



**ROYAL INSTITUTE
OF TECHNOLOGY**

STRATEGIC BUSINESS AND IT ALIGNMENT ASSESSMENT
A MODELING APPROACH ASSOCIATED WITH ENTERPRISE ARCHITECTURE

José Leonel Plazaola Prado

June 2009

Submitted in partial fulfillment of the requirements for the
degree of Doctor of Philosophy

Industrial Information and Control Systems
KTH, Royal Institute of Technology
Stockholm, Sweden

TRITA-EE 2009:028
ISSN 1653-5146
ISRN KTH/ICS/R--09/01--SE

Stockholm 2009, Universitetsservice US AB

ABSTRACT

Information Technology (IT) systems are pervasive tools for contemporary enterprises to achieve their mission and goals. A key issue for a well functioning enterprise is to keep business and IT strategies aligned as they continuously evolve. Although many practitioners and researchers offer business and IT alignment theories and approaches there is no silver bullet solution for all the issues involved in Strategic Business and IT Alignment (SBITA), which is still ranked amongst the five top enterprise executives' concerns year after year.

The main contributions of this thesis are two SBITA assessment methods. The first is the Organization-wide Approach (method), developed as an enhancement of Jerry N. Luftman's SBITA assessment approach in terms of measurability, traceability and organizational involvement. The second is the model-based Alignment Metamodel Assessment Method (AMAM). Both methods have roots on well established references and approaches, their development, the linking among them and their applications are presented in the included papers and reported case studies.

This is a composite thesis that, besides the introduction, includes five papers (papers A-E). Paper A describes Luftman's SBITA assessment approach and its enhancement in terms of measurability, traceability and organizational involvement, the developed Organization-wide Approach (method) for Assessing SBITA. Results from applying this approach in two case studies in companies in Sweden and Nicaragua are also included. Paper B describes the AMAM method. It explains how this metamodel, i.e. a modeling artifacts, and inference rules for assessment the SBITA, was deduced and how the SBITA assessment should be performed. This paper argues that the AMAM can be affiliated to the EA discipline as a guide or reference for identifying the relevant EA's representations for the SBITA concern, mitigating the expenses and drawbacks of the often larger modeling efforts required in applying EA frameworks. Paper C shows a weighting of the importance of the SBITA topics and issues taking as reference the Henderson & Venkatraman Strategic Alignment Model (SAM)—the basis of Luftman's SBITA assessment approach—by relating it to highly cited references in the field of SBITA. Paper D explains the criteria and the process for associating the AMAM 's artifacts with the Zachman's Enterprise Architecture Framework and reports the pattern of such association into the EA dominion. Paper E reports the details of the processes and results of applying the developed AMAM in a case study conducted in an intensive IT services enterprise in Nicaragua.

Key words: Strategic Business and IT Alignment assessment; Modeling approach; Enterprise Architecture; Case studies on Strategic Business and IT Alignment assessment.

ACKNOWLEDGEMENTS

This thesis is dedicated to Elianne, Katerina and Emiliano, who gave me the active support and love to endure with resilience this delightful *yin and yang* journey.

My gratitude to the Swedish Agency for Research and Cooperation with Developing Countries (Sida/SAREC) and to the National University of Engineering (UNI), Managua, Nicaragua. This research has been conducted in a *sandwich* cooperation model at the Industrial Information and Control Systems Department (ICS) at the Royal Institute of Technology, KTH, Stockholm, Sweden. This model allows researchers from UNI to spend part time in Sweden and researchers from KTH to spend part time in Nicaragua. Leaving aside the details on the advantages and drawbacks of the *sandwich* model, this has been an experience in which I built a close cultural and academic interchange and personal friendship with colleagues in Sweden.

To my supervisor Torsten Cegrell thanks for his support and success in keeping ICS-KTH an environment where research ideas can flourish and meet reality. Thanks to the *gang* at ICS-KTH for their assistance during my stays in the beautiful, sometimes cold and sunless, Sweden. Special thanks to Judy Westerlund for her charming personality and the care that keeps this ICS-KTH team rolling!

My deepest gratitude to Pontus Johnson and Mathias Ekstedt who supported this research work and journey, including invaluable suggestions during the writing of this thesis. Both of you, my friends, succeeded in making me feel that ICS-KTH was my second workplace.

I would also like to thanks Marvin S., Oscar, Marvin A., Enrique and the rest of the *seniors and juniors* Nicaraguan researchers, the *special troops* who are embarked on similar research journeys in other areas, all of them colleagues who have been sharing, trusting and encouraging in many senses the research program to which this project belongs and I have the honor to coordinate.

Last and definitively not least my thanks to Joaquín Martínez, who has been playing an active role in initiating and keeping this KTH-UNI cooperation, and to Inger, Maija, Håkan, Cecilia, Afzal, Thomas, Adriana Flores and all the other people who have been involved in this cooperation not just as a job, but as a commitment!

Stockholm, June 2009

José Leonel Plazaola Prado

LIST OF PAPERS IN THE THESIS

Paper A: Ekstedt M., Jonsson N., Plazaola L., Silva E., Vargas N., “An Organization-wide Approach for Assessing Strategic Business and IT alignment.” *Proceedings of the Portland International Conference on Management of Technology (PICMET2005)*, Dept. of Engineering and Technology Management, Portland State University. Oregon, USA. July 2005.

Paper B: Plazaola L., Silva E., Vargas N., Flores J., Ekstedt M., “A Metamodel for Strategic Business and IT Alignment Assessment.” *Proceedings of the Fourth Conference on Systems Engineering 2006 (CSER2006)*, University of Southern California, USC, California, USA. April 2006.

Paper C: Silva E., Plazaola L., Ekstedt M., “Strategic Business and IT Alignment: A Prioritized Theory Diagram.” *Proceedings of the Portland International Conference on Management of Technology (PICMET2006)*, Dept. of Engineering and Technology Management, Portland State University. Oregon, USA. July 2006.

Paper D: Plazaola L., Flores J., Silva E., Vargas N., Ekstedt M. “An Approach to Associate Strategic Business-IT alignment Assessment to Enterprise Architecture.” *Proceedings of the Fifth Conference on Systems Engineering 2007 (CSER2007)*, Stevens Institute of Technology. New Jersey, USA. March 2007.

Paper E: Plazaola L., Flores J. Vargas N., Ekstedt M., “Strategic Business and IT Alignment Assessment: A Case Study Applying an Enterprise Architectural-based Metamodel.” *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS41)*, IEEE Computer Society, January 2008.

TABLE OF CONTENTS

INTRODUCTION	1
OUTLINE OF THE THESIS.....	1
BACKGROUND	1
RESEARCH PURPOSE	3
RELATED WORKS	3
RESULTS	11
CONTRIBUTIONS	24
RESEARCH DESIGN	25
REFERENCES.....	29
PUBLISHED PAPERS NOT INCLUDED IN THE THESIS	41
PAPER A.....	42
AN ORGANIZATION-WIDE APPROACH FOR ASSESSING STRATEGIC BUSINESS AND IT ALIGNMENT	
PAPER B	62
A METAMODEL FOR STRATEGIC BUSINESS AND IT ALIGNMENT ASSESSMENT	
PAPER C	76
STRATEGIC BUSINESS AND IT ALIGNMENT: A PRIORITIZED THEORY DIAGRAM	
PAPER D.....	94
AN APPROACH TO ASSOCIATE STRATEGIC BUSINESS-IT ALIGNMENT ASSESSMENT WITH ENTERPRISE ARCHITECTURE	
PAPER E	111
STRATEGIC BUSINESS AND IT ALIGNMENT ASSESSMENT: A CASE STUDY APPLYING AN ENTERPRISE ARCHITECTURE-BASED METAMODEL	
ANNEX I.....	128
DETAILS ON THE ALIGNMENT METAMODEL ASSESSMENT METHOD	

INTRODUCTION

OUTLINE OF THE THESIS

This thesis is divided into six sections, the first of which is this introduction. It contains the background of the work, the research purpose, related works, a summary of the research results, contributions made from this research work, the Strategic Business and IT Alignment (SBITA) assessment methods developed and case studies performed, and a description of the research design. It is followed by five sections, papers A through E, which constitute the main part of the thesis and contain details of the research activities and the results.

BACKGROUND

Contemporary enterprises rely on Information Technology¹ (IT) systems for achieving their mission and goals. The IT systems have been developed historically through implementing specific support to particular business processes or organizational units, creating what can be called *islands of automation*. As the IT systems expanded their scope and number, the need to exchange information between systems has been required [1]. This has led to a situation where interactions among the IT systems are usually ad-hoc designed, numerous, heterogeneous and poorly documented [2][3][4]. Moreover, factors like new services and products for local or global markets, regulatory changes or new technologies drive the dynamic evolution of the enterprise's business, in turn demanding new, sometimes immediate IT support. The combination of non-planned development of the IT and the rapid changes and evolution of the business environment has made many enterprises IT ineffective in many ways, making the IT's management a truly complex and critical issue [5].

It is thus not surprising that Business and IT Alignment (BITA) is a major concern that has been correlated to enterprise performance such as market growth and product or service innovation, as shown by Xia et al [6], Chan et al [7] and the European Union ICT task force [8], among others. According to Luftman [9] benefits must be realized from investments in IT. Papp [10] and Luftman [11] consider it the basis for sustainable competitive

¹ In some literature sources there are distinctions among Information Systems (IS), Information Technology (IT) systems, and Information and Communication Technology (ICT) systems. No such distinction is made in this thesis and IT will be used as a generic and interchangeable term.

advantage. However, executives usually have the perception that BITA efforts facilitate projects with emphasis on technical objectives rather than projects that would clearly leverage enterprise resources and improve enterprise goals [12]. There is still an extreme lack of awareness and trust in the benefit of IT [8]. According to Dailey [13] there is a division on how enterprise executives consider the IT organization: 54% consider it a necessary burden, while 46% view it as a value provider and partner.

In order to attain a more balanced BITA, this thesis focuses on SBITA in the frame of the conceptual enterprise domains and relations, shown in a simplified way in Figure 1.

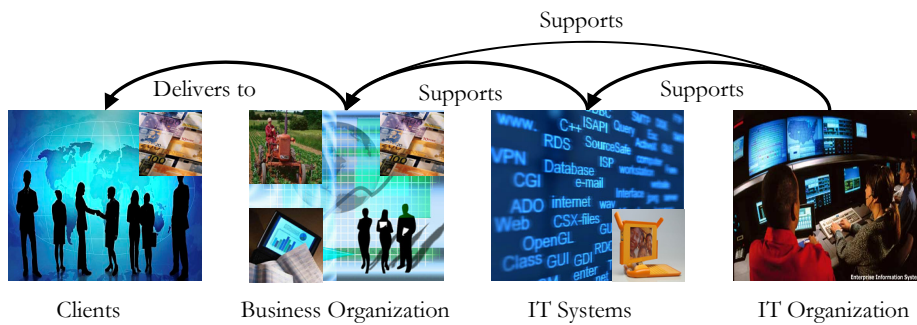


Figure 1 Conceptual enterprise domains and relations.

The business organization delivers dependable services or products to its clients. IT systems support the business organization with technological services, e.g. data for business processes, communication means and integrated information for decision support and enterprise resource planning [14][15][16][17]. A specialized part of the enterprise organization—the IT organization—supports the IT systems with operation, maintenance, planning and acquisition, among others; it also typically supports the business with services such as training, helpdesk, manuals and others [14][15][18]. SBITA encompasses the alignment among the IT organization, the IT systems and the business organization domains.

Many practitioners and researchers are offering business and IT alignment theories and approaches [19][20][21][22][23][24][25][26][27][28]. None, however, have solved the multifaceted alignment issue, which is still ranked amongst the top five enterprise executive concerns year after year [12][29][30][31][32][33]. Among the limitations on those theories or approaches are that they are internally focused on “how-to” lists that omit external perspectives, are limited to technology issues, are mostly top-down approaches, and do not pay enough attention to the vital communication and understanding between the IT organization and the business organization [12][34][35].

