individual efforts.
2 Developing	Being actively developed. Basic Enterprise Architecture Process program is documented based on OMB Circular A-130 and Department of Commerce Enterprise Architecture Guidance. The architecture process has developed clear roles and responsibilities.
3 Defined	The architecture is well defined and communicated to IT staff and business management with Operating Unit IT responsibilities. The process is largely followed.
4 Managed	Enterprise Architecture process is part of the culture, with strong linkages to other core IT and business processes. Quality metrics associated with the architecture process are captured. These metrics include the cycle times necessary to generate Enterprise Architecture revisions, technical environment stability, and time to implement a new or upgraded application or system.
5 Optimizing	Concerted efforts to optimize and continuously improve architecture process.

Score	Element 2. Architecture Development
0 No EA	No Enterprise Architecture documentation to speak of.
1 Initial	Enterprise Architecture processes, documentation, and standards are established by a variety of ad hoc means and are localized or informal.
2 Developing	IT Vision, Principles, Business Linkages, Baseline, and Target Architecture are identified. Architecture standards exist, but not necessarily linked to Target Architecture. Technical Reference Model and Standards Profile framework established.
3 Defined	Gap Analysis and Migration Plan are completed. Architecture standards linked to Business Drivers via Best Practices, IT Principles, and Target Architecture. Fully developed Technical Reference Model and Standards Profile. The architecture aligns with the DOC and Federal Enterprise Architectures.
4 Managed	Enterprise Architecture documentation is updated on a regular cycle to reflect the updated Enterprise Architecture. Business, Information, Application and Technical Architectures defined by appropriate de-jure and de-facto standards. The architecture continues alignment with the DOC and Federal Enterprise Architectures. An automated tool is used to improve the usability of the architecture.

5 Optimizing	Defined and documented Enterprise Architecture metrics are used to drive continuous process improvements. A standards and waivers process is used to improve architecture development process improvements.

Score	Element 3. Business Linkage
0 No EA	No linkage to business strategies or business drivers.
1 Initial	Minimal, or implicit linkage to business strategies or business drivers.
2 Developing	Explicit linkage to business strategies.
3 Defined	Enterprise Architecture is integrated with capital planning and investment control and supports e-government. Explicit linkage to business drivers and information requirements.
4 Managed	Capital planning and investment control are adjusted based on the feedback received and lessons learned from updated Enterprise Architecture. Periodic re-examination of business drivers.
5 Optimizing	Architecture process metrics are used to optimize and drive business linkages. Business involved in the continuous process improvements of Enterprise Architecture.

Score	Element 4. Senior-Management Involvement
0 No EA	No support from senior executives. Status quo is actively defended
1 Initial	Limited management team awareness or involvement in the architecture process.
2 Developing	Management awareness of Architecture effort. Occasional, selective management team involvement in the architecture process with various degrees of commitment/ resistance.
3 Defined	Senior-management team aware of and supportive of the enterprise-wide architecture process. Management actively supports architectural standards.
4 Managed	Senior management reviews architecture and variances.
5 Optimizing	Senior-management team directly involved in the optimization of the enterprise-wide architecture development process and governance.

Score	Element 5. Operating Unit Participation
0 **No EA**	No part of Operating Unit participates or is involved with Enterprise Architecture process.
1 **Initial**	Limited Operating Unit acceptance of the Enterprise Architecture process. Support exists only to the extent that the architecture process maintains the status quo.
2 **Developing**	Enterprise Architecture responsibilities are assigned and work is underway. There is a clear understanding of where the organizations architecture is at present time. Recognition that it is costly supporting too many kinds of technologies.
3 **Defined**	Most elements of Operating Unit show acceptance of or are actively participate in the Enterprise Architecture process. Recognition that architectural standards can reduce integration complexity and enhance overall ability to Operating Unit IT to achieve business goals.
4 **Managed**	The entire Operating Unit accepts and actively participates in the Enterprise Architecture process.
5 **Optimizing**	Feedback on architecture process from all Operating Unit elements is used to drive architecture process improvements.

Score	Element 6. Architecture Communication
0 **No EA**	None.
1 **Initial**	Little communication exists about the Enterprise Architecture process and possible process improvements. The DOC Enterprise Architecture Web Page contains the latest version of the Operating Units Enterprise Architecture documentation.
2 **Developing**	The Operating Unit Architecture Home Page, which can be accessed from the DOC Enterprise Architecture Web Page, is updated periodically and is used to document architecture deliverables. Few tools (e.g., office suite, graphics packages) are used to document architecture. Communication about architecture process via meetings, etc., may happen, but sporadic.
3 **Defined**	Architecture documents updated and expanded regularly on DOC Enterprise Architecture Web Page. Tools are used to support maintaining architecture documentation. Periodic presentations to IT staff on Architecture content.
4 **Managed**	Architecture documents are updated regularly, and frequently reviewed for latest architecture developments/ standards. Regular presentations to IT staff on Architecture content. Organizational personnel understand the architecture and its uses.
5 **Optimizing**	Architecture documents are used by every decision maker in the organization for every IT-related business decision.

Score	Element 7. IT Security
0 No EA	No IT Security considerations in Enterprise Architecture.
1 Initial	IT Security considerations are ad hoc and localized.
2 Developing	IT Security Architecture has defined clear roles and responsibilities.
3 Defined	IT Security Architecture Standards Profile is fully developed and is integrated with Enterprise Architecture.
4 Managed	Performance metrics associated with IT Security Architecture are captured.
5 Optimizing	Feedback from IT Security Architecture metrics are used to drive architecture process improvements.

Score	Element 8. Governance
0 No EA	None. Funding is the sole decision point for projects.
1 Initial	No explicit governance of architectural standards. Limited agreement with governance structure.
2 Developing	Governance of a few architectural standards (e.g. desktops, database management systems) and some adherence to existing Standards Profile. Variances may go undetected in the design and implementation phases. Various degrees of understanding of the proposed governance structure.
3 Defined	Explicit documented governance of majority IT investments. Formal processes for managing variances. Senior management team is supportive of enterprise-wide architecture standards and subsequent required compliance.
4 Managed	Explicit governance of all IT investments. Formal processes for managing variances feed back into Enterprise Architecture. Senior-management team takes ownership of enterprise-wide architecture standards and governance structure.
5 Optimizing	Explicit governance of all IT investments. A standards and waivers process is used to improve architecture development and governance - process improvements.

Score	Element 9. IT Investment and Acquisition Strategy
0 **No EA**	No regard for Enterprise Architecture in formulation of strategic IT acquisition strategy by Operating Unit.
1 **Initial**	Little involvement of strategic planning and acquisition personnel in enterprise architecture process. Little or no adherence to existing Standards Profile.
2 **Developing**	Little or no formal governance of IT Investment and Acquisition Strategy. Operating Unit demonstrates some adherence to existing Standards Profile.
3 **Defined**	IT acquisition strategy exists and includes compliance measures to IT Enterprise Architecture. Operating Unit adheres to existing Standards Profile. RFQ, RFI and RFP content is influenced by the Enterprise Architecture. Acquisition personnel are actively involved in Enterprise Architecture governance structure. Cost-benefits are considered in identifying projects.
4 **Managed**	All planned IT acquisitions are guided and governed by the Enterprise Architecture. RFI and RFP evaluations are integrated into the Enterprise Architecture planning activities.
5 **Optimizing**	Operating Unit has no unplanned IT investment or acquisition activity.

Table B.2: EA characteristics that validate the score for each level of the Maturity Model.

