STRATEGIC BUSINESS AND IT ALIGNMENT
ADDRESSING ASSESSMENT AND GOVERNANCE

Enrique Javier Silva Molina

May 2010

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
ABSTRACT

Strategic business and IT alignment assessment is growing in importance. Different assessment methods have been used to try to pursue the complexity of this dynamic and evolutionary alignment. Despite the fact that alignment is a real problem and a challenge of utmost importance, no consensus can be found on what alignment really is, how it should be measured in the organization in practice, or what measures should be taken to maintain and improve it. Consequently, the key question about how to assess and accomplish (define, identify, measure, maintain and improve) the strategic business and IT alignment is still a great unanswered challenge for many enterprises.

In this thesis work, three main research questions were formulated: how can the validity and reliability of an alignment assessment method be improved, what are the dominant topics in the area of alignment, and how to facilitate the analysis of the business and IT governance alignment based on business process simulation and balanced scorecard methods.

This is a composite thesis work that includes an introduction and six papers (paper A-F). The main contributions and results of this thesis are described in published and included technical papers. In papers A and B an alternative organization-wide approach and metamodel for assessing strategic business and IT alignment are proposed. Two case studies were performed applying the proposed approach. In paper C, a prioritized diagram of the most widely accepted strategic alignment model, with the purpose of categorizing the most important topics in the research area of strategic business and IT alignment is presented. One of the relevant topics that were identified is governance. In papers D, E and F, there are presented a business process simulation approach and a balanced scorecard method in order to facilitate the assessment of the business and IT governance alignment. An illustrative example of the simulation approach is presented in an appendix of this thesis.

This research work aims to improve the decision-making process for business and IT managers at different levels in an enterprise by means of increasing the level of understanding and knowledge as well as by enhancing existing models and methods, for evaluating strategic business and IT alignment.

Key words: Enterprise Architecture, Strategic Business and IT Alignment, IT Governance, Business Governance, Business Process Simulation, Balanced Scorecards, IT Services, ITIL, COBIT.
These research studies are part of an ongoing Enterprise Architecture Research Program (EARP) at the Royal Institute of Technology (KTH) in Stockholm, Sweden. The overall goal of the research program is to provide the business and IT manager’s functions with architecture-based tools and planning and decision-making methods for enterprise-wide information systems. The purpose of the overall research project is to develop a method for assessing the level of Strategic Business and IT alignment (SBITA) in the frame of Enterprise Architecture.

The research work and professional experience accumulated during the last nine years is presented in this thesis. My research work started with the research focus on IT Investment Evaluation by using a Business Process Simulation Approach and is ending with one of the top CIO concerns, which is SBITA.

The presented thesis is a composite one. Therefore, the reader can find in the last chapter the complete text of six published papers included in the thesis, and a list of other publications that are not included.

The included papers can be grouped into three types. Papers A and B present the big picture of SBITA and propose an organization-wide approach and metamodel for assessing it. Paper C presents a prioritized development of the most widely accepted strategic alignment model for the purpose of categorizing the most important topics and trends in the research area. Papers D, E and F present the governance alignment perspective as one of the most relevant SBITA concern, proposing different models and methods for evaluating business and IT processes alignment measures, i.e., balanced scorecard and business process simulation.

The details of the three presented contributions are contained in papers A, B, C, D, E and F, which are included in this thesis. In paper A the authors are listed in alphabetical order and the main specific contribution of the author of this thesis consisted on building the conceptual part of the assessment method and to conduct one of the case studies, including the results analysis and conclusions of that. In paper B, the author of this thesis is the second in the list of authors and his main contribution was related to the building process of the metamodel. In papers, C, D, E and F the author of this thesis, heading the list of authors, was the main contributor of the proposed methods and models.
ACKNOWLEDGEMENTS

I would like to express my gratitude to various people and organizations for their support
and contributions to this research thesis work.

Now that I have reached this top-level stage in my academic career, I would like to say
thank you and muchas gracias to my supervisor, Professor Torsten Cegrell, for his encourag-
ment and to my friends Dr. Leonel, Dr. Johnsson, Dr. Ekstedt and Dr. Andersson for their
contributions to my understanding and valuable advice over many years. I am indebted to
many colleagues at the Department of Industrial Information and Control Systems, KTH,
for their valuable suggestions and discussions. I especially thank Mrs. Judy Westerlund for
her ongoing support and kindness.

There is no way to really recognize the valuable support and contribution received from the
all members of my big and lovely family: Cristina, Adri, Gabi, Javi, Robertin, Socorro,
Roberto and Alfonso. My infinite gratitude to my wife and parents.

Furthermore, I would like to thank all the people and organizations, especially those from
the Swedish International Development Agency and the Universidad Nacional de Inge-
niería (UNI), who contributed in different ways to the success of this thesis work.

I would like to express my great appreciation to the people of Sweden for their valuable
cooperation with Nicaragua.