Enterprise Architecture (EA) is a business and IT management approach that has shown benefits in its ability to support the communication and traceability of the impact that business and IT have over each other using modeling frameworks [36][37][38][39].

The EA approach is based on architectural frameworks that model the relevant business and IT structures within the enterprise. The plethora of proposed architectural frameworks is overwhelming and it is rarely evident when and why a particular one is preferable over others. A commonly seen drawback in such frameworks is the tendency to be developed as all encompassing, multi-concern and high resource-demanding *over-modeling* projects [34][40][41][42][43][44]. Many SBITA theories and approaches have been proposed and implemented before or parallel to the advent of EA.

RESEARCH PURPOSE

The overall purpose of the research presented in this thesis is to develop a model-based method for assessing SBITA in enterprises. More specific goals are:

- i. To develop SBITA assessment methods based on well established references, with high-validity outcomes, and systematically documented for their application and replication.
- ii. To associate the SBITA assessment method with the EA modeling frameworks.
- iii. To develop application processes of the SBITA assessment method tested in case studies at enterprises in Nicaragua and Sweden.

SBITA in this thesis is defined as a continual adjustment process of conscious and coherent interrelation of all business and IT components and personnel in order to contribute appropriately and in a timely manner to the business goals and needs over time [23][24][45][142]. SBITA will hereafter be shortened to alignment.

The SBITA assessment methods, combining the knowledge and maturity available in the alignment approaches with the modeling representations in the frame of the EA, will improve in dealing with the complex nature of the SBITA.

In this thesis the enterprises under study were the standard “brick and mortar” small and medium size enterprises in which there are identifiable mission and vision, organization structure, functions and processes, non-temporary operation, clear use of IT systems, etc [149].

RELATED WORKS

The activities undertaken in this research have close links to a number of research and academic fields and disciplines. Foremost are the theories and approaches on **alignment**, as the core issue of the problem tackled by this thesis.

Enterprise Architecture is the discipline dealing with consistent and systematic representation (modeling) of the subsystems that constitute an enterprise in order to be used as the basis for analysis, design, decision-making, understanding and communication at the enterprise level. The field of **IT governance** supports IT-related decisions regarding goals, processes, people and technology on a tactical or strategic level, hence clearly supporting the alignment issue.

These fields, and especially its related frameworks, were a source of several clarifications or interpretations of some issues—sometimes declared as “*rules of thumb*”—that were not clearly detailed in the theories and approaches on alignment sources.

THEORIES AND APPROACHES ON ALIGNMENT

The benefits and potential for the IT to support not only business processes but also business strategies and even influence new business strategies has been amply shown [35][46][47][48][49][50][51][52][53][54][55][56][57][58][59][60][143]. Despite the widespread acceptance that business and IT strategies should be aligned, the nature of such alignment is diverse and unclear in the literature [20][21][22]. Alignment has many facets and interpretations as well as various alternative terms such as balance [23], coordination [61], fit [62], linkage [63] and harmony [64]. Those semantic terms usually have attached emphasis in certain alignment characteristics and represent certain interpretation stands. A comparative example is shown in Table 1.

Table 1. Comparison of linkage and alignment concepts. [23]

Characteristic	Linkage	Alignment
Focus of IT	Internal domain (i.e. concerned with choices pertaining to the administrative structure and the business processes – e.g. product delivery, product development, customer service, etc.- as well as the acquisition and development of human resource skills necessary for achieving the required organizational competencies)	Internal domain and External domain (i.e. business arena in which the enterprise competes and is concerned with decisions such as product-market offering and the distinctive business strategy attributes, as well as the range of “make-vs.-buy” decisions, including partnership and alliances)
Management objectives	Ensuring that IT activities are linked to business requirements	Selecting appropriate alignment perspectives for achieving business objectives
IT executive roles	IT functional support to production line management	Multiple executives roles in the production line and IT managers
Dominant criteria for performance assessment	Cost and service considerations	Multiple criteria, e.g. cost, QoS, ROR, ROI

Sometimes such interpretations or stands have contradictory definitions of alignment as either an event [65][66] or a continuous process [22][51][60][67][68][69]. This thesis adopts the stand that alignment is a continual² adjustment process of conscious and coherent interrelation of all business and IT components and personnel in order to contribute appropriately and quickly to the business goals and needs over time. Moreover, alignment has bidirectional repercussions in the business and IT strategies in the enterprises [22][48][50][53][59][60][67][68][69][70].

Although alignment has the diverse interpretations shown above, several descriptions³ of dynamic business and IT interactions and alignment approaches have been developed [19][20][21][22][23][24][25][27][28][48][51][68][71]. The Henderson and Venkatraman model, also known as Strategic Alignment Model (SAM) [23], shown in Figure 2, is considered the key reference alignment model; almost all later descriptions are variants of the SAM [35][72][73][74][75][76].

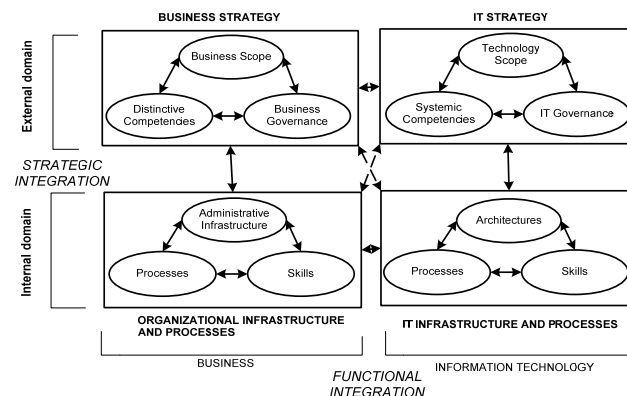


Figure 2. The SAM model [23].

The SAM identifies four main components to consider for alignment, i.e. *business strategy*, *IT strategy*, *organizational infrastructure and processes* and *IT infrastructure and processes*. It also specifies two types of integration. The first is the *strategic integration* between the business strategy and the IT strategy in the context of the external domain. The second is the *functional integration* between the *business organizational infrastructure and processes* and the *IT infrastructures and processes* in the context of the internal domain. Henderson and Venkatraman (H&V) [23] clearly stated that any alignment based on the SAM's two components is dysfunctional and efficient alignment requires a balance across all four SAM components. Although they also provide examples of dominant alignment perspectives, involving three of the four SAM

² Continual implies an activity that is undertaken on a phased, regular basis as part of a process. Continuous is more suitable for the definition of activities intended to operate without pause.

³ Sometimes called frameworks, patterns or models.

components that were successful alignment experiences in 14 transnational companies. They made clear concluding remarks that the SAM is a model with proven worthiness as a representation tool for attending alignment’s key issues yet awaits pragmatic elaborations to translate the SAM into a management framework.

Two elaborations based on the SAM, one by Maes [35][77] and the other by Luftman [78][79], are of special interest given the attention paid to them in the literature and its contribution to the clarification of details on the SAM [76]. Maes et al [35] proposed the Generic Framework for Information Management, defining the concept of information management for alignment and proposing its components in a revised SAM representation. Hence the SAM’s internal domain is divided with clearer emphasis on a *structural* domain and an *operational* domain, arguing that although the SAM has both infrastructure and process in the internal domain, there is a tendency to focus this domain on infrastructural issues to the detriment of operational considerations. A middle column is also introduced representing the needed internal and external *information and communication* aspects, as can be seen in Figure 3.

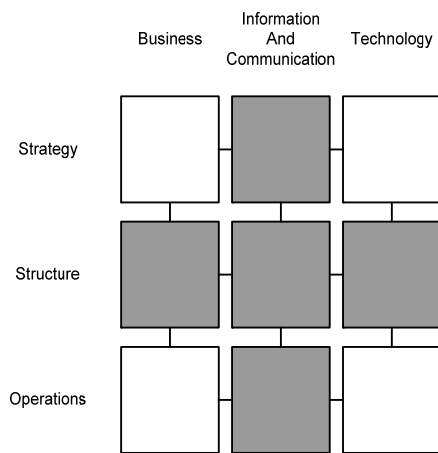


Figure 3. The Generic Framework for Information Management [28]

Luftman et al [80] elaborated a framework on how to manage the SAM by defining details inside the model’s internal and external domains. The external domain was defined to deal with the *scope*, which concerns the choice for certain market segments; *core competencies*, which helps in deciding the business or IT strategy; and *governance*, which is the selection and use of intra- and inter-organizational relationships to obtain certain competencies. The internal domain was defined to deal with *work processes*, which are needed for operations; *skills* understood as the acquisition, training and development of competencies required to manage and operate the processes; and *IT infrastructure*. Luftman et al [20][81][144] further consolidated their approach by providing insight into the enterprise’s activities that enable

or inhibit the alignment. The findings were based on analyzing five years of data from 500 firms representing 15 industrial sectors and involving 1,000 executives. Alignment was proposed to be managed by focusing on maximizing the enablers and minimizing the inhibitors.

Luftman [9][32][43][79] proposed a refined *Strategic Alignment Maturity Model*, SAMM, based on the above elaborations and the empirical evidence collected. Luftman [9][32][43][79] proposes six assessment criteria: (i) *Communications*: The exchange of ideas, knowledge and information among the IT and business organizations, enabling both to have a clear understanding of the company's strategies, business and IT environments, priorities and what must be done to achieve them. (ii) *Competency/Value Measurements*: The use of measures that demonstrate the contribution of IT and the IT organization to the business in terms the business understands and accepts. (iii) *Governance*: The degree to which the authority for making IT decisions is defined and shared among management, and the processes that managers in both IT and business organizations apply in setting IT priorities and allocating IT resources. (iv) *Partnership*: The relationship among the business and IT organizations, including the IT organization's involvement in defining business strategies, the degree of trust between the two organizations, and how each perceives the contribution of the other. (v) *Scope and Architecture*: The extent to which IT is able to provide a flexible infrastructure, evaluate and apply emerging technologies, enable or drive business processes, and provide customized solutions to meet customer and internal needs. (vi) *Skills*: Practices such as training, giving performance feedback, encouraging innovation and providing career opportunities, as well as the IT organization's readiness for change, capability for learning and ability to leverage new ideas. For each criterion Luftman [9][24] further defines 38 sub-criterion components for the total set of six assessment criteria. Those sub-criterion or assessment attributes constitute the operational assessment level. Luftman [78] bases the assessment on the concept of identifying a maturity level in line with the Software Engineering Institute's Capability Maturity Model, hence each attribute is assessed on a Likert scale from one to five, one (1) being the lowest score and five (5) the highest. Luftman [78] argues that experience shows that no single activity will enable an organization to attain and sustain alignment since there are too many variables to deal with. Knowledge of the maturity of the strategic choices and alignment practices makes it possible to see where the organization stands and how it can be improved. The careful assessment of an organization's alignment maturity is an important step in identifying the specific actions necessary to alignment enhancements [9].

In this thesis we adopt Luftman's business-IT alignment assessment approach [25] as a comprehensive, largely benchmarked and well established description of how to assess the complex alignment phenomena. A graphical interpretation of SAMM can be found on-line in [135].

IT GOVERNANCE

There are several definitions of IT governance. One of the first can be found in Henderson & Venkatraman [23] as the “...selection and use of mechanisms (for example, joint ventures with vendors, strategic alliances, joint research on and development of new IT capabilities) for obtaining the required IT competencies.” Weill and Ross [82] focus on “Specifying the decision rights and accountability framework to encourage desirable behavior in the use of IT.” The IT Governance Institute, ITGI [83], expands the definition to include underpinning mechanisms: “... the leadership and organizational structures and processes that ensure that the organization’s IT sustains and extends the organization’s strategies and objectives” [84]. Some other definitions are available [85][86][87][88][89][90] and Webb [91] has addressed the fact that the discipline lacks a uniform definition. In a literature study embracing 60 articles on the topic, the following working definition is proposed: “IT governance is the preparation for, making and implementation of IT-related decisions regarding goals, processes, people and technology on a tactical or strategic level” [92]. Several supporting mechanisms or frameworks are developed to guide the implementation of IT governance. Some well known examples of those frameworks are the IT Infrastructure Library (ITIL) [93] and the Control Objectives for Information and related Technology (COBIT) [88]. The information security standard BS 7799/ISO 17799 is often mentioned together with IT governance; see e.g. [94][95][96].