Score	Focus	Architecture Element
0	No Enterprise Architecture Program	No Enterprise Architecture to speak of.
1	**Initial** - Informal Enterprise Architecture Process Underway	1. Processes are ad hoc and localized. Some Enterprise Architecture processes are defined. There is no unified architecture process across technologies or business processes. Success depends on individual efforts. 2. Enterprise Architecture processes, documentation, and standards are established by a variety of ad hoc means and are localized or informal. 3. Minimal or implicit linkage to business strategies or business drivers. 4. Limited management team awareness or involvement in the architecture process. 5. Limited Operating Unit acceptance of the Enterprise Architecture process. 6. The latest version of the Operating Unit's Enterprise Architecture documentation is on the Web. Little communication exists about the Enterprise Architecture process and possible process improvements 7. IT Security considerations are ad hoc and localized. 8. No explicit governance of architectural standards. 9. Little or no involvement of strategic planning and acquisition personnel in enterprise architecture process. Little or no adherence to existing Standards Profile

Score	Focus	Architecture Element
2	Enterprise Architecture Process Is **Under Development**	1. Basic Enterprise Architecture Process program is documented based on OMB Circular A - 130 and Department of Commerce Enterprise Architecture Guidance. The architecture process has developed clear roles and responsibilities. 2. IT Vision, Principles, Business Linkages, Baseline, and Target Architecture are identified. Architecture standards exist, but not necessarily linked to Target Architecture. Technical Reference Model and Standards Profile framework established. 3. Explicit linkage to business strategies. 4. Management awareness of Architecture effort. 5. Responsibilities are assigned and work is underway. 6. The DOC and Operating Unit Enterprise Architecture Web Pages are updated periodically and is used to document architecture deliverables. 7. IT Security Architecture has defined clear roles and responsibilities. 8. Governance of a few architectural standards and some adherence to existing Standards Profile. 9. Little or no formal governance of IT Investment and Acquisition Strategy. Operating Unit demonstrates some adherence to existing Standards Profile.
3	**Defined** Enterprise Architecture Including Detailed Written Procedures and Technical Reference Model	1. The architecture is well defined and communicated to IT staff and business management with Operating Unit IT responsibilities. The process is largely followed. 2. Gap Analysis and Migration Plan are completed. Fully developed Technical Reference Model and Standards Profile. IT goals and methods are identified. The architecture aligns with the DOC and Federal Enterprise Architectures. 3. Enterprise Architecture is integrated with capital planning & investment control and supports e-government. 4. Senior-management team aware of and supportive of the enterprise-wide architecture process. Management actively supports architectural standards. 5. Most elements of Operating Unit show acceptance of or are actively participating in the Enterprise Architecture process. 6. Architecture documents updated regularly on DOC Enterprise Architecture Web Page. 7. IT Security Architecture Standards Profile is fully developed and is integrated with Enterprise Architecture. 8. Explicit documented governance of majority IT investments. 9. IT acquisition strategy exists and includes compliance measures to IT Enterprise Architecture. Cost-benefits are considered in identifying projects.

Score	Focus	Architecture Element
4	**Managed** and Measured Enterprise Architecture Process	1. Enterprise Architecture process is part of the culture. Quality metrics associated with the architecture process are captured. 2. Enterprise Architecture documentation is updated on a regular cycle to reflect the updated Enterprise Architecture. Business, Information, Application and Technical Architectures defined by appropriate de-jure and de-facto standards. The architecture continues alignment with the DOC and Federal Enterprise Architectures. An automated tool is used to improve the usability of the architecture. 3. Capital planning and investment control are adjusted based on the feedback received and lessons learned from updated Enterprise Architecture. Periodic re-examination of business drivers. 4. Senior-management team directly involved in the architecture review process. 5. The entire Operating Unit accepts and actively participates in the Enterprise Architecture process. 6. Architecture documents are updated regularly, and frequently reviewed for latest architecture developments/standards. 7. Performance metrics associated with IT Security Architecture are captured. 8. Explicit governance of all IT investments. Formal processes for managing variances feed back into Enterprise Architecture. 9. All planned IT acquisitions and purchases are guided and governed by the Enterprise Architecture.
5	**Optimizing** - Continuous Improvement of Enterprise Architecture Process	1. Concerted efforts to optimize and continuously improve architecture process. 2. A 'standards and waivers' process are used to improve architecture development process improvements. 3. Architecture process metrics are used to optimize and drive business linkages. Business involved in the continuous process improvements of Enterprise Architecture. 4. Senior management involvement in optimizing process improvements in Architecture development and governance. 5. Feedback on architecture process from all Operating Unit elements is used to drive architecture process improvements. 6. Architecture documents are used by every decision maker in the organization for every IT-related business decision. 7. Feedback from IT Security Architecture metrics are used to drive architecture process improvements. 8. Explicit governance of all IT investments. A standards and waivers process is used to improve governance-process improvements. 9. No unplanned IT investment or acquisition activity.

Table B.3: The Evaluation Scorecard.

Evaluation	Score
1. Architecture Process: Is there an established Enterprise Architecture process?	
Level: 0. Architecture process not established. 1. Ad-hoc and localized architecture process defined. 2. Basic Enterprise Architecture Process program is documented based on OMB Circular A-130 and Department of Commerce Enterprise Architecture Guidance. The architecture process has developed clear roles and responsibilities. 3. The architecture is well defined and communicated to IT staff and business management with Operating Unit IT responsibilities. The process is largely followed. 4. Enterprise Architecture process is part of the culture, with strong linkages to other core IT and business processes. Quality metrics associated with the architecture process are captured. These metrics include the cycle times necessary to generate Enterprise Architecture revisions, technical environment stability, and time to implement a new or upgraded application or system. 5. Concerted efforts to optimize and continuously improve architecture process.	
2. Architecture Development: To what extent is the development and progression of the Operating Units' Enterprise Architecture documented?	
Level: 0. No Enterprise Architecture documentation to speak of. 1. Enterprise Architecture processes, documentation and standards are established by a variety of ad hoc means, and are localized or informal. 2. IT Vision, Principles, Business Linkages, Baseline, and Target Architecture are documented. Architecture standards exist, but not necessarily linked to Target Architecture. Technical Reference Model and Standards Profile framework established. 3. Gap Analysis and Migration Plan are completed. Architecture standards linked to Business Drivers via Best Practices, IT Principles and Target Architecture. Fully developed Technical Reference Model and Standards Profile. 4. Enterprise Architecture documentation is updated on a regular cycle to reflect the updated Enterprise Architecture. Business, Information, Application and Technical Architectures defined by appropriate de-jure and de-facto standards. 5. Defined and documented Enterprise Architecture metrics are used to drive continuous process improvements. A ‘standards and waivers’ process are used to improve architecture development process improvements.	

Evaluation	Score
3. **Business Linkage**: To what extent is the Enterprise Architecture linked to business strategies or drivers.	
Level: 0. No linkage to business strategies or business drivers. 1. Minimal or implicit linkage to business strategies or business drivers. 2. Explicit linkage to business strategies or drivers. 3. Enterprise Architecture is integrated with capital planning and investment control. Explicit linkage to business drivers and information requirements. 4. Capital planning and investment control are adjusted based on the feedback received and lessons learned from updated Enterprise Architecture. Periodic re-examination of business drivers. 5. Architecture metrics are used to optimize and drive business linkages. Business involved in the continuous process improvements of IT Architecture.	
4. Senior Management Involvement: To what extent are the senior managers of the Operating Unit involved in the establishment and ongoing development of an IT Architecture?	
Level: 0. No management team awareness or involvement in the architecture process. 1. Limited management team awareness or involvement in the architecture process. 2. Occasional/selective management team involvement in the architecture process with various degrees of commitment. 3. Senior-management team aware of and supportive of the enterprise-wide architecture process. Management actively supports architectural standards. 4. Senior-management team directly involved in the architecture review process. 5. Senior-management team directly involved in the optimization of the enterprise-wide architecture development process and governance.	
5A. Operating Unit Participation: To what extent is the Enterprise Architecture process accepted by the Operating Unit?	
Level: 0. No Operating Unit acceptance. 1. Limited Operating Unit acceptance of the Enterprise Architecture process. 2. Enterprise Architecture responsibilities are assigned and work is underway. There is a clear understanding of where the organization's architecture is at present time. 3. Largest elements of Operating Unit show acceptance of the IT Architecture process. 4. The entire Operating Unit accepts and actively participates in the IT Architecture process. 5. Feedback on architecture process from all Operating Unit elements is used to drive architecture process improvements.	