Stockholm, May 2010

Enrique Javier Silva Molina
LIST OF INCLUDED PAPERS


### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>I</td>
</tr>
<tr>
<td>PREFACE</td>
<td>II</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>III</td>
</tr>
<tr>
<td>LIST OF INCLUDED PAPERS</td>
<td>IV</td>
</tr>
<tr>
<td>INTRODUCTION AND SUMMARY</td>
<td>1</td>
</tr>
<tr>
<td>BACKGROUND</td>
<td>1</td>
</tr>
<tr>
<td>RESEARCH PURPOSE</td>
<td>3</td>
</tr>
<tr>
<td>RELATED WORKS</td>
<td>3</td>
</tr>
<tr>
<td>RESULTS</td>
<td>9</td>
</tr>
<tr>
<td>CONTRIBUTIONS</td>
<td>18</td>
</tr>
<tr>
<td>RESEARCH DESIGN</td>
<td>19</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>21</td>
</tr>
<tr>
<td>PAPER A</td>
<td>33</td>
</tr>
<tr>
<td>PAPER B</td>
<td>53</td>
</tr>
<tr>
<td>PAPER C</td>
<td>67</td>
</tr>
<tr>
<td>PAPER D</td>
<td>85</td>
</tr>
<tr>
<td>PAPER E</td>
<td>101</td>
</tr>
<tr>
<td>PAPER F</td>
<td>117</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>137</td>
</tr>
<tr>
<td>GLOSSARY</td>
<td>156</td>
</tr>
</tbody>
</table>
INTRODUCTION AND SUMMARY

This thesis consists of two main chapters. The first presents a general introduction and summary of the research work and contains six sections in the following order: background, research purpose, related works, results, contributions and research design. The second presents the entire text of the published technical papers (from paper A to paper F). All published papers included in this thesis constitute the main research contributions of the author in the field of strategic business and IT alignment.

BACKGROUND

With the rapid and continuous evolution of both business operation models and information technology (IT) it is important to anticipate movements and trends in business strategies and understand how IT strategy drives or reacts to these. But an organization is a complex mechanism, with many levels of communication, which makes it difficult to identify investment priorities or to align business and IT strategies. In this case, the decision-making process can be a long and complex one, accompanied by biased discussion and misinterpretations, often leading to incorrect or untimely decisions.

It has long been argued by academics and practitioners that the contribution of IT deployment to business performance is based on the strategic business and IT alignment (hereafter in this thesis shortened to alignment). The strategic benefit of deploying IT to support business is moreover seen as the basis for sustainable competitive advantage, and it has been reported to be positively associated with business performance indicators such as market growth, financial performance and product-service innovation.

Organizations that have been able to successfully align business and IT have created significant business returns and quality improvement [119]. Business and IT managers who have aligned business with IT strategies argue that the integration was crucial to the firm’s survival and its success. IT organizations have added value to a firm’s effectiveness by acting as change agents, focusing on business imperatives and helping to achieve effectiveness and efficiency, reducing costs, creating barriers to entry, improving customer and buyer/supplier relationships and creating new products and business solutions.

Alignment seems to grow in importance as companies strive to link technology and business in light of dynamic business strategies and continuously evolving technologies. Importance aside, what is not clear is how to achieve and sustain this harmony relating business and IT, how to measure the level of alignment, and what the impact of misalignment might be on the enterprise [68], [70], [86], [87]. The ability to achieve and sustain this synergistic relationship is anything but easy. Alignment addresses both: doing the right things (effectiveness) and doing things right (efficiency).
Ciborra [22] portrays complexity of alignment as being like building a bridge between two constantly moving shores, technology on the one side and business on the other. An effort has been made to pursue the complexity of this dynamic and evolutionary alignment through assessments. Measuring the “as-is” alignment situation can serve as input for an informed decision-making process for a desired “to-be” scenario in terms of identifying and pinpointing problems and opportunities that need to be addressed to improve the alignment.

Many different models and methods for assessing the strategic business and IT alignment have been proposed in the academic and practitioner literature, i.e., business strategy vs. IT strategy, organizational infrastructure vs. IT infrastructure, IT governance, alignment mechanisms, etc. Some of the studies and methods focus on business process redesign and reengineering, process model and simulation, IT service delivery, cost-benefit analysis, strategic planning, maturity models, etc. However, there is no generally accepted theory, model or framework for assessing the strategic business and IT alignment. Consequently, the key question about how to assess and accomplish (define, identify, measure, maintain and improve) the strategic business and IT alignment is still a great unanswered challenge for many enterprises.

As a particular case of strategic business and IT alignment, academics and practitioners have become increasingly interested in one of the main criteria of the alignment, which is the business and IT governance alignment because it is proving relevant to achieving the organization’s goals. It is integral to the success of business governance because it assures efficient and effective measurable improvements in related business processes.

Taking into consideration the above, it is not surprising that Luftman [68], along with many other authors, reports that alignment has been at or near to the most prominent concern of business executives in studies conducted by academics, consultants and research firms. Accordingly, alignment is also a recurrent theme in the information systems and information technology literature [6], [7], [8], [11], [15], [16], [18], [20], [21], [22], [24], [25], [26], [28], [37], [40], [41], [42], [43], [50], [54], [55], [57], [58], [59], [63], [67], [68], [69], [70], [71], [72], [73], [74], [75], [76], [78], [80], [86], [87], [88], [90], [91], [92], [95], [96], [97], [98], [99], [104], [106], [107], [108], [119], [120], [121], [122], [123], [124], [130], [131], [132], [133], [134], [140], [141].