ITIL [97][98][99], developed and maintained by the United Kingdom's Office of Government Commerce, is a customizable framework of best practices designed to promote quality computing services in the IT. It provides a systematic approach to the providing and management of IT services from inception through design, implementation, operation and continual improvement. Although it provides useful best practice in the field of service management and service delivery, it does not cover the strategic impact of IT and the relation between IT and the business [92]. COBIT [93] is a framework that is standardizing the best IT security and control practices, providing tools to assess and measure the performance of 34 IT processes of an organization. COBIT is widely supported and case studies can be found at the IT Governance Institute (ITGI) [97] and the Information Systems Audit and Control Association (ISACA) [93]. Little support is given in COBIT on the arrangement of decision rights within the enterprise, although the problem has been partly addressed in the latest version [89].

It is clear that IT governance and the documented experiences on applying its supporting mechanisms is a needed and key issue to take into account for any alignment effort.

ENTERPRISE ARCHITECTURE

Enterprise Architecture (EA) is a recent discipline that has emerged mainly from the business and IT management perspectives [100] and it is based on models using systematic

architectural frameworks. These frameworks represent the relevant structures within the enterprise, typically business, applications, information, technology and their relationships to business performance. An EA can be built with a particular and defined architectural framework or some customization of an existing framework [36][101][102]. The article published by J. Zachman, “A Framework for Information Systems Architecture,” [103] is considered the cornerstone of the EA. Since then many authors have contributed to the EA discipline, for instance [2][4][14][17][41][44][80][102][104][105][106][107][108][109][110][111][112][113][145][146]. Several architectural frameworks have been suggested, such as the Zachman Architectural Framework (ZEAF) [103]; the Department of Defense Architecture Framework (DoDAF) [114], the Open Group Architectural Framework (TOGAF) [102], the Federal Enterprise Architecture (FEA) [115], the Reference Model of Open Distributed Processing (RM-ODP) [116], the Computer Integrated Manufacturing Open System Architecture (CIMOSA) [117] and the Generalized Enterprise Reference Architecture and Methodology (GERAM) [118], and others are emerging. These frameworks propose a holistic approach defining a consistent and systematic modeling of the systems, including their relationships, which constitute an enterprise. This consistent and systematic modeling is intended to serve as the basis for analysis, design, decision-making, understanding and communication at the enterprise level [36].

The plethora of proposed Enterprise Architecture frameworks, defining what and how to model is overwhelming, and when and why a particular framework is preferable over others is rarely evident. The main reason for this confusion is that the link between a model’s contents and structure on the one hand and its purpose on the other is normally unclear or not well limited [40][119]. Architectural frameworks are often developed as all-encompassing, multi-concern and high resource-demanding *over-modeling* projects [34][40][42][44][45][120]. This makes it important to be explicit about which analyses or concerns the architecture will be subjected to in order not to collect data that is irrelevant to the model’s use. The information needed has to be carefully selected for the chosen purpose [34][120][121][122][123].

In order to standardize some concepts and definitions regarding the diverse architectural frameworks, the IEEE Std 1471-2000 [124] is used as a reference in this thesis. Although this standard was meant for *Software Architecture* and therefore does not cover the whole spectrum of the EA frameworks, it was adopted and published in July 2007 by the International Standards Organization (ISO) [125][126], and has been released as ISO/IEC 42010 [126] as the first international standard focused on describing architectures. In this thesis, complying with the IEEE Std 1471-2000[124][126] *viewpoints* are the sets of specifications of the conventions, patterns or templates called here metamodel, for constructing and using *views* or *models* for alignment assessment. A *view* or *model* is a representation of the enterprise from the perspective of the alignment concern. Each *view* or *model* addresses one or more of the enterprise stakeholders’ concerns.

Special attention was given in this thesis to the Zachman Enterprise Architecture Framework (ZEAFF) [103][127], which is considered a generic taxonomy for expressing the basic elements of EA. ZEAFF considers that more specific architectural frameworks or representations are additive and complementary. ZEAFF is defined independently of tools or methodologies, and Enterprise Architecture issues can be mapped against it to understand where they fit in the enterprise stakeholder’s perspective and constraints [121][128]. The taxonomy was derived from analogous structures found in the older disciplines of architecture (i.e. construction) and engineering (i.e. manufacturing) that classify and organize the process of designing and producing complex physical products (e.g. buildings or airplanes), as can be seen in Figure 4.

The Zachman Classification System for an Enterprise™

Audience Perspective	WHAT	HOW	WHERE	WHO	WHEN	WHY	Interrogative Perspective
Scope	Inventory Identification Scope Entity	Function Identification Scope Process	Network Identification Scope Location	Organization Identification Scope Role	Timing Identification Scope Cycle	Motivation Identification Scope End	Visionaries
Business	Inventory Definition Business Entity Business Relationship	Function Definition Business Process Business Input	Network Definition Business Location Business Connection	Organization Definition Business Role Business Work	Timing Definition Business Cycle Business Moment	Motivation Definition Business End Business Means	Executive Leaders
System	Inventory Representation System Entity System Relationship	Function Representation System Process System Input	Network Representation System Location System Connection	Organization Representation System Role System Work	Timing Representation System Cycle System Moment	Motivation Representation System End System Means	Architects
Technology	Inventory Specification Technology Entity Technology Relationship	Function Specification Technology Process Technology Input	Network Specification Technology Location Technology Connection	Organization Specification Technology Role Technology Work	Timing Specification Technology Cycle Technology Moment	Motivation Specification Technology End Technology Means	Engineers
Component	Inventory Manifestation Component Entity Component Relationship	Function Manifestation Component Process Component Input	Network Manifestation Component Location Component Connection	Organization Manifestation Component Role Component Work	Timing Manifestation Component Cycle Component Moment	Motivation Manifestation Component End Component Means	Implementers
Operations	Inventory Instantiation Operations Entity Operations Relationship	Function Instantiation Operations Process Operations Input	Network Instantiation Operations Location Operations Connection	Organization Instantiation Operations Role Operations Work	Timing Instantiation Operations Cycle Operations Moment	Motivation Instantiation Operations End Operations Means	Workers
Target Domain	INVENTORY	FUNCTION	NETWORK	ORGANIZATION	TIMING	MOTIVATION	Target Contributor

© 2003-2005 John A. Zachman, Zachman International

Figure 4. The Zachman Framework [129]

The two dimensional classification of ZEAFF is a matrix that has six columns representing the *interrogative triggers* related to *aspects* of the processes at the enterprise, i.e. *What* related to *Data or inventory*, *How* related to *Function*, *Where* related to *Network*, *Who* related to *People or organization*, *When* related to *Time*, and *Why* related to *Motivation*. Those columns are intersected by six distinct rows representing *viewpoints* of the enterprise stakeholders related to *enterprise perspectives*, i.e. *Planner* related to *Scope and context*; *Owner* related to *Business model and visionary concepts*; *Designer* related to *System models and their logic*; *Builders or Engineers* related to *Detailed representations of the technology*; *Implementers*, sometimes called *Sub-contractors*, related to *Detailed representations of the components*; and *Worker* related to *Operations* [34].

The intersecting cells of the framework correspond to models or views which, if documented, can provide a holistic representation of the enterprise [130].

Since it is over-ambitious to build and maintain a model containing detailed information on every aspect or concern about business and IT, an important goal of this thesis is to help determine relevant data for the alignment assessment concern. The openness and flexibility provided by the ZEAF [34][127] makes it a reference to which the viewpoints or meta-model for the alignment assessment presented in this thesis were associated.

RESULTS

The main results of the research are outlined in this section for the purpose of summarizing the argumentation and linking of the composite results. Their details are found in papers A to E. The sequence and links of these results are shown below in Figure 5

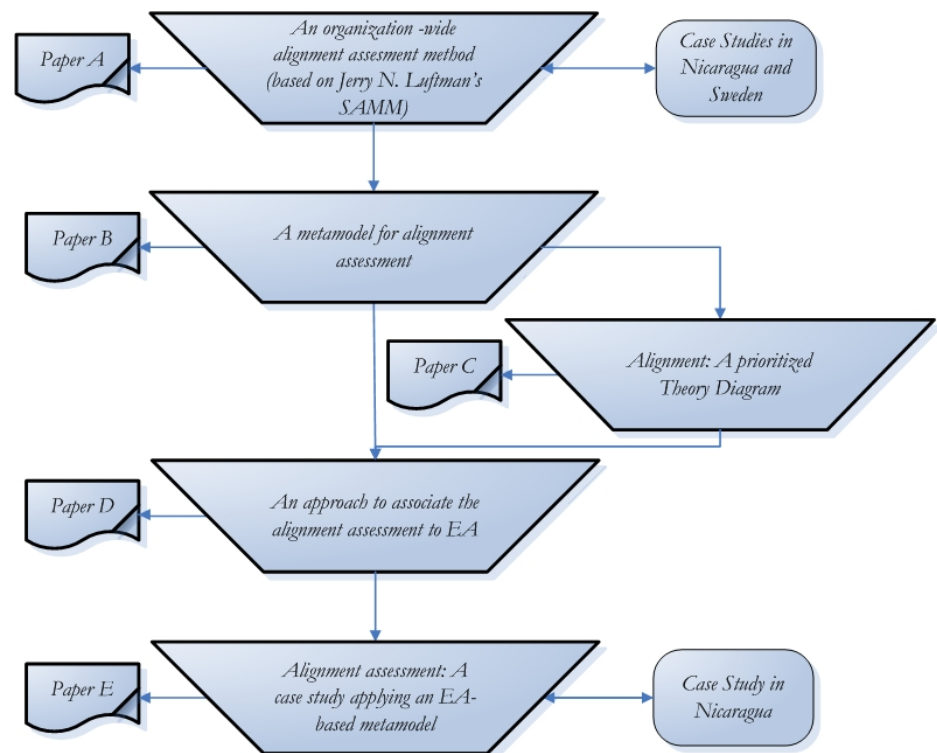


Figure 5. The sequence and links of the main research results

AN ORGANIZATION-WIDE APPROACH FOR ASSESSING ALIGNMENT

Jerry N. Luftman’s SAMM has a solid empirical basis, has been tested and benchmarked in 60 global companies and based on an IBM research project involving executives from over 500 firms representing 15 industries [20][24][43]. This research step develops the Organization-wide Approach for Assessing Alignment that enhances the SAMM approach in terms of measurability, accuracy and credibility in the data collection, repeatability and organizational involvement. The Organization-wide Approach for Assessing Alignment developed here enhances SAMM alignment assessment with specific questions for each of Luftman’s original criteria and attributes. The questions were translated into a questionnaire that addresses a wider set of respondents from all levels of the business and IT organizations, respectively. For purposes of credibility, the questionnaire triangulates the posed questions by collecting evidence from both direct interviews and alternative sources such as documents.

As not all of Luftman’s original criteria and attributes are stringently defined, some interpretation was needed in order to make operational measurements. ITIL and COBIT were used to support the needed interpretations sometimes called “*rules of thumb*” on such issues. Complementary support for the proper interpretation and use of SAMM has been published, for instance, in [131] where a correlation between SAMM and COBIT is presented. Also a correlation on the level of alignment from the perspective of IT key performance indicators linked to ITIL and COBIT can be found at [132]. The Organization-wide Approach for Assessing Alignment was tested in case studies. The application of the approach consists of five steps where each step has one or several inputs and outputs (see Figure 6). Two case studies were performed with this alignment assessment method. The first was performed in Nicaragua, at a major state agency. The subject of the alignment assessment was the part of the organization that uses computers intensively and was developing a comprehensive IT strategy [133]. The second was performed in Sweden, the Swedish part of a transnational electricity enterprise [134][133]. In that case the subject of the alignment assessment was the service order process used by several companies and the enterprise resource planning system related to that process. The purpose of both case studies was to test the process and applicability of the Organization-wide Approach for Assessing Alignment.