Evaluation	Score
5B. Operating Unit Participation: To what extent is the Enterprise Architecture process an effort representative of the whole organization?	
Level: 0. No enterprise-wide effort. 1. Localized individual support of Enterprise Architecture process. 2. Limited organizational involvement. 3. Majority of organization is involved. 4. Cross-enterprise architecture involvement. 5. Entire organization uses feedback on the architecture process to improve its process.	
6A. Architecture Communication: To what extent are the decisions of Enterprise Architecture practice documented?	
Level: 0. No documentation is available. 1. Little communication exists about the Enterprise Architecture process and possible process improvements. The DOC Enterprise Architecture Web Page contains the latest version of the Operating Unit's Enterprise Architecture documentation. 2. The Operating Unit Architecture Home Page, which can be accessed from the DOC Enterprise Architecture Web Page is updated periodically and is used to document architecture deliverables. Communication about architecture process via meetings, etc., may happen, but sporadic. Few tools (e.g., office suite, graphics packages) are used to document architecture. 3. Architecture documents updated and expanded regularly on DOC IT Architecture Web Page. Periodic presentations to IT staff on Architecture process, content. Tools are used to support maintaining architecture documentation. 4. Architecture documents are updated regularly, and frequently reviewed for latest architecture developments/standards. Regular presentations to IT staff on architecture content. 5. Architecture documents are used by every decision maker	
6B. Architecture Communication: To what extent is the content of the Enterprise Architecture made available electronically to everybody in the organization?	
Level: 0. No electronic means of communication. 1. Limited electronic means of communication. 2. Occasional updates published via e-mail. 3. More widespread electronic publication of Enterprise Architectures. 4. An online Web site is used to make available communications across the organization. 5. All Operating Units are actively involved through electronic updates.	

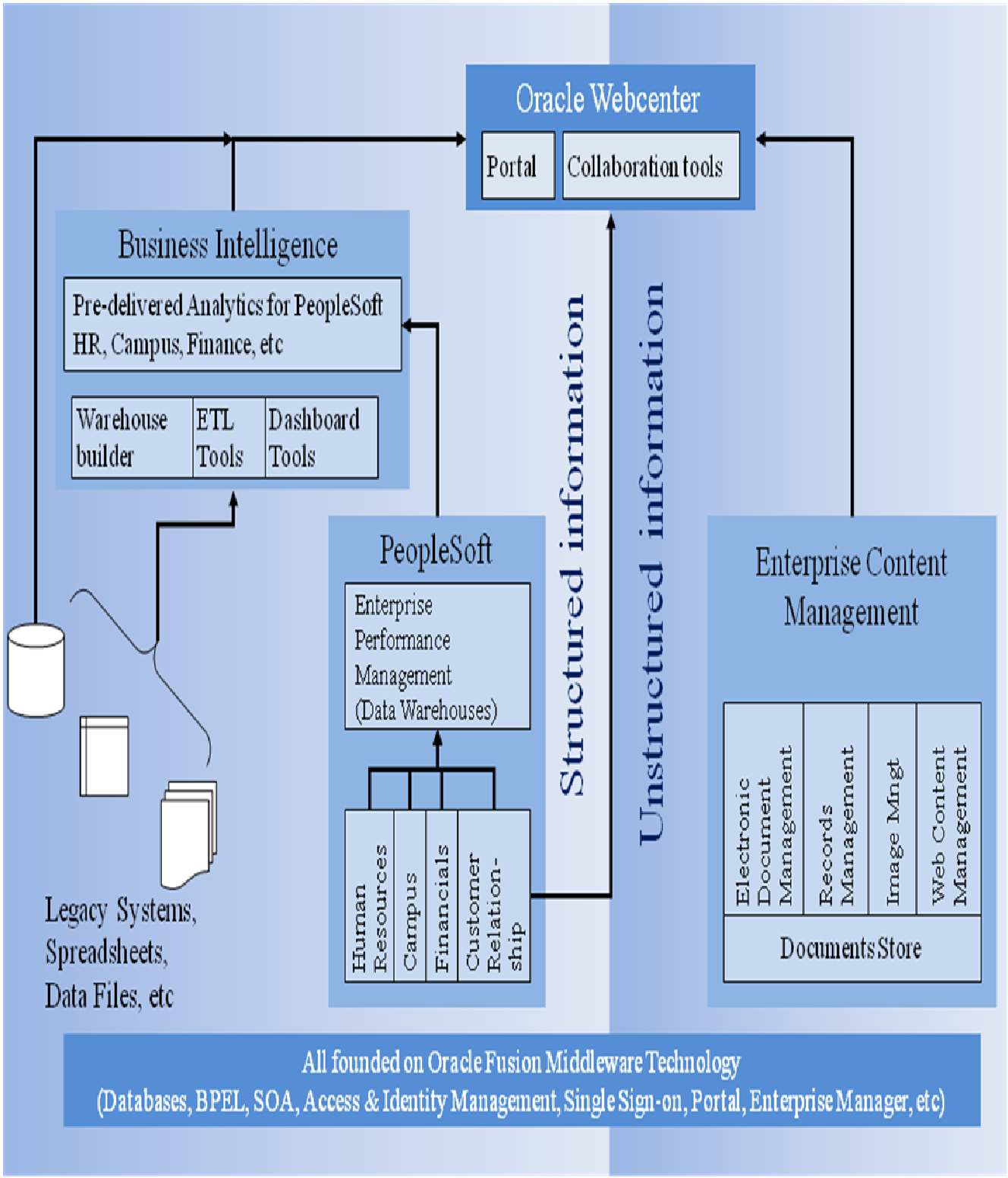
Evaluation	Score
6C. Architecture Communication: To what extent is architecture education done across the business on the Enterprise Architecture process and contents?	
Level: 0. No education. 1. Limited education. 2. Architecture education done for IT staff. 3. More widespread education done across various Operating Units. 4. Most Operating Units participate actively in Enterprise Architecture education. Ongoing education on the value of an Enterprise Architecture across Operating Units. 5. All Operating Units participate in staff education and understanding of IT Architecture. Various education/communication tools utilized across all Operating Units.	
7. **IT Security**: To what extent is IT Security integrated with the Enterprise Architecture?	
Level: 0. No IT Security considerations in Enterprise Architecture. 1. IT Security considerations are ad hoc and localized. 2. IT Security Architecture has defined clear roles and responsibilities. 3. IT Security Architecture is fully developed and is integrated with IT Architecture. 4. Performance metrics associated with IT Security Architecture are captured. 5. Feedback from IT Security Architecture metrics are used to drive architecture process improvements.	
8. Governance: To what extent is an Enterprise Architecture governance (governing body) process in place and accepted by senior management?	
Level: 0. None. Everyone does their own thing. 1. No explicit governance of architectural standards. Limited agreement with governance structure. 2. Governance of a few architectural standards (e. g. desktops, database management systems) and some adherence to existing Standards Profile. Various degrees of understanding of the proposed governance structure. 3. Explicit documented governance of majority IT investments. Formal processes for managing variances. Senior management team is supportive of enterprise-wide architecture standards and subsequent required compliance. 4. Explicit governance of all IT investments. Formal processes for managing variances feed back into Enterprise Architecture. Senior-management team takes ownership of enterprise-wide architecture standards and governance structure. 5. Explicit governance of all IT investments. A standards and waivers process is used to improve governance process improvements.	

Evaluation	Score
9. IT Investment and Acquisition Strategy: To what extent does the Enterprise Architecture influences the IT Investment and Acquisition Strategy?	
Level: 0. No regard for Enterprise Architecture in formulation of strategic IT Acquisition strategy by Operating Unit. 1. Little or no involvement of strategic planning and acquisition personnel in enterprise architecture process. Little or no adherence to existing Standards Profile. 2. Little or no form al governance of IT Investment and Acquisition Strategy. Operating Unit demonstrates some adherence to existing Standards Profile. 3. IT acquisition strategy exists and includes compliance measures to IT Enterprise Architecture. Operating Unit adheres to existing Standards Profile. RFQ, RFI and RFP content is influenced by the Enterprise Architecture. Acquisition personnel are actively involved in Enterprise Architecture governance structure. Cost-benefits are considered in identifying projects. 4. All planned IT acquisitions and acquisitions are guided and governed by the Enterprise Architecture. RFI and RFP evaluations are integrated into the IT Architecture planning activities. 5. Operating Unit has no unplanned IT investment or acquisition activity.	

APPENDIX C
FUTURE-STATE ARCHITECTURE OF THE UNIVERSITY OF PRETORIA (PRETORIUS, 2009; PRETORIUS, 2010)

Appendix C.1: Future-state architecture of UP
Appendix C.2: EA elements framework from Gartner Inc.
Appendix C.3: Expanded framework of EA elements.