According to Luftman [75] achieving alignment is evolutionary and dynamic. IT requires strong support from senior management, good working relationships, strong leadership, appropriate prioritization, trust and effective communication, good IT governance in order to set IT priorities and allocate IT resources, as well as a thorough understanding of the business and technical environments. For effective assessment of business and IT alignment, the author of this thesis considers that enterprises need to assess how well they are currently performing and be able to identify where and how improvements can be made by using a business process simulation approach.
One of the major sources of error in alignment studies is poor quality of the measurements [124]. Therefore, any proposal for operationalizing the alignment assessment requires attention to core concepts of research methodology, namely validity and reliability. The concepts of reliability and validity are strongly relevant in order to characterize the measurement procedure of the alignment. In this thesis, these concepts are defined as follows: Reliability is the degree to which a measurement procedure produces similar outcomes when it is repeated. Reliability is about consistency; it is the expectation that there won’t be different findings each time the measures are used, assuming that nothing has changed in what is being measured. This illustrates that the more ways we ask something, the more the potential for reliability increases. Validity is the test for determining whether a measure is actually measuring the concept the researcher thinks is being measured. Construct validity is based on actual results; sometimes it is not achieved until after the data have been collected and analyzed. Then this information is available for the next time someone proposes research on this topic [94]. Achieving reliability and validity is part of the process of operationalizing the business and IT alignment in this research work.

**RESEARCH PURPOSE**

The research presented in this thesis has two main purposes: firstly, to increase the level of understanding and knowledge of strategic business and IT alignment and secondly, to enhance existing models and methods for evaluating strategic business and IT alignment. Both purposes aim to improve the decision-making process for business and IT managers at different levels in an enterprise.

The following specific research questions were formulated:

**Q1:** How can the validity and reliability of an alignment assessment method be improved?

**Q2:** What are the dominant topics in the area of alignment?

A more specific third research question, with a narrowed scope, was formulated along the way as follows:

**Q3:** How can the assessment of the business and IT governance alignment be facilitated?

**RELATED WORKS**

Several disciplines, models and methods are related to the research work presented in this thesis. This section presents a brief description of the most relevant ones.

**Strategic Business and IT Alignment:** Business and IT alignment as a construct concerns the degree of congruence or harmony of the IT strategy and infrastructure of an organization with its strategic business objectives and infrastructure. Several definitions supporting this characterization of alignment are available in the literature. Alignment is a concept aiming at the effective exploitation of IT in an organization, which implies both
strategic positioning and operational implementation. Alignment refers to the arrangement of things in relation to one another. From a management perspective, the goal is to maximize the delivery of value from IT to the enterprise [2], [10], [12], [14], [17], [19], [36], [60], [61], [62], [68], [69], [70], [71], [72], [73], [74], [75], [76], [78], [80], [86], [87], [88], [126], [127], [130], [131], [132], [133], [134], [138], [140], [141].

Research in the alignment field is typically positioned as the interaction among the components of business strategy, organization structure, information system strategy and information system structure and processes. Many of the studies conducted to date have relied, either directly or indirectly, on Henderson and Venkatramann’s strategic alignment model (SAM). The SAM describes alignment along two dimensions. The dimension of strategic fit differentiates external focus, directed towards the business environment, from internal focus; directed towards administrative structures. The other dimension of functional integration separates the business and the IT. Altogether, the model defines four domains that must be harmonized to achieve alignment [37], [40], [41], [42], [43]. See figure 1.

Figure 1: Henderson and Venkatramann’s Strategic Alignment Model (SAM).

Although Henderson and Venkatramann’s model views alignment as an interaction among the four essential components, the majority of research undertaken to date has evaluated binary relationships between just two of the components, rather than taking a holistic view of the interaction among all four factors. Henderson and Venkatramann conceived the strategic alignment model as a dynamic one. For example, they conclude by stating: "We believe that the challenge of organizational transformation is best conceptualized as a dynamic strategic alignment process." Further support for the fact that alignment is a dynamic process is also provided by a broader set of information system authors such as Ciborra [22]. Although numerous authors following Henderson and Venkatramann also acknowledge that alignment is a dynamic process (see, for example, Chan [20, 21]; Sabherwal et al. [105, 106, 107]), few have attempted to examine alignment from a process perspective such as Tallon [118, 119, 120, 121, 122, 123, 124].
Despite the language used, most of the alignment studies reviewed by the author of this thesis have used a cross-sectional approach, that is, they have taken snapshots of a number of the factors at a point in time, hence taking a static view of alignment. However, some other authors, like Hackney et al. [35], argue that strategic IT and business alignment is in essence a dynamic and complex balance and should be understood more in an “interpretative” and evolutionary way than a “rational and prescriptive” one. Maes [76] defines alignment as the continuous process, involving management and design sub-processes, of consciously and coherently relating all components of the business IT relationship in order to contribute to the organization’s performance over time [80]. The perspective presented by the author of this thesis considers both the dynamic and the static view in the assessment of alignment.

As already mentioned, there are several theories, typically labeled models or frameworks that describe the nature of the alignment phenomenon. In particular, two assessment theories of alignment are widely published; one proposed by Luftman [68], [69], [70], [71], [72], [73], [74], [75], and the other by Raymond Papp [85], [86], [87], [88]. Both are based on the Henderson and Venkatramann model and aim at meeting the challenge of developing metrics that can be used across different organizations, as well as keeping the data of these metrics as objective as possible so that the interpretation of the same factor does not differ with different people across the organization.