Figure 6. Steps in the Organization-wide Approach for Assessing Alignment

The details of the Organization-wide Approach for Assessing Alignment and the report on the two case studies performed can be found in paper A. Two MSc theses at the Royal

Institute of Technology, KTH, Sweden, were developed using such approach and supported the findings and conclusions in this case study [133][134].

After the empirical experience and feedback from the case studies to the Organization-wide Approach for Assessing Alignment, steps to introduce modeling concepts were started.

A METAMODEL FOR ALIGNMENT ASSESSMENT

In order to further enhance the Organization-wide Approach for Assessing Alignment proposed above, the Alignment Metamodel Assessment Method, or AMAM, was developed. The main motivation in this research step was to introduce the advantages offered by the modeling approaches in order to propose a feasible model-based management tool that can be used as support for the decision-making of an enterprise's business and IT system operation and evolution.

Luftman's alignment assessment approach was shaped into a theory diagram. A theory diagram is a syntactic representation in boxes of the key concepts of a theory with compositional, correlation or causal relations and the measurements property of the key concepts. Theory diagrams help us decompose intangible or hard-to-measure properties (concepts) into more detailed sub-properties (sub-concepts) that are measurable. This decomposition can be performed repeatedly in order to generate a theory diagram in a tree-structured hierarchy in any number of levels with the objective of defining, measuring or making operational a theory, in this case Luftman's alignment approach, and its key elements. By doing this, a structured, concrete and transparent definition of the subject can be achieved [40][135].

Luftman's alignment assessment approach theory diagram is constructed by representing the 6 original criteria, involving 38 attributes, and the alignment levels for each attribute expressed by its particular set of measurable conditions and properties. Each alignment level is related to the corresponding attribute, while the attributes have a composition relationship with their corresponding criterion. The complete graphical interpretation of Luftman's theory diagram can be found on line at [136]. For space reasons, Figure 7 shows only a partial representation of Luftman's theory diagram using details from the selected criterion example.

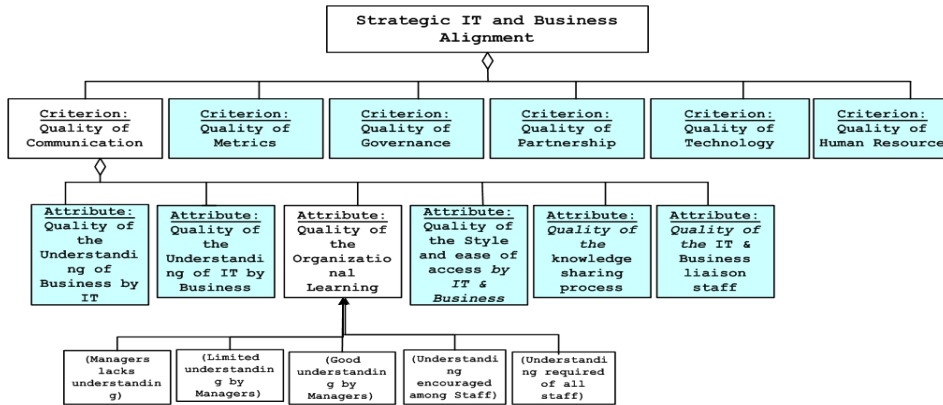


Figure 7. Partial representation of Luftman’s alignment assessment approach as a theory diagram

The purpose of the elaborated theory diagram is to illustrate the aspects to discern for conducting the alignment assessment of Luftman’s approach. Firstly, it makes the theory explicit, facilitating critical examination for defining the measurable aspects of each attribute. Secondly, it will be the basis for deriving a reusable metamodel (modeling templates) for the alignment assessment.

A syntactic and semantic analysis was applied to Luftman’s theory diagram, retaining the process from the Organization-wide Approach for Assessing Alignment, thus keeping its benefits of measurability, traceability and organizational involvement. Academic and practitioners’ references and the already mentioned IT governance frameworks were used to interpret the conditions and properties for assessing each attribute in order to propose the set of artifacts (i.e. entities, attributes, relationships, etc.) that should be used as a modeling template, or metamodel, so that Luftman’s *attributes* and *level of alignment* become the **viewpoint components** in the AMAM. See as an example the developed template for the viewpoint component *Understanding of business by IT* in Figure 8 below.

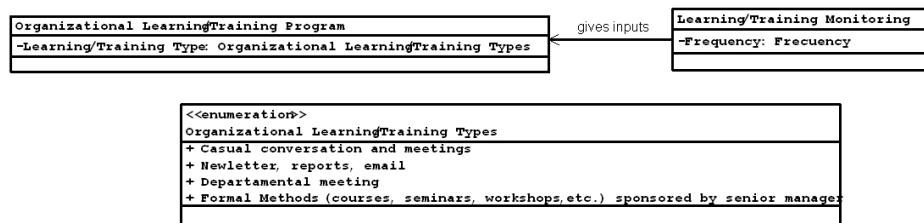


Figure 8. Example of artifacts of the viewpoint component “Understanding of business by IT”

In summary, what are criteria and attributes and levels of alignment assessment in the theory diagram are respectively **viewpoints** and **viewpoint components** in the AMAM. The full presentation of the AMAM can be found on line at [137], and in Appendix I.

For space reasons only a partial representation is drafted and details presented on the chosen viewpoint component (see Figure 9).

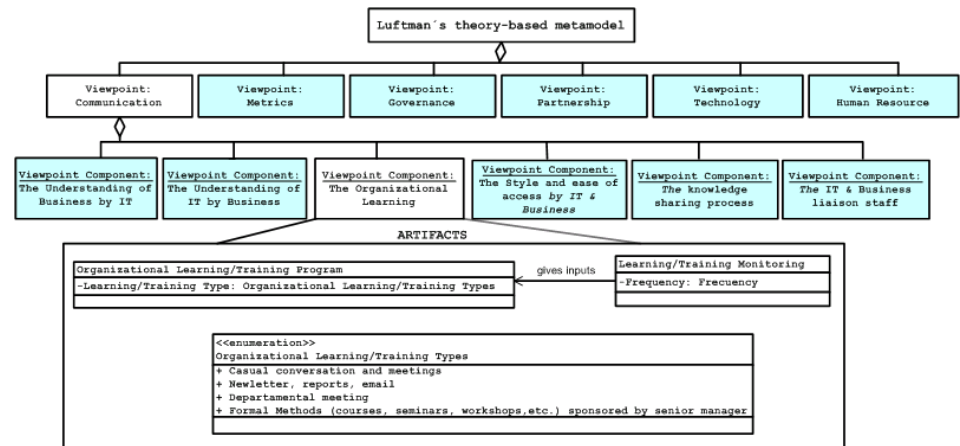


Figure 9. Partial representation of Luftman's theory-based metamodel

The AMAM also includes inference rules for analyzing the alignment level of the enterprise model or views. Table 2 shows an example of such inference rules, while the full set can be found on line at [137] as well as in Appendix I.

Table 2. Set of inferences rules for the IT & B Liaison staff Viewpoint component

<p>(Viewpoint component 1.6)</p> <p>INPUTS</p> <p>The instances of B-IT Liaison staff</p> <p>The attribute Frequency of existence</p> <p>The attribute Access Type</p> <p>The attribute Type of Scope</p> <p>OUTPUTS</p> <p>IF the instance of <i>B-IT Liaison</i> has the attribute <i>Frequency of existence</i> and it is <i>Never</i> OR <i>When there is a problem/needed</i> THEN Level 1 is: <i>None or use only as needed.</i></p> <p>IF the instance of <i>B-IT Liaison</i> has the attribute <i>Access Type</i> and it is <i>Tactical and technology based</i> THEN Level 2 is: <i>Primary IT-B link.</i></p> <p>IF the instance of <i>B-IT Liaison</i> has the attribute <i>Access Type</i> and it is <i>Formal knowledge sharing process</i> THEN Level 3 is: <i>Facilitate knowledge transfer.</i></p> <p>IF the instance of <i>B-IT Liaison</i> has the attribute <i>Access Type</i> and it is <i>Formal knowledge sharing process</i> AND <i>Long-term benefits seen and pursued</i> AND has the attribute <i>Type of Scope</i> and it is <i>At all level of the Organization</i> THEN Level 4 is: <i>Facilitate relationship-building.</i></p> <p>IF the instance of <i>B-IT Liaison</i> has the attribute <i>Access Type</i> and it is <i>Formal knowledge sharing process</i> AND <i>Long-term benefits seen and pursued</i> AND has the attribute <i>Type of Scope</i> and it is <i>Include Partners</i> THEN Level 5 is: <i>Building relationship with partners.</i></p>

The AMAM inherited the data collection enhancements already discussed in the Organization-wide Approach for Assessing Alignment. The AMAM, because its model-based nature, defined a clear set of artifacts, which reduces subjective complexity by enabling standard communication processes (the artifacts) as well as reducing complexity by defining a limited set of artifacts, attributes and links.

Details on the development, proposal and application processes of the proposed AMAM can be found in paper B.

Paper B argues that the AMAM affiliation to EA can serve as a guide or reference for identifying the relevant representations of the alignment concern that can mitigate the

expenses and drawbacks of the often larger modeling required for applying the multi-concern EA Frameworks.

A PRIORITIZED ALIGNMENT THEORY DIAGRAM

The main purpose of this research step was to look for a prioritization of the alignment topics and subtopics in order to get a clearer vision and categorization of their importance given the current knowledge basis. For that purpose Henderson & Venkatraman’s SAM, the basis of Luftman’s alignment approach, was used as the reference, as it was already explained in the related works section. SAM was transformed into a theory diagram and the process followed can be seen in Figure 10.

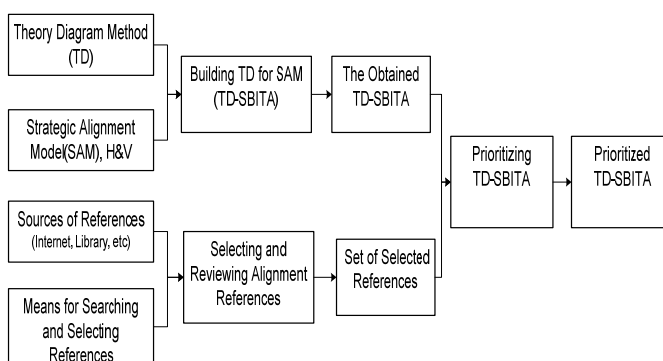


Figure 10. Work flow of the processes for prioritizing the alignment topics

The SAM expressed as theory diagram is partially presented in Figure 11 (18 “boxes” from a total of 36).

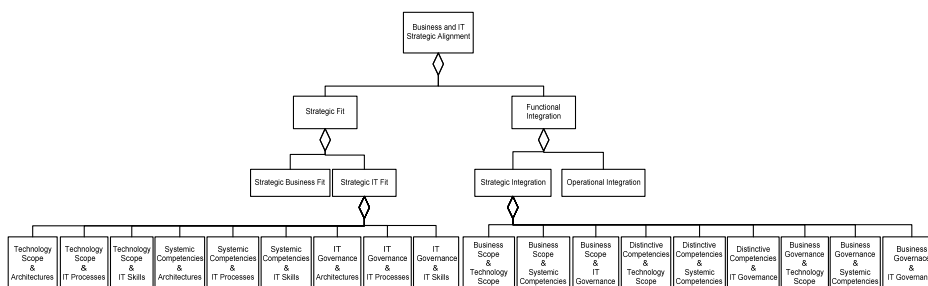


Figure 11. TD-SBITA for SAM

A literature search and review was performed based on a broad search of academic and practitioners’ information sources after defining a set of search keywords: *alignment, business and IT alignment, strategic alignment, IT alignment, IT architecture, IT management, IT and business fit, IT and business fusion, alignment models, measuring IT and business performance, and strategic IT and*

business planning. All references were selected and classified based on the search results (citation score) provided by the search engine, i.e. Google scholar [139] and Citeseer [140] using the Reference Author Index, RAI, Science Citation Index, SCI, Institute for Scientific Information, IS, Publications Research Index and PRI. After a general search process, more than 150 documents on the alignment field were found and reviewed in a general way; then a more detailed selection was performed and a more in-depth analysis was made of the 85 most relevant, highly cited research papers, books and technical professional and consultant reports.