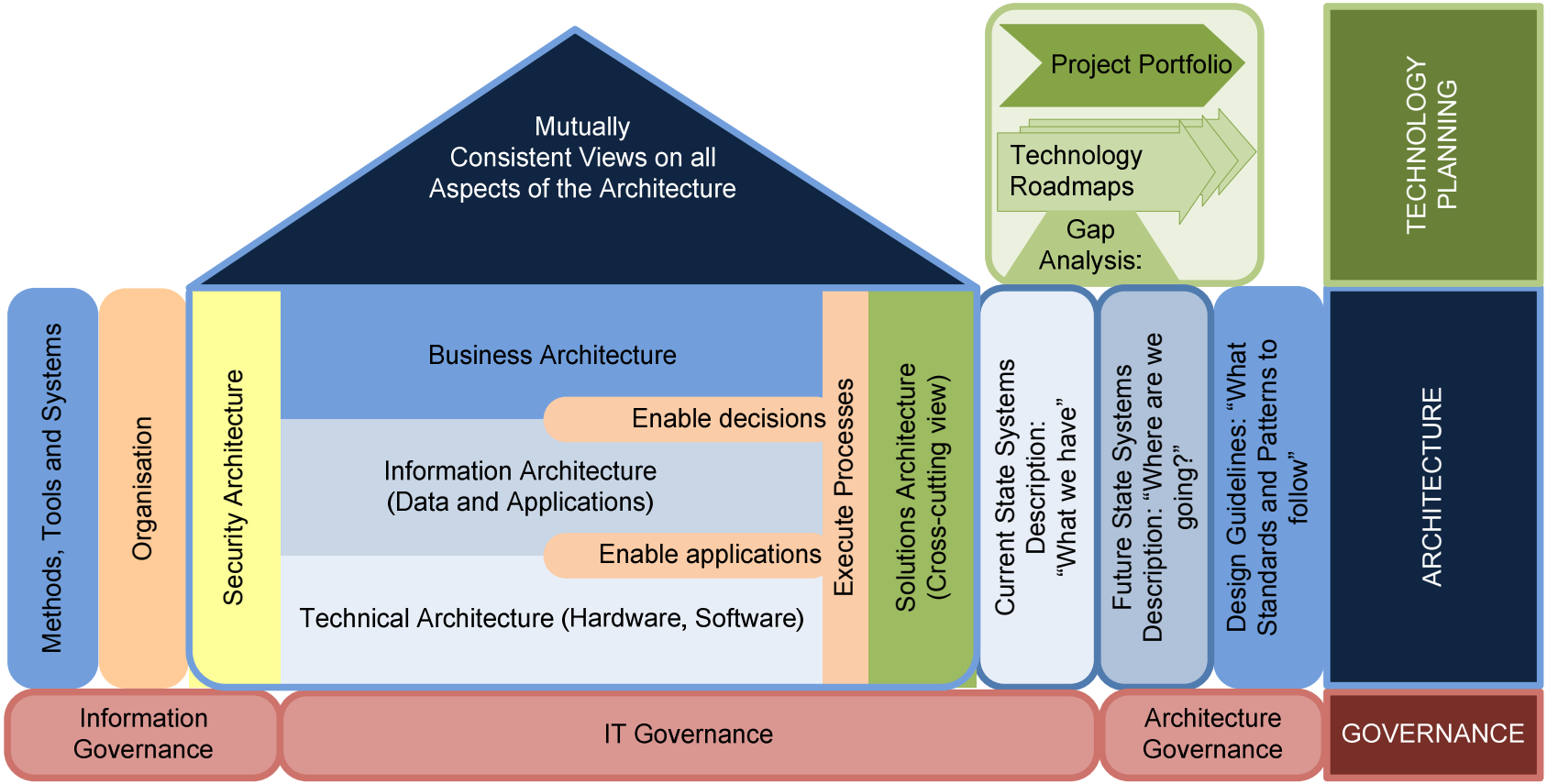
Appendix C.1: The future-state architecture of UP.



Appendix C.2: EA elements framework from Gartner Inc.

<table>
<tr><td colspan="2" rowspan="2">Enterprise IT Architecture Viewpoints</td><td colspan="3">Two Aspects of Architecture</td></tr>
<tr><td colspan="2">Description of Systems</td><td>Principles</td></tr>
<tr><td colspan="2"></td><td>Current State</td><td>Future State</td><td>Design Guidelines</td></tr>
<tr><td>Business Architecture</td><td rowspan="3">Solutions Architecture (cross-cutting view)</td><td rowspan="3">“What we have”</td><td rowspan="3">“Where are we going?”</td><td rowspan="3">“What standards and patterns to follow”</td></tr>
<tr><td>Information Architecture (Data and Applications)</td></tr>
<tr><td>Technical Architecture (IT hardware and software infrastructure)</td></tr>
<tr><td colspan="3">Sphere of IT Governance</td><td colspan="2">Sphere of Architecture Governance</td></tr>
</table>

Appendix C.3: Expanded framework of EA elements.



APPENDIX D
ALIGNMENT MATRIX OF IT PRINCIPLES AND UP STRATEGIC DRIVERS (PRETORIUS, 2009)

Appendix D.1: Main IT Principles defined by the ITS.
Appendix D.2: Alignment matrix of the main IT Principles and UP strategic drivers.

Appendix D.1: Main IT Principles defined by the ITS.

Area	Principle/Maxim
Institutional success EBS1	We will strive to apply technology for academic research and teaching and learning within a stable and agile IT architecture.
Use of information EBS2	We will win by channeling high-quality information to recipients.
Organization and governance EBS3	All common IT services will be centralized wherever possible to provide economies of scale and effectiveness of service delivery, in alignment with the shared services aspects of the management model.
Sourcing EBS4	We will always buy IT applications, unless development is required for strategic differentiation. Development will increasingly focus on integration and differentiating processes.
Architecture EBS5	We will never do anything to our Enterprise Architecture that will prevent us from rapidly responding to changing requirements and scaling services to academic demand.
Approach to technology EBS6/7	We will avoid bleeding-edge technologies in production (not in academic endeavors) to ensure stability, sustainability and availability of IT services. Open standards and interoperability are key technology selection drivers.
Leadership and people EBS8	Effective teamwork by skilled people is the key to sustainable and flexible IT service provision.
Risk EBS9	All IT risks will be actively managed in a framework compatible with the institutional risk register.

Appendix D.2: Alignment matrix of the main IT Principles and UP strategic drivers.