When discussing business-IT alignment, terms like harmony, linkage, fusion and integration are frequently used synonymously with the term alignment. It does not matter whether one considers business-IT alignment or IT-business alignment; the objective is to ensure that the organizational strategies adapt harmoniously [74], [76], [100], [101], [117], [129]. According to Luftman, alignment addresses both how IT is in harmony with the business, and how the business should or could be in harmony with IT. Alignment evolves into a relationship where the function of IT and other business functions adapt their strategies together [86], [87], [88].

Luftman’s strategic alignment maturity model is one of the best known alignment models that describe the complex alignment phenomena and is also an empirically well founded model. In this thesis work, Luftman’s theory and models have been used extensively as one the main references. It is based on a combination of twelve relationships between components of the strategic alignment model (SAM) and research results from previous studies on alignment inhibitors and enablers. It has been applied in 60 global companies. It examines six dimensions (criteria), rating each on a scale of 1 (lowest) to 5 (highest):

- **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 and priorities, and what must be done to achieve them.
• **Competency/Value Measurements**: the use of measures that demonstrate the contribution of IT and the IT organization to the business in terms that the business understands and accepts.

• **Governance**: the degree to which the authority for making IT decisions is defined and shared among management and the processes applied by managers in both IT and business organizations in setting IT priorities and allocating IT resources.

• **Partnership**: the relationship between 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.

• **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.

• **Skills**: the practices such as training, 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 further defines several (sub-) attributes: thirty-eight in total for the six criteria, to be exact. The attributes constitute the lowest, hence the operationalized, level of the theory. Luftman bases the assessment on the concept of identifying a maturity level (in line with the Software Engineering Institute’s Capability Maturity Model concept); hence each attribute is to be assessed on a Likert scale from one to five. The numbers of the scale follow a general meaning for all attributes: 1 - means that this does not fit the organization, 2 - stands for low-level fit for the organization, 3 - is moderate fit for the organization, 4 - determines that this fits most of the organization, and 5 - describes a strong level of fit throughout the organization. The maturity level of a criterion is calculated as an average of the attributes below, and the overall maturity level of business and IT alignment is calculated as an average of the six criteria [73], [75], [78].

**Business and IT Governance**: strategic business and IT governance alignment is one of the main topics of strategic business and IT alignment, according to different authors. Within the governance field, strategic alignment is becoming more important in achieving the organization’s goals by adding value and balancing business risk versus return over IT. IT governance is integral to the success of business governance by assuring efficient and effective measurable improvements in related business processes. [23], [33], [34], [38], [44], [49], [110], [113], [114], [115], [116], [135].

There are many types of governance mechanisms and techniques and they are grouped into three categories based on what they accomplish — mechanisms that facilitate decision-
making, processes that ensure alignment among technology and business goals and processes, and methods for communicating governance principles and decisions [45]. According to Ross and Weill [136], just as business governance is critical for ensuring that key decisions are consistent with enterprise vision, values and strategy, IT governance is critical for ensuring that IT-related decisions match organization-wide objectives. Simply put, good IT governance makes organizations more successful by establishing coordinated mechanisms that link business objectives to measurable goals [136], [137].

According to the control objectives for information and related technology (COBIT) [45], [47], [48]) framework, business governance focuses on the board’s role in making strategic decisions, assessing risk and understanding the drivers for business performance. Business governance is the system by which organizations are directed and controlled. The business dependency on IT has resulted in the fact that business governance issues can no longer be solved without considering it. IT governance enables the enterprise to take full advantage of its information systems, and can be seen as a driver for business governance in the strategic and operational levels. It ensures that IT is properly aligned with business processes and is properly organized and controlled and provides the structure that links IT processes and IT resources to business strategies and goals. IT governance integrates and institutionalizes best practices of planning, organizing, acquiring, implementing, delivering, supporting and monitoring IT performance, to ensure that the enterprise’s information and related technology support its business objectives and processes.

According to COBIT, IT governance is performed by a board or senior management responsibility in relation to IT to ensure that IT is aligned with the business strategy, or in other words, that IT delivers the functionality and services in line with the organization’s needs so the organization can do what it wants to do. These IT-related services and functionality can be delivered at the maximum economical value or in the most efficient manner.

Many researchers and practitioners are trying to develop the concept of governance. For instance, Luftman [74, 75] defined it as the degree to which the authority for making IT decisions is defined and shared among management, and the processes that managers apply in setting IT priorities and allocating IT resources.

Van Grembergen indicates that IT management must be involved in the IT governance processes [32]. However, there is a clear difference between IT governance and IT management. IT management is focused on the effective supply of IT services and products and the management of IT operations. IT governance in turn is much broader and concentrates on performing and transforming IT to meet present and future demands of the business and its customers.

**Balanced Scorecard (BSC):** Kaplan and Norton first presented the concept of a balanced scorecard system for measuring organizational performance from a holistic perspective.
The BSC outlines both an organization’s current operating performance and future performance drivers by tracking and measuring four dimensions of business: financial, customer, internal processes, and innovation and learning [56], [81].

The BSC has only recently been adopted as a theoretical model for IT management research. Initially, the focus was on building an “IT balanced scorecard,” using the four perspectives of the BSC for a holistic approach to managing IT projects or IT departments [30], [31].