After a process of assigning weights to the topics and subtopics, the prioritized theory diagram based on SAM shown below in Figure 12 was prepared.

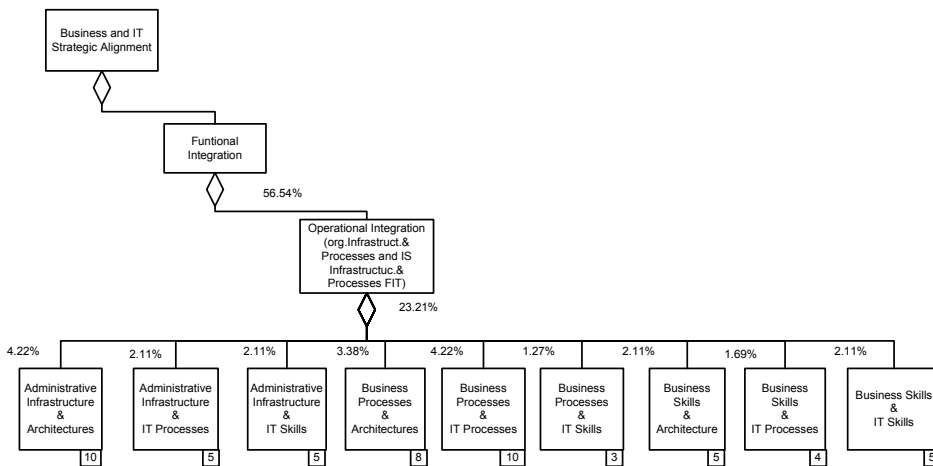


Figure 12. The prioritized theory diagram based on SAM (showing all levels, but only 9 of the 36 “boxes” in the bottom level)

A condensed prioritized theory diagram of SAM can be seen in Figure 13.

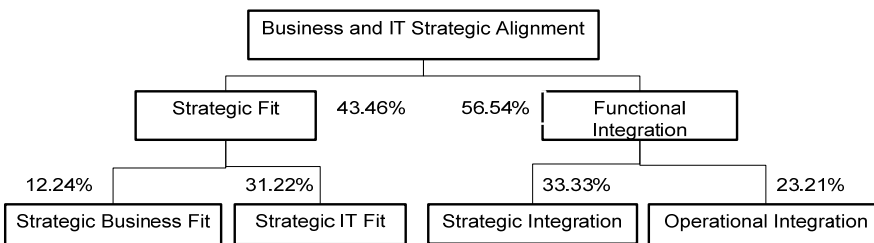


Figure 13. A condensed prioritized theory diagram based on SAM (showing only three of four levels)

As can be seen in the figures above, the prioritization of the topics and subtopics do not indicate major imbalances, although *Strategic business fit* has a lower weight relative to the other topics.

Not enough major arguments were found to revise the equally defined importance of the topics and subtopics addressed by the alignment assessment methods proposed here.

Details of the criteria and process of prioritizing the alignment topics and subtopics can be found in paper C.

AN APPROACH TO ASSOCIATING THE ALIGNMENT ASSESMENT WITH THE EA

The AMAM was associated with the Zachman Enterprise Architectural Framework (ZEAF), the generic reference of EA frameworks and a process and set of criteria were developed for associating the artifacts of AMAM to the ZEAF. This association was done in order to link the representations (the metamodel's artifacts) of the alignment concern with the EA dominion.

The AMAM has 39 different artifacts, not including the relation types. In associating the metamodel's artifacts to ZEAF *aspects*, we associated the 39 artifacts, some of which could be associated with more than one *aspect* as a function of its attributes. The behavior of this association phase is shown in Figure 14.

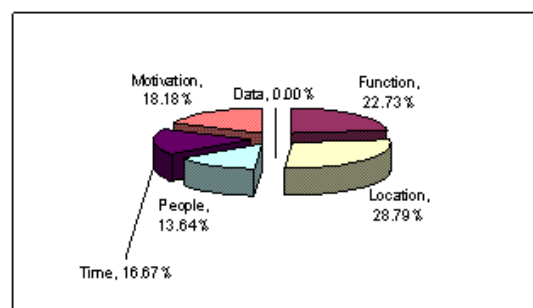


Figure 14. Metamodel's artifacts associated by ZEAF Aspects

Here it can be seen that the developed AMAM has a high association with the ZEAF *aspects* Function (Column 2) and Location (Column 3) with a small, decreased presence in Motivation (Column 6), Time (Column 5) and People (Column 4), in that order. The AMAM covers all ZEAF aspects in a rather well balanced way, except for Data (Column 1), where we found no allocated representation of the AMAM.

In associating the AMAM to the ZEAF perspectives, all artifacts were associated, some of them in more than one perspective as a function of their attributes. The behavior of this association phase is shown in Figure 15.

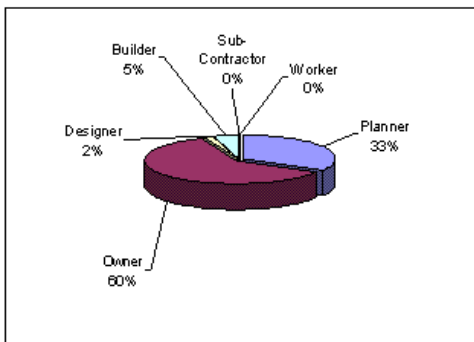


Figure 15. Metamodel's artifacts associated by ZEAF Perspectives.

It can be seen that the AMAM artifacts have a high association with Owner and Planner and almost negligible presence in Contractor and Designer. The current alignment is clearly a concern of the Owner and Planner perspectives, strongly defined by the current conceptual (Owner) and contextual (Planner) definitions at the enterprise. The Designer and Contractor are of interest for information on how the alignment details are working at their level. Perspectives at the Subcontractor and Worker level influence the alignment little to not at all. The AMAM is used to produce the organization *as-is* model of the alignment level, helping to spot possibilities for enhancing the issues for a better alignment and represent further the *to-be* alignment of an enterprise.

The details of the implementation, criteria and process for associating the AMAM with ZEAF *aspects, perspectives* and patterns can be found in paper D.

ALIGNMENT ASSESSMENT: A CASE STUDY APPLYING AN EA-BASED META-MODEL

The Alignment Metamodel Assessment Method (AMAM), already associated to EA dominions in the previous chapter, is also called an Enterprise Architectural-based metamodel method. For purposes of consistency AMAM will be kept as the name. This method was tested in a case study conducted in an intensive IT service enterprise in Nicaragua, and addressed two specific questions: (i) How can the proposed alignment assessment be applied in enterprises? and (ii) What is the quality and use of the results of such an application?

In order to conduct such a case study, a set of 71 questions was derived from the AMAM, specifically from the artifacts' attributes. This set of questions—the survey—allowed the instantiation of the artifacts according to the attributes found in the surveyed enterprise.

The case study was conducted following the phases shown in Figure 16 below.

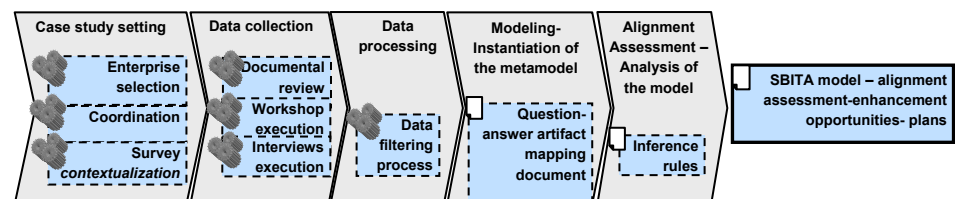


Figure 16. Case study phases

The enterprise selected for this case study is a nationwide Internet Service Provider (ISP) in Nicaragua. Part of the case study settings and conduction there involved weekly scheduled coordination meetings with the enterprise's managers, five workshops and five interviews with business and IT personnel. The weekly coordination meetings were arranged among the top managers and the authors. A list of 11 documents of the enterprise was selected and the time for the data collection was defined as four weeks. A non-disclosure agreement was established between the case study team and the managers. The case study was planned and developed in three months. A total of 30 people at the enterprise, working in the areas of IT, Production, Marketing, Accounting and Billing, were involved in the case study. The top-level enterprise managers were involved in the data collection phase during the weekly meetings. From the metamodel's 74 artifacts, 23 were instantiated (31%). The enterprise alignment model is presented in Figure 17 below.

STRATEGIC BUSINESS AND IT ALIGNMENT ASSESSMENT –A MODELING APPROACH ASSOCIATED WITH ENTERPRISE ARCHITECTURE

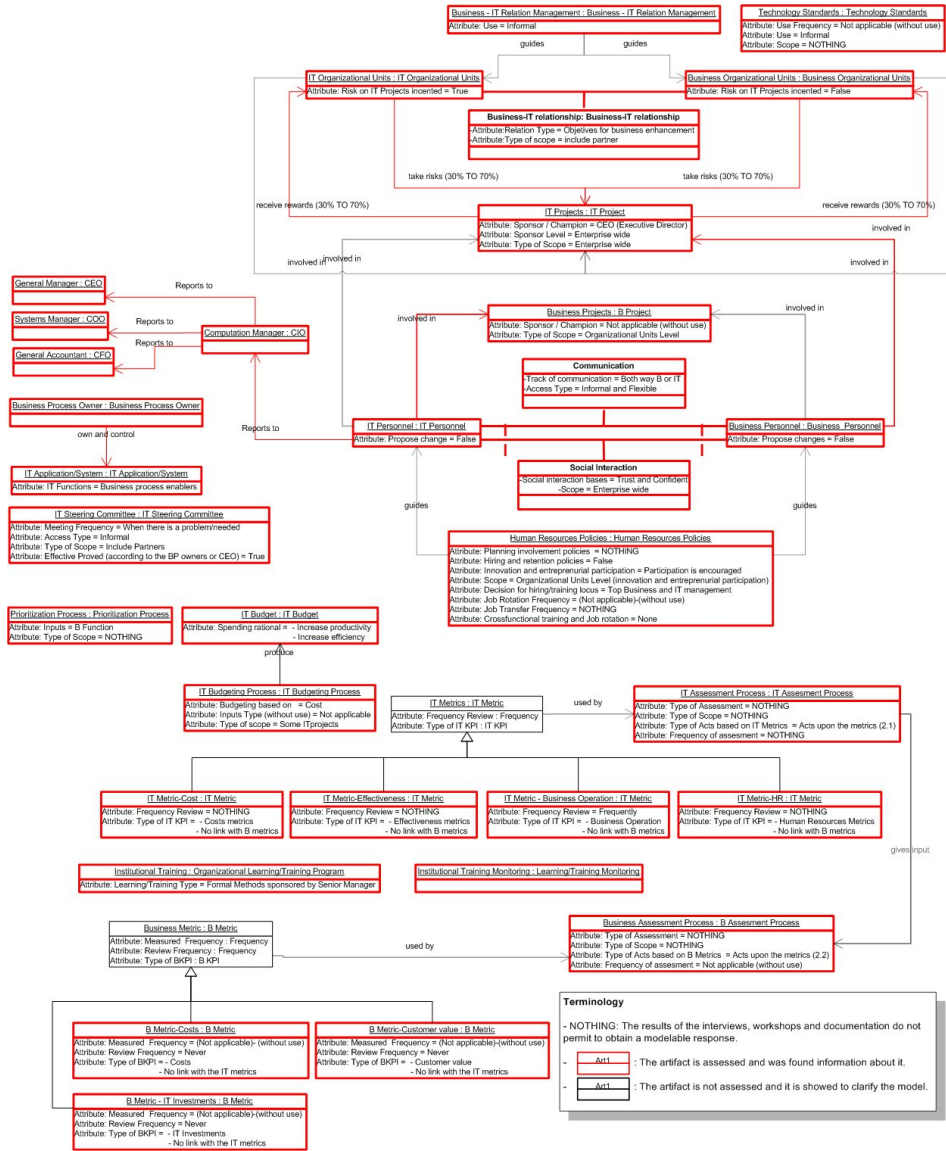


Figure 17. Enterprise's "as-is" alignment model.