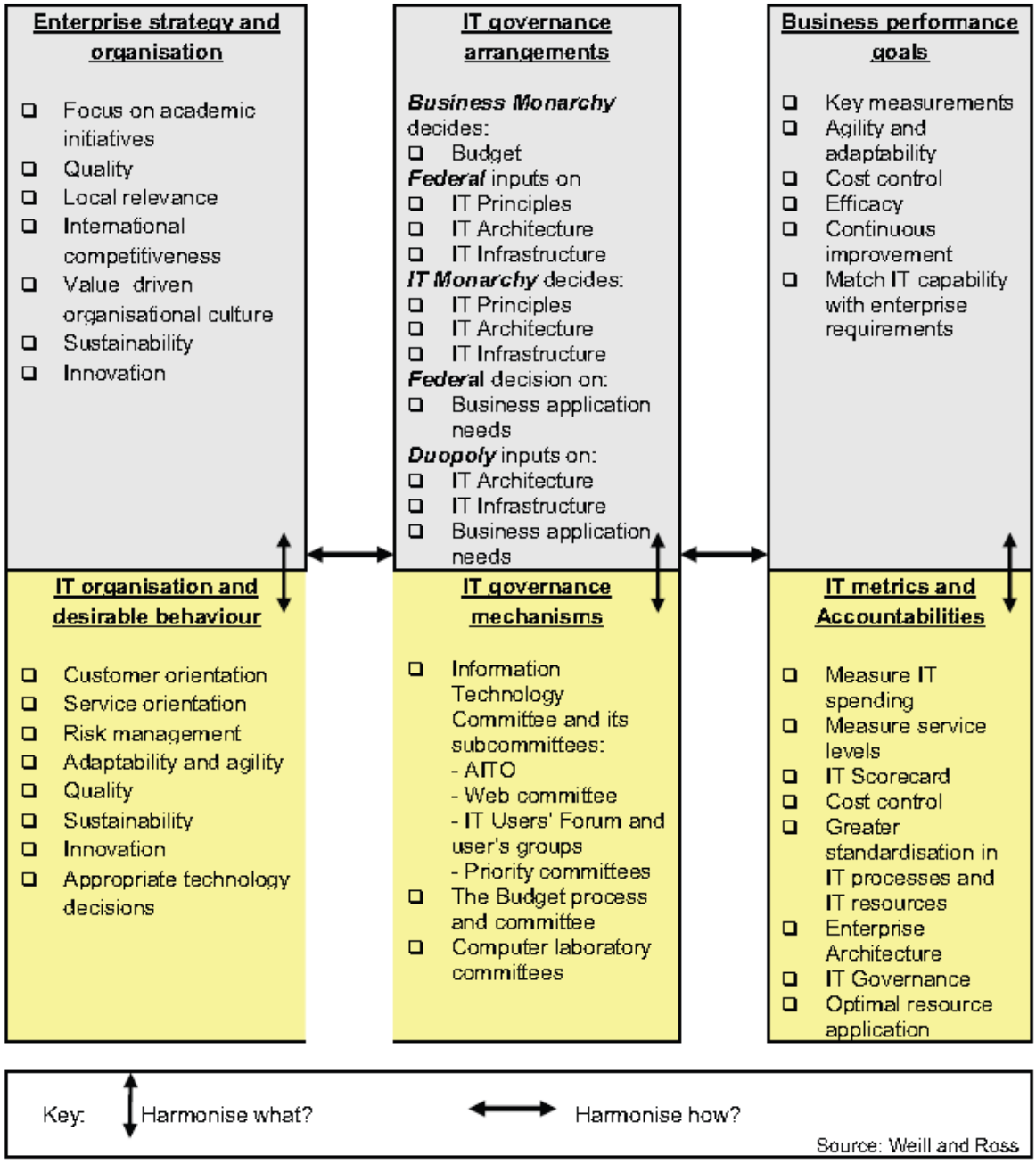
Key: ▣ - somewhat aligned ◘ - significantly aligned ■ - totally aligned

IT Decision-Making Principles \ UP Strategic Thrusts		Academic Excellence	Quality	Local Impact	Transformation	People centered orientation	Innovation	Interfaces	Sustainability
EBS1	We will strive to apply technology for academic research and teaching and learning within a stable and agile IT architecture.	■							
EBS2	We will win by channeling high-quality information to recipients.	■	■				■	■	■
EBS3	All common IT services will be centralized wherever possible to provide economies of scale and effectiveness of service delivery.	■							■
EBS4	We will always buy applications, unless development is required for strategic differentiation.		■				■		
EBS5	We will never do anything to our Enterprise Architecture that will prevent us from rapidly responding to changing requirements and scaling services to fulfill academic demand.	■					■		
EBS6	We will avoid bleeding-edge technologies in production to ensure stability, sustainability and availability of services.	◘	■	■	◘	▣	◘	■	■
EBS7	Open standards and interoperability are key technology drivers in technology acceptance		■				■		■
EBS8	Effective teamwork by skilled people is the key to sustainable and flexible IT service provision			■	■	■			
EBS9	All IT risks will be actively managed in a framework compatible with the institutional risk register	■	■						■

APPENDIX E
GOVERNANCE AT UP (2005)
(PRETORIUS, 2005)

Appendix E.1: Governance Design Framework of UP in 2005.
Appendix E.2: Governance Arrangement Matrix for UP in 2005.

Appendix E.1: Governance Design Framework of UP in 2005.



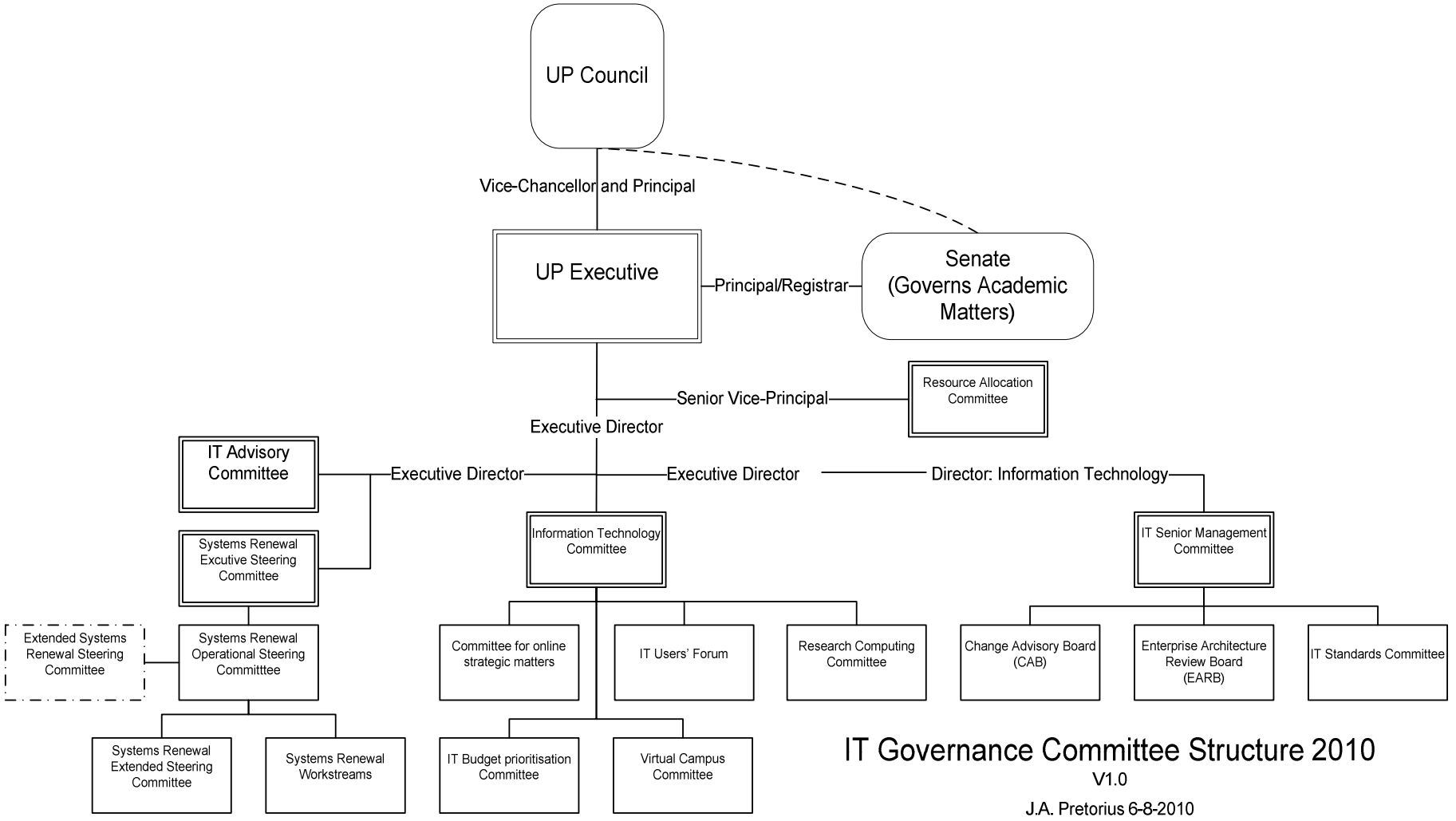
Appendix E.2: Governance Arrangement Matrix for UP in 2005.