Van Grembergen has applied this concept to the IT function and its processes. Recognizing that IT is an internal service provider, the proposed perspectives of the BSC should be changed accordingly, with enterprise contribution, user orientation, operational excellence and future orientation as perspectives. By using a cascade or waterfall of balanced scorecards, a method for business and IT fusion is provided to senior management [32].

The BSC plays a dual role in enhancing communication: providing a platform, or common language, for communication and promoting understanding of the business organization by the IT organization. In addition, the BSC helps IT to understand business areas better [30], [31], [32], [56], [108].

**Business Process Simulation:** The business process simulation is understood as a tool that allows representation of business processes, IT processes and services, people and technology in a dynamic model and consists mainly of four steps: building a model, running the model, analyzing the performance measurements and evaluating alternative scenarios. It mimics the operations of the enterprise and can accurately account for the realities of modern IT and business processes such as variability, uncertainty and resource interdependencies. A process is defined as a specific ordering of work activities across time and place, with a beginning, an end and clearly identified inputs and outputs. To this definition it is relevant to add that the input and output of a process may be either a product or a service. [1], [13], [82], [109], [111], [112].

According to Harrington [39], simulation provides more alternatives, lowers the risks, increases the probability of success and provides information for decision support without the cost of experimenting with the real system. Simulation thus provides a way to rapidly test and evaluate various solutions. Simulation can help quantify performance metrics, measure trade-offs associated with process designs and allow for further analysis of parameters such as time to market, service levels, market requirements, carrying costs and so forth. Simulation thus provides a quantitative approach to measuring performance [7], [8], [37], [39], [77], [81], [95], [99], [111], [124].

**Enterprise Architecture (EA):** There are diverse academic and practitioner work about EA. Different well-known architectural frameworks exist for managing enterprise-wide IT systems. These frameworks propose that abstract models of the enterprise and its IT systems should constitute the basis for analysis, design, decision-making, understanding and...
communication at the enterprise level. One of the main concerns considered in the frame of EA is the strategic business and IT alignment [3], [4], [9], [27], [29], [51], [52], [53], [64], [65], [66], [79], [83], [93], [103], [128], [139], [143].

According to Johnson P. and Ekstedt M. [53], enterprise architecture is defined as a set of methods, models and tools that embody knowledge IT decision-makers can exploit efficiently. It is mainly considered as a tool for making good decisions regarding the enterprise information systems. This approach considers enterprise information systems management in terms of three domains: the business organization, IT organization and information systems. “The business organization may be viewed as the consumer of the services provided by the information systems, which in turn are targets of the services of the IT organization” [53]. One of the main concerns considered in the frame of this approach is the strategic business and IT alignment. The IT organization serves two purposes: to manage the information systems and to deliver services to the business organization directly with IT system-related problems such as change management and user support [125]. “In order to optimize the IT organization it thus has to be aligned with the business organization as well as the information system portfolio.” [53].

RESULTS

The main results of this research work are described in three sub-sections. The papers included in this thesis can be grouped into three types; papers A and B present the big picture of the alignment, proposing an organization-wide approach and a metamodel for assessing it and for improving the validity and reliability of Luftman’s model.

Paper C presents a prioritized diagram of the most widely accepted strategic alignment model (SAM), proposed by Henderson and Venkatramann, with the purpose of categorizing the most important topics and trends in the research area of alignment. Papers D, E and F present the governance alignment perspective, selected by using the developed and presented prioritized diagram, as one of the most relevant topics of alignment. In these papers the author proposes different models and methods for identifying and managing alignment measures, i.e., balanced scorecard, metamodels, and business process simulation.

The details of these results are contained in the papers included in this thesis. The purpose of this section is to summarize the results obtained by the research described in the six included papers.

RESULT 1: A theory-based metamodel for evaluating the maturity level of strategic business and IT alignment.

The theoretical base of this research result presented in papers A and B is Luftman’s strategic alignment maturity model, which is based on Henderson and Venkatramann's SAM. See figure 1. This research work makes its contribution by proposing an alternative organization-wide approach, with the purpose of enhancing the validity and reliability of Luft-
man’s alignment model. Moreover, in order to improve the organization-wide approach, a theory-based strategic alignment metamodel has been proposed using Luftman’s model as a reference. The purpose of building a metamodel was to facilitate a practical decision-making tool for IT and Business Managers in an organization. The developed metamodel is affiliated to the enterprise architecture (EA) discipline as a guide to identifying the relevant representations for specific concerns. The correctness of Luftman’s theory is not discussed in papers A and B; rather Luftman’s strategic alignment maturity model is simply used as a true theory of alignment.

In order to build the theory-based metamodel for evaluating the alignment, first Luftman’s model was translated into a new syntactic representation of their key criteria and concepts in a form of a tree-structured hierarchical diagram. The purpose of building that kind of diagram was to make the theory explicit, facilitating both critical examination and reuse of it. Luftman’s diagram was constructed by representing the above-described six criteria, all 38 attributes and alignment level for each attribute expressed by its set of conditions and properties. Each alignment level has the corresponding attribute, while the attributes have a composition relationship with their corresponding criterion. In figure 2 it is showed partially the hierarchical diagrams described above, according to Luftman’s model. It is presented an illustrative example of the Governance Criteria, as one of the relevant perspective developed in this research work. The complete graphical interpretation of Luftman’s diagram and the complete theory-based metamodel can be found at references [118] and [119], respectively.