The alignment level was derived applying the inference rules to each View and View component. Such levels are represented in histograms per View and per View component. The histogram per View is presented in Figure 18.

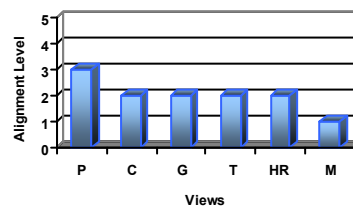


Figure 18. Histogram of the alignment levels at each view

From the histogram the alignment level can be observed for each of the 6 Views: *Partnership (P)*: Has an alignment level 3, i.e. IT is seen as an asset and process driver. *Communication (C)*: Has an alignment level 2, i.e. limited mutual understanding between business and IT. *Governance (G)*: Has an alignment level 2, i.e. governance is tactical, functional and occasionally responsive. *Technology (T)*: Has an alignment level 2, i.e. the technology is used in information transaction processes. *Human Resource (HR)*: Has an alignment level 2, i.e. the human resource capacity differs across the organization and is functionally based. *Metrics (M)*: Has an alignment level 1, i.e. the metrics used in the organization are based merely on technical measurements.

The AMAM has the benefit of a limited set of 74 artifacts that can be modeled through 71 questions. It has been shown that the knowledge and maturity already available in expert's approaches can be used for more focused, limited and relevant representations in the frame of the EA modeling endeavor. These characteristics allow us to avoid over-modeling. The case study also shows that with this approach the top-level managers can not only see the current enterprise alignment level but can also make informed decisions on alignment enhancement possibilities through prioritization of the enhancements agreed to among IT and B managers. Enterprises very seldom will have the possibility of enhancing the alignment in all possible View components. Concrete action plans were derived from the decisions made and the approach presented.

The details of the design and results of the case study in which the AMAM was applied can be found in paper E. A thesis at Nicaragua's National Engineering University (UNI) that was using the Organization-wide Approach for Assessing Alignment supported the findings and conclusions in this case study [148].

CONTRIBUTIONS

This section summarizes the contributions of the present research work.

An Organization-wide Approach for Assessing Alignment. This approach or method is an elaboration based on Jerry N. Luftman's well established theoretical and empirical alignment assessment approach and was aimed at enhancing the measurability, traceability and organizational involvement, in short assuring high-validity outcomes, and systematically documented and replication. Results from applying the proposed approach in two case studies in companies in Sweden and Nicaragua are also presented. This alignment assessment method and the case studies provided close, detailed insights into the alignment assessment approach adopted as reference, i.e. Luftman's approach. The details are published in paper A.

An Alignment Metamodel Assessment Method (AMAM), associated with EA frameworks. The AMAM developed consists of 74 artifacts and 190 inference rules that can be found on-line at [137]. The clearly stated set of artifacts in the metamodel, templates of entities and their attributes, relations and inference rules define a systematically documented and replicable alignment assessment method. The process is systematically documented as shown in Figure 17 above. The process and outcomes from the application to a case study are shown in Figure 16. The reusability of the alignment assessment method is a direct derivative of the systematically documented process and outcomes discussed above. The viability of the method has been tested in the case study reported in paper E and the details of this contribution can be found papers B, C and D. The validity of the outcomes is achieved by the above-mentioned measurability, accuracy and credibility in the data collection, and organizational involvement inherited by the Organization-wide Approach for Assessing Alignment elaborated.

The AMAM was **associated with the Zachman framework.** The elaborated metamodel can be considered a custom built architectural framework for the specific alignment assessment concern [101]. The relevant modeling artifacts of the AMAM were associated in the *aspects* and *perspectives* of the ZEAF. The details are reported in paper D.

Both alignment assessment methods described above have been tested in case studies in this research work. AMAM was performed in a major Internet Service Provider in Nicaragua and is reported in paper E. Two case studies were performed with the Organization-wide Approach for Assessing Alignment in enterprises in Nicaragua and Sweden, as reported in paper A. The use of the AMAM for informed decisions on alignment enhancement possibilities is reported in paper E.

The details of the contributions are found in papers A to E. In paper A the authors are listed in alphabetical order, the author of this thesis was the initiator of the paper, as well

the proposed assessment method, responsible for the data collection process, and the analysis of one of the case studies as well as coordinating the questionnaires and the selection of respondents in the cases studies reported. In paper B, D, and E the author of this thesis, heading the list of authors, was the initiator of the papers, developer of the proposed assessment method, responsible for the data collection process, and the analysis of the case study reported. In paper C the author of this thesis was responsible for the definition of the process or “logical flow” for the BITA issues prioritization presented in this paper.

RESEARCH DESIGN

This section covers a summary of the methodological aspects that have guided this work. The particulars of the research conduction are found in papers A-E.

A number of literature research strategies can be found. Table 3 below presents a number of different research strategies (adapted from [141]). These strategies vary with the type of research questions, the amount of control the investigator has over the event investigated and the degree of interaction with the studied object.

Table 3. Research strategies. Adapted from [139].

	Type of research question	Control over event	Interaction
Experiments	How, Why	Yes	Partial to Full
Survey	Who, what, where, how many/much	No	None
Document/Archival analysis	Who, what, where, how many/much	No	None
Case study	How, why	No	Partial

Mainly two strategies have been used in this research work. The document analysis research strategy was used to define the appropriate assessment approach from the alignment field and the further elaborations to enhance the particular gaps found in the chosen approach. Details and results on such issues can be found in papers B and C. This research strategy was also used to develop the alignment method proposed; special attention was devoted to elaborating the derived metamodel, as can be seen in papers E and F. For the development of the AMAM and association with the EA, please see details in papers A, B and D. The case studies approach was used to corroborate the theoretical proposals the author was developing; the main aim of this research approach was to test the proposed alignment method. Details and results on such issues can be found in papers A and C.

A number of data collection methods can be used, for instance Documentation, Archival Records, Interviews and Direct observations [140]. Table 4 shows the data collection methods used in this work.

Table 4. Data collection methods, strengths and weakness for different sources. Adapted from [Yin 94]

	Strengths	Weakness	Used in this thesis
Documentation	Stable: can be reviewed repeatedly Unobtrusive: not created as a result of the study Exact: contains exact references and details of an event Broad coverage: long span of time, many events and many settings	Retrievability: can be low Selectively biased: if collection is incomplete Reporting bias: reflects (unknown) bias of the author(s) Access: may be deliberately blocked	Yes
Interviews	Targeted: focused directly on the topic of study Insightful: provides perceived causal inferences	Bias: due to poorly constructed questions Response bias Inaccuracies: due to poor recall Reflexivity: interviewee gives what interviewer wants to hear	Yes
Direct observations	Reality: covers event in real time Contextual: covers context and event	Time-consuming Selective: unless broad coverage Reflexivity: event may proceed differently because it is being observed Cost: hours needed by human observers	No
Participant observations	(Same as above for direct observation) Insightful into interpersonal behavior and motives	(Same as above for direct observation) Bias due to investigator's manipulation of events	No

The documentation and structured interviews used to gather information for the applications of the alignment assessment method proposed here is detailed in paper A, precursor test, and in paper E. The data gathered in the interviews were in some cases complemented with data from documentation for the case study reports.

Some of the weaknesses in the documentation data collection were dealt with by assembling and training a team of case study supporters, who were undergraduate students at UNI and KTH working on these case studies as part of their own thesis activities. In such training a search for and creation of a documentation and data retrieving inventory was covered and designed using keywords—key concepts—based on the data demanded by the assessment methods.

In one of the case studies, because the documents were chosen from an inventory available from a previously conducted organizational assessment, the inventory of documents requested was not controlled by the organization under study. The availability of such requested documents was checked *in-situ* giving little opportunity for conscious bias of available or unavailable documentation. The assessment methods proposed in this thesis did not rely only on data retrieved from the documentation; the possible bias from incomplete document collection was diminished by doing data collection through organization-wide interviews. However, the greatest confidence in the data came from documents. No problem of access to existing documents was detected during the case studies. For details see papers A and E.

The interviews were conducted using an organization-wide approach. Interviewed personnel at each organization were defined randomly by the case study team at each of the organizational departments chosen. The interview questions were closed ones and presented to groups of interviewees with no possibility of sharing responses as the answers were written rather than oral. The questions were asked of the group with a short explanation and limited time to answer. A test of the clarity of the questions was conducted with other “test interviewers” at two different organizations with analogous expertise to the targeted interviewed personnel, thus decreasing the possible problem of unclear questions or subjective interpretation of them. The data collected in the interviews were validated with the data collected in the documentation and any other evidence, e.g. report available on IT systems. For details see paper A and E.

REFERENCES

- [1] Pontus J., & Ekstedt M., and Studentlitteratur 2007, Enterprise Architecture: Models and Analyses for Information Systems Decision Making, ISBN 978-91-44-02752-4.
- [2] Andersson J., Enterprise Information Systems Management – An Engineering Perspective Focusing on the Aspects of Time and Modifiability, Ph.D. Thesis, Royal Institute of Technology (KTH), 2002.
- [3] Haglind M., Information Systems Planning in the Deregulated Electric Power Industry – Addressing Small and Medium-sized Enterprise, Ph.D. Thesis, Royal Institute of Technology (KTH), 2002.
- [4] Johnson P., Enterprise Software and System Integration – An Architecture Perspective, Ph.D. Thesis, ISSN 11043504-TRITA-ICS-0202, Royal Institute of Technology (KTH), 2002.
- [5] Marques, C. and Sousa, P., “Enterprise Architecture: Business and IT alignment. Symposium on Applied Computing”, Proceedings of the 2005 ACM symposium on Applied Computing. Santa Fe, New Mexico.
- [6] Xia W., King, R., 2002, “Determinants of organizational IT infrastructure capabilities”, MIS Research Center Working Papers, http://misrc.umn.edu/workingpapers/fullPapers/2002/0210_030102.pdf. (Downloaded: April 2008.)
- [7] Chan Y., Huff S., 1993, “Strategic Information Systems Alignment”, Business Quarterly, 58(1), 51-56.
- [8] Fostering the competitiveness of Europe’s ICT industry. EU ICT task force report. Brussels, November 27, 2006, http://ec.europa.eu/enterprise/ict/policy/doc/icttf_report.pdf. (Downloaded: December.2007)
- [9] Luftman J., 2000, “Assessing Business-IT Alignment Maturity”, Communication of AIS, Volume 4, Article14.
- [10] Papp R., 2001, “Strategic Information Technology: Opportunities for Competitive Advantage”, Idea Group Publishing.
- [11] Luftman J., and McLean E., “Key Issues for IT Executives”, MIS Quarterly Executive, Vol. 3 No. 2, June 2004.