Decision / Archetype	IT Principles		IT Architecture		IT Infrastructure Strategies		Business Application Needs		IT Investment	
	Input	Decision	Input	Decision	Input	Decision	Input	Decision	Input	Decision
Business Monarchy									Budget Committee Faculties and Support Services	Executive. Budget Committee
IT Monarcy	IT Manage-ment	Director IT & IT Architect	IT Manage-ment	Architec-ture review committee	IT Manage-ment Information Technology Committee	IT Manage-ment	IT Manage-ment			
Feudal										
Federal	Information Technology Committee (ITC)		Information Technology Committee (ITC)		Information Technology Committee (ITC) IT Coordinating Committee		Information Technology Committee (ITC) Priority Commitees Systems Renewal Committee	Systems Renewal Commitee, Priority Commitees. Reviewed and approved by IT Manage-ment	ITC Budget requests IT Manage-ment Priority commitees	
Duopoly			AITO IT User's Forum		AITO IT User's Forum Lab committees		AITO Lab Committees		AITO	
Anarchy										

APPENDIX F
STEP MM1 – GOVERNANCE AND SUPPORT FRAMEWORKS

Appendix F.1: Committee Structure as defined by the IT Director (Pretorius, 2010).
Appendix F.2: IT Governance Framework, Version3 (Pretorius, 2010).
Appendix F.3: IT Operating Model (Pretorius, 2009).
Appendix F.4: IT Demand Management Framework (Pretorius, 2009).
Appendix F.5: Information Management and Governance Framework (Pretorius, 2009).

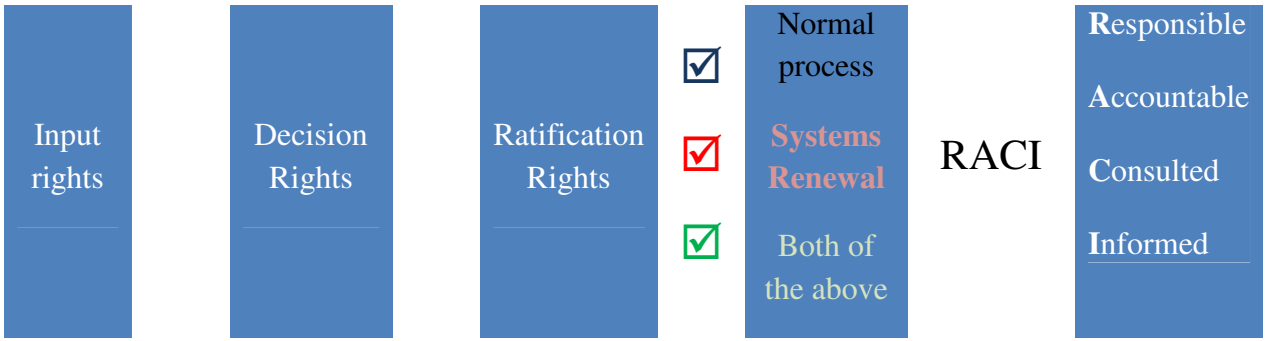
Appendix F.1: Committee Structure as defined by the IT Director (Pretorius, 2010).



Appendix F.2: IT Governance Matrix, Version 3 (Pretorius, 2010).

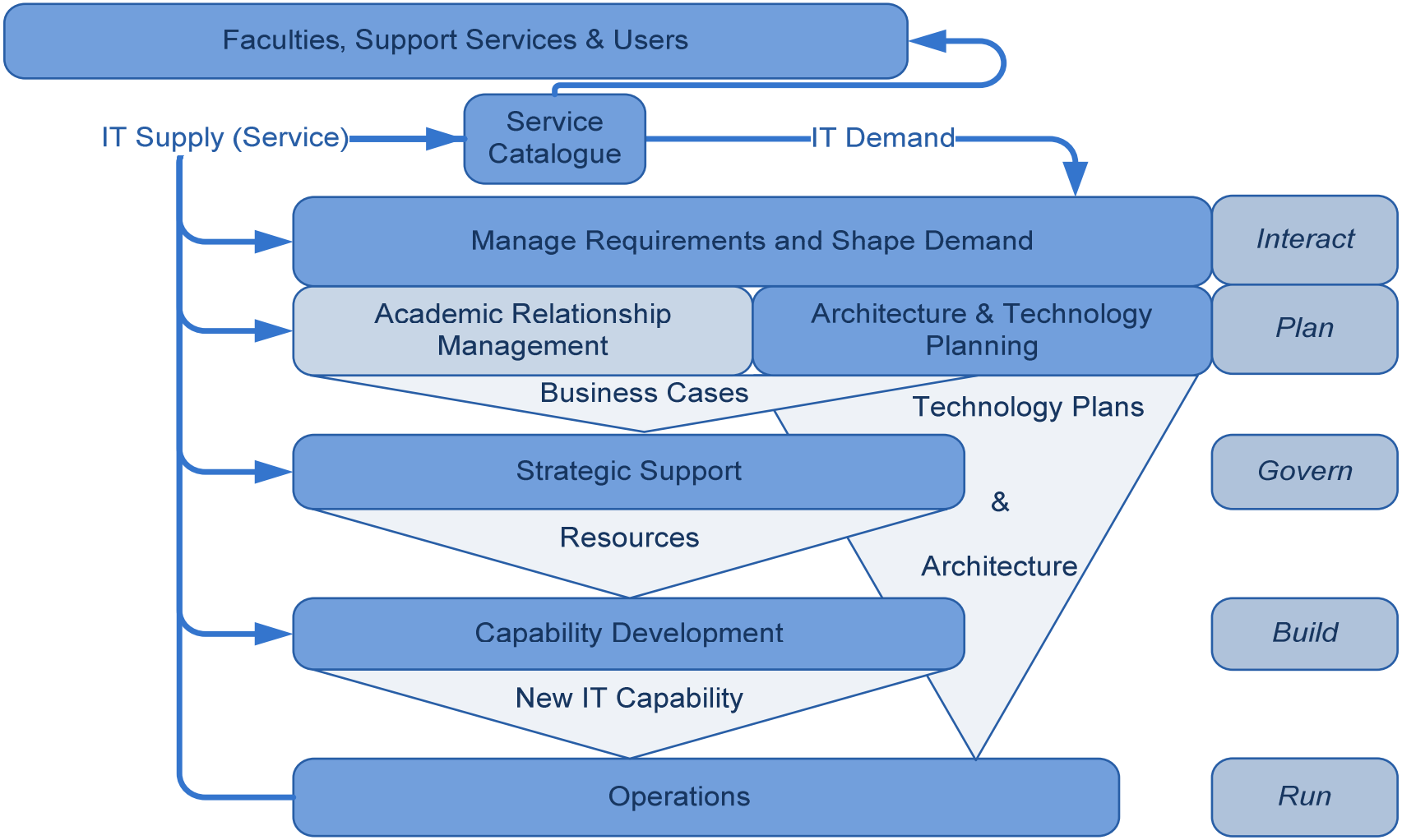
Areas / Mechanism/ Function	IT Principles		IT Architecture		IT Infrastructure		Business Applications functionality (Systems Renewal)		Investment and Prioritisaion: Purchase or development of systems within approved budget		Investment and prioritisation: Approval of customisation (Systems Renewal)	
SR Executive Steering Committee								A			☑	A
SR Operational Steering Committee	➤	C	➤	C	➤	I	☑	R			☑	R
SR Extended steering committee							➤	C			➤	
SR Workstream Leader							◆	R			➤	
SR Workstream Team							➤				➤	
Functional owner/unit							➤		➤		➤	
IT Director	➤◆	A	➤◆	A	➤☑◆	A			➤	A		C
Project Director	➤	R	➤	R	➤◆	R	◆		➤	C	◆	R
ITS Management	➤	R	➤	R	➤◆	R		I	➤	C		C
EA Review Board	➤☑	R	➤☑	R		I				I		I
Priority Committee									◆☑	R		

LEGEND:

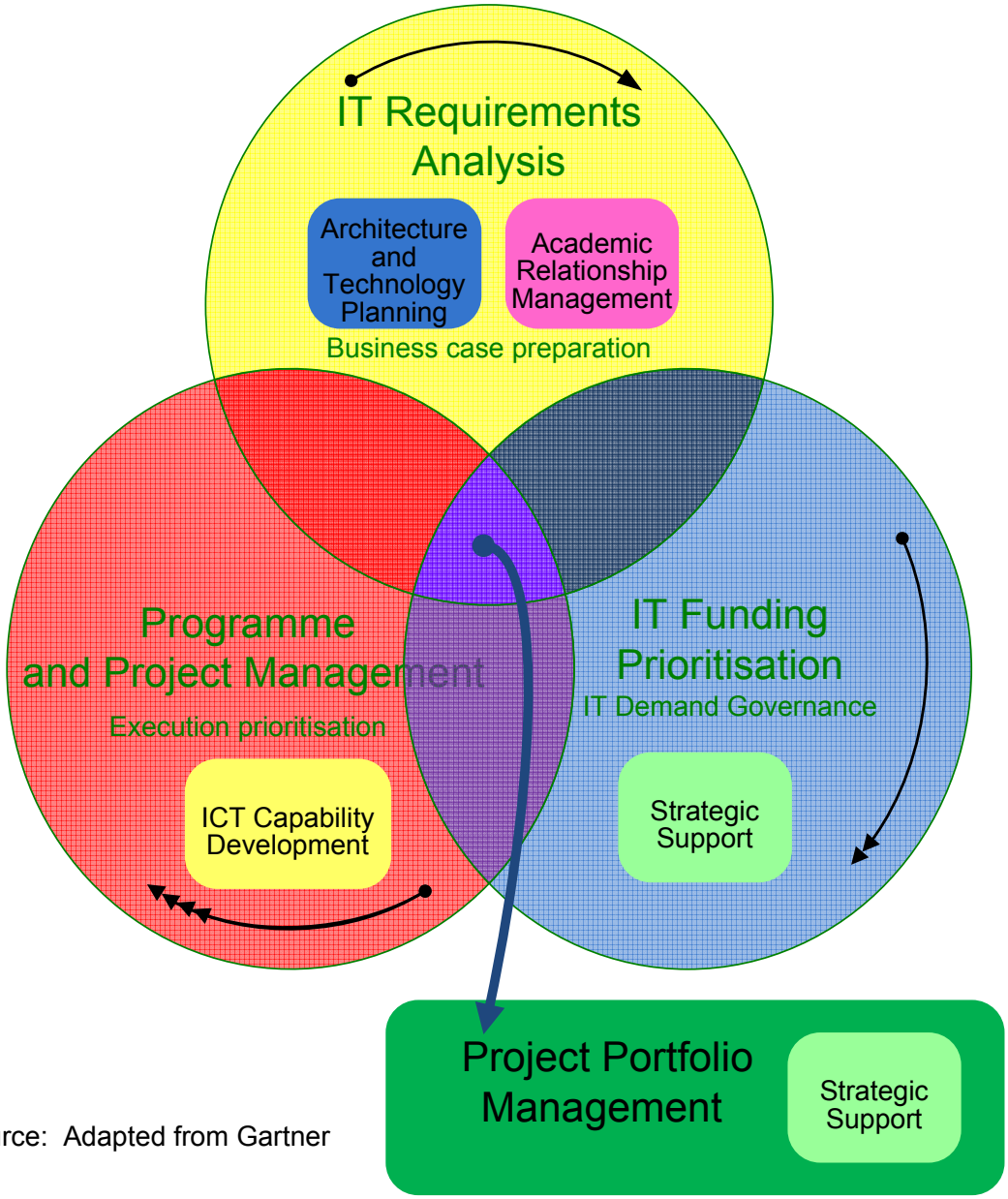


Term	Abbreviation	Description
Responsible	R	"Owns" the area governed
Accountable	A	To whom "R" is accountable – who must sign off (approve)
Consulted	C	Has information necessary or capability necessary to provide input to the area governed
Informed	I	Must be notified, but need not be consulted

Appendix F.3: IT Operating Model (Pretorius, 2009).

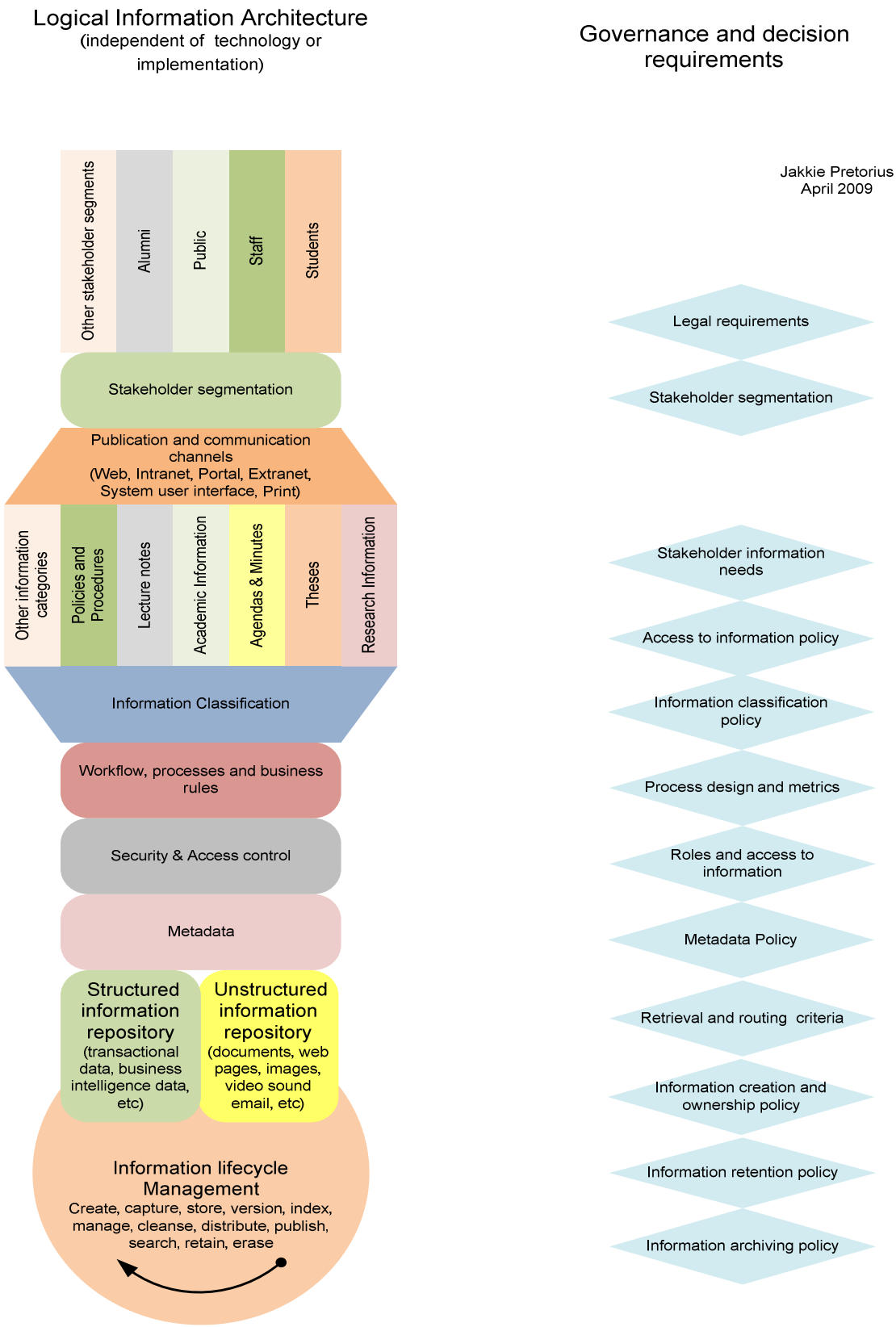


Appendix F.4: IT Demand Management Framework (Pretorius, 2009).



Source: Adapted from Gartner

Appendix F.5: Information Management and Governance Framework (Pretorius, 2009).



APPENDIX G
STEP MM2 – GOVERNANCE MECHANISMS

Appendix G.1: IT future-state mechanisms (Pretorius, 2009) .
Appendix G.2: ITS Balanced Scorecard and Strategy Map CITATION Jak09 \l 7177 (Pretorius, 2009) .

Appendix G.1: IT Future-state mechanisms CITATION Jak09 \l 7177 (Pretorius, 2009) .