Figure 2: A partial view of Luftman’s diagram, representing the Governance Criteria

The attributes and descriptions of levels of the strategic alignment maturity model were refined so that each of the 38 attributes assigned to the 6 alignment criteria are broken down one further level into a set of new questions developed on the lowest level of the model and easy to pose to the respondent. So, instead of estimating the level of maturity for an attribute (on the scale ranging from 1 to 5), the attribute was measured by obtaining a couple of “yes” or “no” answers (see paper A and B). Data for evaluating the alignment...
are collected from the people working in the different hierarchical levels, particularly covering business and IT, management and staff. A question is addressed to a person based only on the presumption that the person may be most knowledgeable in providing the best answer within the organization. Moreover, validity is addressed partly by broadening the assessment base in terms of more sources of information within the organization and partly by using different ways of measuring the same phenomena.

The proposed metamodel puts forward Luftman’s theory and presents a more valid and reliable model-based assessment for evaluating strategic business and IT alignment. A more valid alignment method means that the performed measures are more appropriate than the ones proposed by Luftman. A more reliable one means that the procedure of measurement is producing similar outcomes for different alignment models. It suggests an alternative to tackle some lessons learned, suggesting less ambiguous data collection processes and tools. There were proposed templates, a set of artifacts for modeling, to build the view components, instantiations of viewpoint components with the corresponding assessed level of alignment. See figure 3.

In summary in the metamodel, the criteria and attributes are represented by viewpoints and the levels of alignment are represented by view point components. This theory-based metamodel is a further contribution to the benefits of the enterprise-wide assessment approach published and applied in two case studies [96]. See more details in paper B.

The models and methods presented in this thesis have been deployed in two case studies in different cultural environments. Results from these two pilot studies show that the organization-wide approach as such is practically viable, considering the importance of the valid and reliable assessment method for any type of organization. The empirical results from
applying the proposed approach are presented by means of two case studies, one performed in a Swedish private company and the other in a Nicaraguan public organization.

2) RESULT 2: A categorization and prioritization of the most relevant topics in the field of strategic business and IT alignment.

The purpose of this section is to present the categorization and prioritization results obtained from an extensive literature review and most frequently cited authors on strategic business and IT alignment.

The developed and presented categorization and prioritization of strategic business and IT alignment works give indications on how important the alignment community finds the different sub-topics in the field of alignment. It is reasonable to classify and prioritize alignment sub-topics, since it is the de-facto classification and prioritization made by experts in the field. It shows in percentage form the level of importance of different key alignment sub-topics or properties presented by the relevant selected literature sources. Use of the diagram highlights deviations or focus variations of different alignment theories and concepts among the selected and used references that are not immediately apparent when looking at the different references or theories separately. The categorization was based on the Henderson and Venkatramann model (SAM) because this is the model most widely accepted among academics and practitioners. See figure 4 and 5.

An extensive literature review on alignment was conducted in this thesis work to identify the most generally accepted (by scoring the number of citations) works on alignment. In total, more than 150 articles, books and technical reports were selected and included in the assessment. All references were selected and classified using the reference author index (RAI), science citation index (SCI), Institute for scientific information (ISI) and publications research index (PRI). The most widely cited—279 citations according to the searching process described in section five of paper C and the strategic business and IT alignment model used—is the one presented by Henderson & Venkatramann in 1993. Hence it is natural to use it as the reference model in this research work.

The SAM model was turned into a new format in order to be able to use it as a framework for categorizing alignment literature. The idea behind these kinds of diagrams is to decompose intangible and hard-to-measure properties (topics) into more detailed sub-properties. One may thus interpret each level in the subdivided tree as the sum of its underlying sub-levels. This decomposition can of course be performed repeatedly in order to generate a tree-structured hierarchy on any number of levels with the objective of defining and measuring the alignment theory and its key elements. By doing this, a structured, concrete and transparent definition of the subject can be achieved. In this case the SAM is transformed into a hierarchical diagram, which is only a syntactic operation where no new categories are added or existing ones excluded. Consequently, the first subdivision of the SAM is strategic
fit and functional integration, followed by strategic business fit, strategic IT fit, strategic integration and operational integration.

On the bottom level the diagram ends up with 36 sub-topics relating concepts like business and technology scope, architectures, business and IT governance, business process and IT skills, distinctive competencies and administrative infrastructure, etc. all directly mapped to the SAM presented by Henderson and Venkatraman in figure 1.

The obtained diagram for SAM is partially presented in figure 4 (18 topics from a total of 36).

![Figure 4: Strategic Business and IT Alignment Diagram for SAM.](image-url)

The prioritization process consists of weighting the importance of the alignment sub-topics presented by the most relevant and cited alignment references found. Given the large set of relevant references, it is then possible to picture how the alignment community as a whole is prioritizing its area. The weighting procedure consists of assessing each of the selected references and its corresponding statements, identifying general and specific alignment topics and relating them to the levels and topics presented in the diagram. Once a sub-topic is identified and related to a specific topic, a value weight of “1” is assigned to that sub-topic in the diagram. The process is repeated for each assessed reference, and then all weights are accumulated and assigned in the corresponding sub-topic. At the end of this weighting process, all accumulated values in all 36 topics are added together, making it possible to calculate percentages for each topic by dividing the accumulated value in each by the calculated total. The corresponding percentages are added to get the percentage for
each of the four boxes of the next level up in the diagram. See the example in figure 5. See more details in Paper C included in this Thesis work.