- [12] Weiss J., and Thorogood A., “A Diagnostic for Exploring IT Alignment as a Strategic Weapon”, Proceedings of the 39th Hawaii International Conference on System Sciences, 2006.
- [13] Dailey P., Trends L., “The Consultancy Approach to aligning Business and IT”, IT Pro Magazine, Issue May-June 2001.
- [14] Boar B., “The Art of Strategic Planning for Information Technology”, John Wiley & Sons Inc., 1993.
- [15] Bolles Gary A., “This old infrastructure: Enterprise Architecture”, CIO Insight web-page published January 1st 2004.
- [16] Borja V., et al, “Product Re-Engineering Process Using an Enterprise Modelling Architecture, International Journal of Agile Management Systems”, 2/3, 2000.
- [17] Boster M., et al, “Getting the Most from Your Enterprise Architecture”, IEEE IT Pro Magazine. July/Aug, 2000.
- [18] Board B., “A Blueprint for Solving Problems in Your IT Architecture, IT Pro”, Nov/Dec, 1999.
- [19] Papp R., Motiwalla L., “A knowledge Based System For Measuring Business-IT Alignment”, http://aisel.isworld.org/article_by_author.asp?Author_ID=410 . (Accessed: December 2007).
- [20] Luftman J., Competing in the Information Age: Practical Application of the Strategic Alignment Model, New York, Oxford University Press, 1996.
- [21] Hsaio R., Ormerod R., “A New Perspective on the Dynamics of IT-Enabled Strategic Change”, Information System Journal 8(1), 21-52, 1998.
- [22] Burn M., A Professional Balancing Act: Walking the Tightrope of Strategic Alignment, in the book Steps to the future – fresh thinking on the management of IT – based organizational transformation, The Jossey – Bass business & management series, 1997, ISBN 0-7879-0358-2.
- [23] Henderson C and Venkatraman N., “Strategic alignment: Leveraging information technology for transforming organizations,” IBM System Journal, Vol. 32, No. 1, 1993.
- [24] Luftman J., Competing in the Information Age – Align in the Sand, Oxford Press, 2003.

- [25] Papp R., (1995), Determinants of Strategically Aligned Organizations: A Multi-industry, Multi-perspective Analysis, PhD Thesis, Hoboken, NJ, Stevens Institute of Technology.
- [26] Kearns, G.S. and Lederer, Resource-Based View for Strategic IT Alignment: How knowledge Sharing Creates Competitive Advantage. Decision Sciences, 2003.
- [27] Reich H., and Benbasat I., Factors that influence the social dimension of alignment between business and information technology objectives. MIS Quarterly, 2000. 24(1): p.81.
- [28] Maes R., Dirksen V., & Truijens O., “A critical evaluation of the strategic alignment concept”, Universiteit van Amsterdam, PrimaVera Working Paper, to appear (2000), Program for Research in Information Management (<http://primavera.fee.uva.nl>). (Accessed: December 2007)
- [29] Torsten Cegrell, Asa Lindström, Markus Grandell, “The top IT concerns for chief information officers in the European electric power industry” CIGRE Symposium, November 2006.
- [30] <http://www.cio.co.uk/concern/>. (Downloaded: December 2007).
- [31] Society for Information Management, SIM. IT/Business Alignment and Keeping It Real. July/2007. <http://www.simnet.org>. (Downloaded: December 2007)
- [32] Ekstedt M., Johnson N., Plazaola L., Silva E., Vargas N., “An Organization-wide Approach for Assessing Strategic Business and IT Alignment”, Proceedings of the Portland International Conference on Management of Technology (PICMET2005), Dept. of Engineering and Technology Management, Portland State University. Oregon, USA. July 2005.
- [33] The pre-ICIS 2007 SIM Academic Workshop, December 8, 2007, in Montreal. Annual survey of SIM members indicates that IT-business alignment remains among the top concerns of CIOs today. Program Co-Chairs: Ritu Agarwal (University of Maryland) & V. Sambamurthy (Michigan State University) (Society for Information Management web page).
- [34] Plazaola L., Flores J., Silva E., Vargas N., Ekstedt M. “An Approach to Associate Strategic business – IT alignment Assessment to Enterprise Architecture”, Proceedings of the Fifth Conference on Systems Engineering 2007 (CSER2007), Stevens Institute of Technology. New Jersey, USA. March 2007.
- [35] Weis, JW., Thorogood A., and Anderson Jr., “Three IT-Business Alignment profiles: Technical Resources, Business Enabler and Strategic Weapon”, in Bentley College Research Papers, 2005.

- [36] Plazaola L., Flores J., Vargas N., Ekstedt M., “Strategic Business and IT Alignment Assessment: A Case Study Applying an Enterprise Architectural-based Metamodel”, Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS41), IEEE Computer Society, January 2008.
- [37] Inmon, W. H., Zachamn, J.A., and Geiger J.G., Data Stores, Data Warehousing, and the Zachman Framework. MacGraw-Hill, 1997.
- [38] Niederman, F., Brancheau, J.C. and Wetherbe, J.C., “Information Systems Management Issues for the 1990s”. MIS Quartely, Volume 4, Number 4, December 1991.
- [39] Young, Collen, “The Unexpected Case for Enterprise IT Architecture”, Gartner Group Strategy, Trends and Tactics. January 2001
- [40] Johnson P., Ekstedt M., Silva E., Plazaola L., “Using Enterprise Architecture for CIO decision making: On the importance of theor”, Proceedings of the second Conference on Systems Engineering 2004 (CSER2007), Stevens Institute of Technology. New Jersey, USA. April 2004
- [41] Perks C., Beveridge T., “Guide to Enterprise IT Architecture”, Springer Verlag, 2003.
- [42] Ekstedt M., Johnson P., Lindström Å., Gammelgård M., Johansson E., Plazaola L., Silva E., Lilieskökl J., “Consistent Enterprise Software System Architecture for the CIO - A Utility-Cost Based Approach,” Proceeding of the 37th Annual Hawaii International Conference on System Sciences (HICSS37), IEEE Computer Society, January 2004.
- [43] Luftman J., Competing in the Information Age, Align in the Sand; Oxford University Press; ISBN 0-19-515953-5.
- [44] Lindström Å., Using Architectural Principles to Make the IT-Strategy Come True - Focusing on the Electric Power Industry, PhD Thesis, ISSN 1653-5146, TRITA-EE-2006-39, Royal Institute of Technology, KTH, 2006.
- [45] Luftman J., “Measure Your Business-IT Alignment”, Optimize: Business execution for CIOs Magazine. Issue 26, December 2003.
- [46] Keen G., Shaping the Future, Harvard Business School Press, Boston, MA (1991).
- [47] Konsynski B and McFarlan W., “Information Partnerships-Shared Data, Shared Scale”, Harvard Business Review 68, No. 5, 114-120 (September-October 1990).

- [48] Morton S., *The Corporation of the 1990s* Oxford University Press, Oxford (1991).
- [49] Venkatraman N., “Information Technology-Induced Business Reconfiguration: The New Strategic Management Challenge”, *The Corporation of the 1990s*, M. S. Scott Morton, Editor, Oxford University Press, Oxford (1991).
- [50] Ciborra U. and Lanzara F., (1994). “Formative contexts and information technology” *Accounting, Management and Information Technology*, 4, 2 December: 61 – 86.
- [51] McLean E., and Soden J., (1977). *Strategic planning for MIS*. New York: John Wiley and Sons.
- [52] Mills P., (1986) *Managing Service Industries*, New York: Ballinger.
- [53] Parker M. and Benson R., with H. E. Trainor, *Information Economic: Linking Business Performance to Information Technology*, Prentice-Hall, Inc., Englewood Cliffs, NJ (1988).
- [54] Brancheau J., and Wetherbe J., (1987) “Issues In Information Systems Management”, *MIS Quarterly*, (11), 1, pp. 23-45.
- [55] Dixon P., and John D., (1989) “Technology Issues Facing Corporate Management in the 1990”, *MIS Quarterly* (13), 3, pp. 247-55.
- [56] Niederman F., Brancheau J., and Wetherbe J., (1991), “Information Systems Management Issues For the 1991s”, *MIS Quarterly*, (15), 4, 475-95.
- [57] Earl J., (1983), *Corporate Information Systems Management*. Homewood. III: Richard D. Irwin, Inc.
- [58] Latour., *Social theory and the study of the computerized work sites*, in Orlikowski W., Walshman G., Jones M and DeGroos J(eds), *Information Technology and Changes in Organizational Work*, Chapman and Hall, London. P 295-306. 1996.
- [59] Roach S., “Services under Siege-The Restructuring Imperative”, *Harvard Business Review* 69, No. 5, 82-91 (September-October 1991).
- [60] Gunn R., “It’s Time to Fire Dilbert: Towards Dynamic Strategic Alignment”, 1997, <http://www.strategicfutures.com/articles/dilbert/dilbert.htm>. (Downloaded and accessed: December 2007)
- [61] Lenderer A and Mendelow A., “Issues in Information Systems Planning”, *Information and Management*, march 1986.

- [62] Venkatraman N., “The Concept of Fit in Strategy Research: Toward Verbal and Statistical Correspondence”, *Academy of Management Review*, vol. 14, no.3, 1989.
- [63] Reich H. and Benbasat I., “Development of measures to investigate the linkage between business and information technology objectives”, Working Paper 93-MIS-011, 1993.
- [64] Woolfe R., “The Path to Strategic Alignment”, *Information Strategy: The Executive’s Journal*, winter 1993.
- [65] Broadbent M and Weill P., “Improving Business and Information Strategy Alignment: Learning from the Banking Industry”, *IBM Systems Journal* vol. 32, no. 1, 1993.
- [66] Barclay W., Chan Y., Copeland, D.G. and Huff, S.L., “Business Strategic Orientation, Information Systems Strategic Orientation, and Strategic Alignment”, *Information Systems Research*, vol. 8, no. 2, 1997.
- [67] Henderson J., Rockart J., and Sifonis J., “Integrating Management Support Systems into Strategic Information Systems Planning”, *Journal of Management Information Systems* 4, No. 1, 5-23 (1987).
- [68] King W., “Strategic Planning for Management Information Systems”, *MIS Quarterly* 2, No. 1, 27-37 (1978).
- [69] Coakley R., Fiegenger K and White M., “Assessing Strategic IT Alignment in A Transforming organization”, *Proceeding of the Association for Information Systems*, Phoenix Arizona, 1996.
- [70] Hax A and Majluf N., *The Strategy Concept and Process: A Pragmatic Approach*, Prentice-Hall, Inc., Englewood Cliffs, NJ (1991).
- [71] Pyburn J., “Linking the MIS Plan with Corporate Strategy: An Exploratory Study”, *MIS Quarterly* 7, No. 2, 1-14 (1983).
- [72] Ciborra U., Hanseth O., “Towards a contingency view of infrastructure and knowledge”, *Proceeding from 19th Annual International conference on Information System (ICIS)*, Helsinki, Finland, December 13-16, 1998.”
- [73] Ciborra U (ed.), (1996a), *Groupware & Teamwork*. Chichester: John Wiley.
- [74] Ciborra U., (1996b), “The platform organization: Recombining strategies, structures and surprises:”, *Organization Science*, 7, 2, March-April: 103-118.

- [75] Ciborra U., (1996c), *Teams, Markets and Systems*, (2nd edition). Cambridge: Cambridge University Press.
- [76] Weill P., “O’Brien and Neo, B.S., (1996). Firm Context and patterns of IT infrastructure capability”, *ICIS Conference Proceeding*, Cleveland, Ohio: 174-191.
- [77] Maes, R., “Reconsidering Information Management Thought: A Generic Framework. Scientific report at the University van Amsterdam”, Department of Accountancy and Information Systems. The Netherlands, September 1999.
- [78] Luftman J., “Assessing Business-IT Alignment Maturity”, Stevens Institute of Technology, USA, 2001.
- [79] Luftman J., Lewis R., Oldach H., “Transforming the enterprise: The alignment of business and information technology strategies”, *IBM Systems Journal*, Vol. 32 No. 1, 1993.
- [80] Luftman J, Lewis P., and Oldach H., “Transforming the Enterprise: The Alignment of Business and Information Technology Strategies”, *IBM Systems Journal* 32, No.1, 198-221 (1993, this issue).
- [81] Luftman J., Papp R., Brier T., “Enablers and Inhibitors of Business-IT Alignment”, *Communications of the Association for Information Systems*, Volume 1, Article 11, (1999).
- [82] Weill P & Ross J., 2004, *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*, Harvard Business School Press, Boston.
- [83] www.itgi.org. (Accessed: April 2008).
- [84] IT Governance Institute 2003, “Board Briefing on IT Governance, 2nd Edition”, Retrieved January 18, 2006 from http://www.isaca.org/Content/ContentGroups/ITG13/Resources1/Board_Briefing_on_IT_Governance/26904_Board_Briefing_final.pdf. (Downloaded: April 2008).
- [85] Maizlish, B., Handler, R., “IT portfolio management step by step—Unlocking the business value of technology”, John Wiley & Sons (2005).
- [86] IT Governance Institute: Board briefing on IT governance. Available online at www.itgi.org (2000). (Accessed: December 2007).
- [87] Van Grembergen, W., “Introduction to the mini track IT governance and its mechanisms”, *Proceedings of the 35th Hawaii International Conference on System Sciences*. IEEE (2002).