Mechanism	Description
Academic Relationship Management	Manages and coordinates academic and user interaction with the institution. This includes the demand side of the IT business, as well as communications and negotiation of service level agreements. The Demand/Relationship management element of the value chain maps directly on to this function.
Strategic Support	Supplies ICT Governance and Resource management capability and capacity. This is where portfolios of resources, assets, new technology discovery and projects are balanced and prioritized. The aspects of the value chain element of IT Enablement for Project/Portfolio Management, as well as prioritization, map on to this function. Other value chain elements which are represented include Risk, Security and Compliance, Sourcing, Staff and Vendors and IT Finance. End-user training also resides in this function.
Architecture and Technology Planning	Focuses on the future-state ICT architecture, strategic planning, interpreting institutional strategy in IT terms and translating IT strategy into a portfolio of new technology discovery projects which will be prioritized by governance functions in the Strategic Support function. Investigation of new technologies and joint technology investigations with other functions of the University also reside in this function. The graphic of the binoculars symbolizes the forward-looking aspects of this function. The Architecture and Portfolio management aspects of the Architecture, Portfolio and Service Delivery element of the supply chain map on to this function.
ICT Capability Development	All new capability development activities are grouped in this function, with a single well-defined responsibility: developing new ICT capability. Hardware and software development are combined with a project management office. However, programme and portfolio management are specifically excluded, and only fully resourced and funded projects are transferred to Capability Development. After completion of the project, ownership is transferred to Operations to maintain and manage in production, for the remainder of the capability's lifecycle. The calendar graphic conveys the idea of activities ranging in duration from weeks to years, but clearly distinct from the daily running of the production environment. The Capability Development element of the value chain maps unambiguously on to this function. The IT enablement element maps on to this function, specifically for Business Process Analysis and

	Software Development Tools, as well as the use of Project Management tools.
System Renewal	Will function in exactly the same way as ICT Capability Development and is only singled out as a separate function due to the scale, scope and schedule of the project. It is envisaged that the same development and project management methodologies will be uniformly applied across the two functions. It is expected that best practice gained from the Systems Renewal Project will cross-pollinate into the ICT Capability Development and assist in maturing methodologies and practices. The programme and portfolio management practices, governance and methodologies for the Systems Renewal Project will mirror those of the Strategic Services Division, including use of the same project management system and similar prioritization mechanisms for e.g. prioritizing access to ring-fenced funds for system customization. Similar to ICT Capability Development, it maps clearly on to the Capability Development element of the supply chain. The space shuttle graphic symbolizes the significant future institutional ICT capability which will result from the project.

ICT operations	All continuous supply-side services and infrastructure are now grouped together into the function, which focuses on service delivery and service level management. It owns the production environment. The graphic of a clock symbolizes continuous service delivery and support. All the service support functions are contained in this function, and a single unit is responsible for delivering services according to Service Level Agreements (SLAs). The Service Delivery and Service Support elements of the supply chain map fully on to this function. A significant portion of the IT Enablement element (which is about IT support systems) also maps on to this function, including the Service Desk software, Network and Server Management Software, but specifically excludes tools for Project and Portfolio management, Systems Development, Business Process modeling and Prioritization.
IT Management Information	Appropriate metrics, will be specified according to the categories illustrated in Figure 4. Appropriate metrics and measurement practices, like the use of maturity models will be deployed. All teams will be measured against team output metrics, and will be encouraged to improve processes continuously by utilizing appropriate process metrics.

Appendix G.2: ITS Balanced Scorecard CITATION Jak091 \l 7177 (Pretorius, 2009)

Goals: Client Perspective

1. Provide value (electronic work processes and information channels) to clients
    - The client understands what ITS is responsible for, and able to, deliver
        - Build and maintain relationships (relationship management) with clients (ITS & System renewal)
        - Implement service catalogue and the continuous improvement thereof.
        - The necessity of aligning project selection/execution with IT Strategy is communicated
    - The client agrees that ITS has delivered on its service offering
        - Ensure agreed SLA measurements are met
    - Establish a demand management capability (BRM/CRM).
        - Refine and calibrate cost recovery models.
        - Ensure that the demand clarification is optimal.
        - Define an IT benefits realisation model.

Goals : Finance and other resource management

1. Sound financial management
    - Increase productivity in specified areas
    - Ratio's as per indicated areas.
    - Ensure the effective management of allocated resources and/or budgets given the revised IT management model.
    - Capital budget
    - Manpower budget
    - Operations budget
    - Systems renewal budget

Goals : Learning and Growth

1. Improve the performance management culture
    - Improve performance management.
    - Develop a remuneration model within the set boundaries of the employer.
2. Ensure ITS attract, develop and retain employees with key competencies.
    - Ensure that ITS met the set Employment Equity targets.
    - Improve the current recruitment process.
    - Introduce a practical career development process.
    - Introduce IDP's
    - Solution based training interventions.
    - Develop a successor planning system that adds value.
        - One successor for every critical position.
    - Grow a culture of innovation & continuous improvement.

Goals: Internal Processes

1. Improve business processes and information channels
    - Ensure operational excellence through infrastructure, processes and services which are well managed.
        - Implement and improve ITIL maturity.
        - Ensure strategic business support through delivering applications and technology
        - Ensure project execution prioritization is aligned with ITS strategy
        - Establish, and continuously improve, an enterprise architecture capability.
        - Improve IT governance, Risk and Compliance processes.
            - Implement and improve CoBIT maturity.
            - Plan for business continuity and disaster recovery.
        - Establish strategic multi-sourcing capability (vendors/partners/skills)

Appendix G.2: ITS Strategy Map CITATION Jak091 \l 7177 (Pretorius, 2009) .

EMBED Visio.Drawing.11

EMBED Visio.Drawing.11

APPENDIX H
STEP MM3- ARCHITECTURE PRINCIPLES
CITATION JAK101 \L 7177 (PRETORIUS, 2010)

IT Principles	
Business Application	
B1	Systems Renewal product selection is guided by the functionality of the Student Administration system. All other systems are presumed to be 'good enough' for the intended function unless proven otherwise.
B2	Packaged applications are not customised unless authorized.
B3	Customizations must be formally approved and budgeted for.
B4	Each application will have a designated functional owner in a business unit.

IT Architecture	
A1	Architecture informs all technology acquisition, deployment and support investments.
A2	Any architecture descriptions or artifacts will be expressed in terms of the following mutually consistent layers: 1. Business Architecture (*translation of business requirements into a format suitable to inform the layers below*). 2. Information Architecture (*translation of information requirements into a format suitable to inform the layers below*). 3. Technical Architecture (*translation of technical requirements into a format suitable to inform the solutions architecture*). 4. Solutions Architecture (*a cross cutting view of an IT solution expressed consistently in terms of the layers above*). 5. Security Architecture (*informs all the layers above).*
A3	Architectural alignment informs all technology investments.
A4	Integration, interoperability and open standards drive all architectural decisions.
A5	Open source applications must be assessed against TCO, skills needed for development and support, as well as maintainability.
A6	Application and IT infrastructure rationalization and optimization guide IT planning.
A7	Governance exceptions management is a defined process.
A8	Enterprise Architecture guides technology acquisition, implementation and integration.
A9	Information Technology Strategy precedes and guides technology acquisition. Technology initiatives and projects must link with business objectives.
A10	Existing technologies are leveraged prior to new technology investments.
A11	Business processes and the IT infrastructure must address information security, risk and business continuity.
A12	The architecture must enforce the capture of data at a single point of entry.
A13	All enterprise information belong to the organization. All data elements have a single defined master source with a designated steward who will be responsible to vet the

	information or data for accuracy or relevance.
A14	All primary data will be captured once at the point of creation, and stored and managed to enable appropriate levels of sharing across the enterprise, subject to agreed security rules.
A15	Information and systems must be available to users through a unified enterprise web portal.
A16	The production environment is owned by IT operations and developers do not have access to the production environment.
A17	Migrations of new releases to, and fixes to code in production have to be done through the formal IT change control process.

Investment and Prioritization	
P1	Project and Programme management discipline drives technology implementation.
P2	A standard project management process based on a standard project management system is used to manage projects.
P3	Business cases are required for all business technology investments.
P4	All IT investments need to support the goals of the University as a whole, and not only the requirements of the business unit with the specific requirement.

IT Infrastructure	
I1	A standardized IT infrastructure is used
I2	Deviations from the standard infrastructure must be formally waived.
I3	Virtualization is used to optimize server and storage capacity.
I4	Operating systems on servers are standardized and selected in a predefined order of preference: 1. Linux 2. AIX. 3 Windows
I5	Enterprise software and their related support environments (such as backup and management systems) will be run in a supported and certified environment.
I6	All software and hardware components of the IT infrastructure will be subjected to formal change control.