![Diagram](image)

**Figure 5**: The prioritized diagram of strategic business and IT alignment based on SAM (three of four levels are presented)

The prioritized diagram thus shows in percentage form the level of importance of different key alignment topics or properties presented by the relevant selected sources. The resulting numbers and percentages were then translated into weights of importance for the corresponding levels, topics and subtopics in the obtained diagram. Therefore, it is more feasible to identify how the most relevant and credible references are defining the alignment construct and which are the more mentioned topics or domains based on the Henderson and Venkatramann definitions.

The obtained categorization and prioritization for the strategic business and IT alignment makes a contribution to the current theoretical and practical assessment frameworks in the alignment field.

**RESULT 3: An approach for analyzing the business and IT governance alignment based on business process simulation model and balanced scorecard method.**

The third result presented in this thesis is described in two parts, one of which presents a business process simulation approach in order to facilitate the process for assessing the business and IT governance alignment (papers E and F) while the other describes the application of IT and business BSC method for analyzing the relationship between business and IT processes and their KPI with the purpose of facilitating the assessment of business and IT governance alignment (paper D). Both methods were proposed as operational means in order to facilitate the process for assessing the business and IT governance alignment.

Firstly, a well known method, the balanced scorecard for evaluating the level of alignment between business and IT processes, is proposed for analyzing KPI for both type of processes and their relationship. In an illustrative example in paper D, two sets of key performance indicators were identified, one for business processes and the other for IT processes. Two well known literature references were proposed in order to select IT key performance indicators, COBIT and ITIL. (IT Infrastructure Library). The set of key business performance indicators can be determined based on the type of business from the well
known business literature. See references in figure 6, which present a conceptual model of business and IT governance alignment by means of business and IT process alignment analysis.

Paper D presents a new perspective and concepts on how to facilitate the analysis of the business and IT governance alignment by means of mapping business and IT balanced scorecards and identifying key performance indicators for selected IT and business processes. In order to implement the proposed method, it is necessary to define business and IT priorities, specific processes, types of metrics, information and documentation availability, scales or perspectives for the BSC, simulation settings, etc. An illustrative example is presented in paper D to show how to put the proposed approach into practice.

The application of the BSC for identifying and measuring the level of business and IT process alignment is the first part presented in this result section. The procedure consists of the processes (business and IT) and their respective key performance indicators (KPI), based on ITIL [46] and COBIT [45] frameworks. Once the two lists of KPI for IT and business processes are decided, the next step is to group and fit them into one of the four specific perspectives defined for the IT and business BSC [32], [56], [81], [108]. A decision also needs to be made about the suitable scale and the appropriate metrics defined in order to compare the two lists. By using the defined scale and metrics, the analysis of relations between the two lists of KPI is performed to determine the level of alignment between business and IT process and consequently an inference can be made about the business and IT governance alignment. This proposed analysis gives a concrete contribution for identifying and measuring the level of strategic business and IT alignment. See figure 6.

In the first part of the figure 6 it is presented a conceptual model of business and IT governance alignment as an extended model of SAM, taking only the bubbles “business governance and IT governance”. In the second part of the figure 6 there are presented the relationship between business and IT processes, and for each of them, their respective key performance indicators related at the same time by using the method of BSC.
Figure 6: The conceptual model of the strategic business and IT governance alignment. Paper D, E and F.

The second part of this research result presents the process modeling and simulation approach for assessing the business and IT process alignment. Process modeling and simulation consists mainly of four steps: building a model, running the model, analyzing the performance measurements and evaluating cost-effective alternative scenarios. The simulation essay presented introduces the business process and IT process service (ITPS) alignment view in order to facilitate the alignment assessment of business and IT governance. See details in papers E and F and practical example in the appendix at the end of this thesis.

This approach provides to the business and IT managers a solid yet flexible dynamic common structure for facilitating the assessment process of BITGA at the operational level. It constitutes a basis for cross-organizational collaboration between business managers re-
sponsible for the separate parts of processes in an organization and IT managers, offering advantages to business and IT managers in making decisions.

For effective assessment of business and IT governance alignment, enterprises need to assess how well they are currently performing (as-is model) and be able to identify where and how improvements can be made (to-be model). This applies to the performance of both the business and IT process services. By utilizing the process simulation, the suggested approach is to assess the current business and IT process services and describe the activities and procedures involved and the information flows. With that information it becomes possible to explore alternatives (“what if” scenarios) that may improve performance measures for those processes.

A very important aspect of the process simulation approach is scenario analysis, which allows the assessment of what-if scenarios. Adoit\(^1\) software provides functionality for comparing metrics from multiple scenarios in a statistically sound way. Scenario analysis is a statistical analysis of model output for a given performance measure under different sets of input data.

Scenario analysis is a technique that has proved consistently effective for dealing with strategic uncertainty in numerous types of organizations. Rather than determining a single correct view of the future and the implicit strategic response, scenario planning embraces uncertainty and devises a range of views of an uncertain future. Paper F includes a description of how to generate scenarios for identifying and measuring the business and IT alignment level. Experiments are designed to determine the effects of changing the input configuration on one or more output statistics. A scenario is a specification of the input configuration, i.e. the input values used for a single simulation run. Scenarios can be created one at a time or en masse. Sometimes the objective of an experiment is to find the best system configuration from a number of configurations.