- [88] IT Governance Institute: Cobit Management Guideline, 3rd Edition. Available online at www.isaca.org (2000). (Downloaded: December 2007).
- [89] IT Governance Institute: COBIT, 4th Edition, December 2005. Available online at <http://www.isaca.org>. (Downloaded: April 2008).
- [90] Luftman, J., *Competing in the Information age – Strategic Alignment in Practice*. Oxford University Press (1996).
- [91] Webb, P., Pollard, C., Ridley, G., “Attempting to define IT Governance: Wisdom or Folly”, *Proceedings of the 39th Hawaii International Conference on System Sciences* (2006)
- [92] Simonsson, M., Johnson, P., “Defining IT Governance – A Consolidation of Literature”, *Working Paper of the Department of Industrial Information and Control Systems, Royal Institute of Technology, KTH, Stockholm, Sweden*. Available online at www.ics.kth.se (2005). (Accessed: December 2007).
- [93] www.ogc.gov.uk/guidance_itil_4899.asp. (Accessed: December 2007)
- [94] Warland, C., Ridley, G., “Awareness of IT control framework in an Australian state government: A qualitative case study”, *Proceedings of the 38th Hawaii International Conference on System Sciences* (2005).
- [95] Calder, A., Watkins, S., “IT Governance – Manager’s Guide to Data Security BS 7799/ISO 17799”, Kogan Page Ltd (2003).
- [96] Von Solms, B., Von Solms, R., “The 10 Deadly Sins of Information Security Management”, *Computer & Security*, vol. 23, Elsevier Science (2004).
- [97] www.ogc.gov.uk/productsandservices.asp. (Accessed: April 2008)
- [98] Office of Government Commerce: *IT Infrastructure Library Service Support*. The Stationery Office (2002).
- [99] Office of Government Commerce: *IT Infrastructure Library Service Delivery*. The Stationery Office (2002).
- [100] Winter, R. and Fischer, R. *Essential Layers*, “Artifacts and Dependencies of Enterprise Architecture”, *EDOC workshop on trends in Enterprise Architecture Research (TEAR 2006)*, October 17, 2006, Hong Kong.
- [101] Armor F., Kaisler S and Liu S., *Building an Enterprise Architecture Step By Step*, part 2, *IEEE IT Pro Magazine* July-August 1999, ISSN 1520-9202/99.

- [102] The Open Group, “The Open Group Architectural Framework Version 8”, The Open Group, 2002. www.opengroup.org/togaf. (Downloaded and accessed: December 2007).
- [103] Zachman J., “A Framework for Information Systems Architecture”, IBM Systems Journal, Vol. 26, No3, 1987.
- [104] Armour F., Kaisler H., Liu Y., “A Big Picture Look at Enterprise Architecture”, IEEE IT Professional Vol. 1, No. 1, 1999.
- [105] Armour F., Kaisler H., “Building an Enterprise Architecture Step by Step”, IEEE IT Professional, Vol. 1, No. 4, 1999.
- [106] Broadbent M., Kitzis E., The New CIO Leader – Setting the Agenda and Delivering the Results, Harvard Business School Press, 2005.
- [107] Clinger-Cohen Act of 1996 (formerly known as the Information Management Reform Act), Division E National Defense Authorization Act for FY, February 10, 1996, published in Cummins F., Enterprise Integration, OMG Press, 2002.
- [108] Earl M., “Experiences in Strategic Information Systems Planning”, MIS Quarterly, Vol. 17, No. 1, 1993.
- [109] Irani Z., Themistocleous M., Love P., “The Impact of Enterprise Application Integration on Information System Lifecycles”, Information and Management 41 (2003) 177-187, 2003.
- [110] Jacobson I., Booch G., Rumbaugh J., “The Unified Software Development Process”, Addison-Wesley, 1999.
- [111] Johansson E., Assessment of Enterprise Information Security – How to Make it Credible and Efficient, PhD Thesis ISSN 1104-3505, TRITA-ICS-0502, Royal Institute of Technology, KTH, 2005.
- [112] Ross W., “Creating a Strategic IT Architecture Competency: Learning in Stages”, MISQ Executive Vol. 2, No.1, 2003.
- [113] Spewack S., Enterprise Architecture Planning: Developing a Blueprint for Data, Applications and Technology, John Wiley & Sons, 1992 ISBN 0471 599859
- [114] Department of Defense Architecture Framework Working Group, DoD Architecture Framework, DoDAF, version 1.0, Department of Defense, 2003.
- [115] OMB –U.S. office of Management and Budget. FEA Consolidated Reference Model Document, version 2.1, 2006. www.whitehouse.gov/omb/egpv/a-2-EAFIF.html. (Downloaded: December 2007)

- [116] ISO/IEC, ISO/IEC 10746-1, Information technology – Open Distributed Processing – Reference Model: Overview, 1998.
- [117] CIMOSA Association, <http://cimosa.cnt.pl/>, 1999. (Accessed March 2007).
- [118] Bernus P., Nemes L., and Schmidt G., Eds., “Handbook on Enterprise Architecture”, Springer Verlag, 2003.
- [119] Popkin., “Building an Enterprise Architecture: The Popkin Process”, Popkin Software, 1999.

- [120] Plazaola L., Silva E., Vargas N., Flores J., Ekstedt M., “A Metamodel for Strategic Business and IT Alignment Assessment”, Proceedings of the Fourth Conference on Systems Engineering 2006 (CSER2006), University of Southern California, USC, California, USA. April 2006.
- [121] Lankhorst M., Enterprise Architecture At Work: Modeling Communications and Analysis, Springer, 2005, page 24-25.
- [122] Johnson E., Ekstedt M., “Using Enterprise Architecture for CIO Decision-Making: on the Importance of Theory”, Proceedings of the Conference on Systems Engineering Research, Los Angeles, USA, 2004.
- [123] Johansson E., Ekstedt M., Johnson P., "Assessment of Enterprise Information Security - The Importance of Information Search Cost", Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06) Track 9, 2006.
- [124] Software Engineering Standards Committee of the IEEE Computer Society, “IEEE Recommended Practice for Architecture Description of Software-Intensive Systems”, developed by the IEEE Architecture Working Group (AWG), 2000.
- [125] www.iso.org. (Accessed: April 2008)
- [126] www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=45991. (Downloaded: April 2008)
- [127] O'Rourke C., Fishman N., Selkow W., “Enterprise Architecture Using the Zachman Framework”, ISBN 0-619-06446-3, 2003 by Thomson Learning, Inc.
- [128] Sowa J., Zachman J., “Extending and Formalizing the Framework for Information Systems Architecture”, IBM Systems Journal, Volume 31, No 3, 1992.

- [129] <http://www.zifa.com/>. (Accessed: April 2008)
- [130] Interview with John Zachman, by Roger Sessions, Editor in Chief, Perspectives of the International Association of Software Architects, www.iasahome.org April 2007. (Accessed: December 2007)
- [131] Johsson N and Simonsson M., “A Bridge Between Practice and Research: Which Governance Vehicle Suits Best the Purpose?”, Royal Institute of Technology, Stockholm, Sweden, proceedings of the 2nd European Conference on IS Management, Leadership and Governance Ministry of Research, Paris, France, 12-13 July 2006.
- [132] Silva E., Plazaola L., Flores J., Vargas N., “How to Identify and Measure the Level of Alignment between IT and Business Governance”, Royal Institute of Technology (KTH) and National University of Engineering (UNI)
- [133] Edman H., Assessing the Strategic Business and IT Alignment – Using an Organization-Wide Approach at DGA in Nicaragua. Royal Institute of Technology (KTH), Master thesis XR-EE-ICS 2005:001. May 2005.
- [134] Matsåker C., Assessing Strategic Business and IT Alignment Using an organization – wide approach at Vattenfall Service Syd: Royal Institute of Technology (KTH), Master thesis XR-EE-ICS 2005:002, May 2005.
- [135] www.lplazaola.uni.edu.ni/luftman_app.html
- [136] www.lplazaola.uni.edu.ni/luftman_td.html
- [137] www.lplazaola.uni.edu.ni/AMAM.html
- [138] Johnson P., “Lagerström R., Närman P., Simonsson M. System Quality Analysis with Extended Influence Diagrams”, Journal of Software. Vol 2, No. 3, September 2007.
- [139] <http://scholar.google.com> (Accessed: April 2008)
- [140] <http://citeseer.ist.psu.edu> (Accessed: April 2008)
- [141] Yin R., Case Study Research – Design and Methods, Sage publications, 2002.
- [142] Maes R., Rijsenbrij D., Trujiens O. Goedvolk, H. (2000)., ”Redefining Business - IT Alignment through a Unified Framework”, Landelijk Architectuur Congres, Amsterdam. Published at <http://www.architecture-forum.org/>. (Accessed: December 2007).

- [143] IBM (1981). Business Systems Planning, Planning Guide, GE20-0527, White Plains, NY: IBM Corporation.
- [144] Luftman J & Brier T., “Achieving and Sustaining Business-IT Alignment”, California Management Review, Third Quarter 1999.
- [145] Johnson P., Ekstedt M., Enterprise Architecture: Models and Analyses for Information Systems Decision Making, Studentlitteratur, 2007.
- [146] Love P., Irani Z., Standing C., Lin C., Burn J.M., “The Enigma of Evolution: Benefits Costs and Risks of IT in Australian Small-Medium-Sized Enterprises”, Information and Management, 2004.
- [147] Armour, F., Kaisler S., “Enterprise Architecture: Agile Transition and Implementation”, IEEE IT Professional Vol. 3, No. 6, 2001.
- [148] López A., Aguirre N., Evaluación del Alineamiento estratégico de la organización y las Tecnologías de Información, Universidad Nacional de Ingeniería (UNI). Thesis required for professional title of Computer Engineer, January, Enero 2008.
- [149] European Commission (2003-05-06), Recommendation 2003/361/EC: SME Definition,
http://ec.europa.eu/enterprise/enterprise_policy/sme_definition/index_en.htm.
(Downloaded and accessed: December 2007)

PUBLISHED PAPERS NOT INCLUDED IN THE THESIS

Paper I: Ekstedt M., Johnson P., Lindström Å., Gammelgård M., Johansson E., Plazaola L., Silva E., Liliesköld J., “Consistent Enterprise Software System Architecture for the CIO - A Utility-Cost Based Approach.” *Proceedings of the 37th Annual Hawaii International Conference on System Sciences (HICSS37)*, IEEE Computer Society, January 2004.

Paper II: Enrique Silva, Leonel Plazaola, Johnny Flores, Norman Vargas, “How to Identify and Measure the Level of Alignment between IT and Business Governance”. *Proceedings of The 2nd European Conference on IS Management, Leadership and Governance (ECMLG2006)*, Paris, France. July 2006.

Paper III: Johnson P., Ekstedt M., Silva E., Plazaola L., “Using Enterprise Architecture for CIO decision making: On the importance of theory”. *Proceedings of the second Conference on Systems Engineering 2004 (CSER2007)*, Stevens Institute of Technology. New Jersey, USA. April 2004.

Paper IV: Norman Vargas, Leonel Plazaola, Johnny Flores, Constructing a General Framework Definition of the Business and IT alignment Concern through selected papers, “Metamodel for Strategic Business and IT Alignment Assessment”. *Proceedings of the Fifth Conference on Systems Engineering 2007 (CSER2007)*, Stevens Institute of Technology. New Jersey, USA. March 2007.

Paper V: Norman Vargas, Leonel Plazaola, Mathias Ekstedt, “A consolidated strategic business and IT alignment representations: A framework aggregated from literature”. *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS41)*, IEEE Computer Society, January 2008