One of the IT processes illustrated in this thesis is the change management (IT process service) according to the ITIL framework [84] and its alignment with a specific business process (sales process). Given the scope of this IT process, it is easy to see why it interacts with every other IT process in the ITIL framework [84] as well as with other business processes. An illustrative numerical example is presented in paper F, showing a possible way to implement the proposed approach. For more details about the application of the proposed simulation essay in paper F, see the appendix at the end of this thesis work.

---

\(^1\) Adoit is software for modeling and simulating IT processes and its relationship with business processes, based on IT infrastructure library.
CONTRIBUTIONS

1) A theory-based metamodel for evaluating the maturity level of strategic business and IT alignment.

This research work proposes a further development of Luftman's approach in terms of validity and reliability as well as systematically documented. The proposal describes an organization-wide assessment approach, where the maturity model criteria and attributes are assessed with sub-questions for clarity. The applied questionnaire during the two performed case studies triangulates the posed questions by collecting evidence from both direct interviews and alternative sources such as documents. The theory-based metamodel of Luftman's alignment assessment theory consists of 74 artifacts and 190 inference rules from which to represent the relevant issues of an enterprise's views for assessing alignment. This assessment method contributes by increasing the validity and reliability of the collected data and obtained results. See the details in paper B.

2) A categorization and prioritization of the most relevant topics in the field of strategic business and IT alignment.

The obtained categorization and prioritization of strategic business and IT alignment is the main contribution in this part of the thesis. The defined categories and founded priorities should give indications on how important the alignment community finds the different topics and sub-topics in the field of alignment. Moreover, it is reasonable to use the prioritized diagram for categorizing the alignment topics, since it is the de-facto prioritization made by experts in the field. The prioritization process consists of weighting the importance of the alignment sub-topics presented by the most relevant and cited alignment references found.

The diagram shows in percentage form the research effort spent in studying the different key alignment topics or properties presented by the selected relevant sources. By using the diagram, it is possible to highlight deviations or focus variations of different alignment theories and concepts among the selected and used references, which are not immediately apparent when looking at the different references or theories separately.

The obtained results in paper C, included in this thesis, make an important contribution to the current theoretical and practical assessment frameworks and approaches in the alignment field.

3) An approach for analyzing the business and IT governance alignment based on business process simulation model and balanced scorecard method.

This approach proposes a business process model for analyzing the strategic business and IT governance alignment as an extended model of SAM (Henderson and Venkatraman).
A business process simulation approach was proposed as a cost-effective and scenario-based method for identifying and operationally measuring the level of alignment between business and IT processes and it proposes a well known method for measuring performance: balanced scorecards for evaluating the relationship between business and IT processes. Both proposed methods were proposed as operational mean in order to facilitate the assessment process of business and IT governance alignment.

**RESEARCH DESIGN**

“The object of all science, whether natural science or psychology, is to coordinate our experiences into a logical system.” Einstein, 1950

This section covers the methodologies that have guided this research study. The research design used in this thesis work was decided on the base of the research questions formulated by the author. Mainly three types of methodologies have been used:

a) The case study methodology was applied for collecting data from different sources of information in two organizations. According to Yin [142], the case study methodology is a way of obtaining valid and reliable information or research findings. It is particularly valuable in answering who, why and how questions in management research. Case studies are not used in this research as a scientific method but rather as a suggestion on how to collect data when employing the proposed methodology. Three types of data sources were considered in the case studies performed: interviews, observations and document reviews. Documentation collected includes technical papers; interim reports; published reports; records of the interviews; internal reports such as technical, financial and organizational; strategic plans and other important documents [94].

The first case study was performed in Nicaragua, at a major state agency. The second was performed in Sweden, the Swedish part of an international energy enterprise. The subject of the alignment assessment was the service order process used by several companies and the Enterprise Resource Planning (ERP) system related to many of the business processes.

The purpose was to gather comprehensive, systematic and in-depth information about each case studied. It was used for proof of concept validation of the method. Wherever possible, purely descriptive data should be converted into quantitative data. According to Quinn [89], the credibility of case study research depends on three distinct but related inquiry elements: rigorous methods, the credibility of the researchers and philosophical belief in the value of qualitative inquiry. In this research, a substantial amount of time and attention was devoted to the issue of the methodology, validity and credibility of the performed case studies. The findings suggested by the case studies are perceived to be useful for IT managers in the decision-making process related to alignment challenges and also for improving the assessment methods for measuring the level of alignment between business and IT (papers A and B).
b) A reference model proposed by Johnson P. [53] was used for building and prioritizing the hierarchical diagram of the alignment. The author performed a broad literature review in order to classify and prioritize relevant alignment topics based on the Henderson and Venkatramann model (paper C). See figure 1. The author also applied a content analysis and archival research in order to understand the wide literature review about the prioritization of alignment topics. It was based on developing a way of coding and classifying the information in the documents or media being studied. It includes qualitative methods and some kinds of quantification of collected data.

c) Moreover, different and well known conceptual models and methods [13], [32], [39], [56], [81], [82], [108], [109], [112], were used for the development of the process simulation alignment models and balanced scorecard analysis, as well as many different types of documents and literature for evaluating and measuring strategic business and IT alignment (papers D, E and F). An explanation of the process-oriented approach was considered as a relevant methodological topic for inclusion in this research. A process-oriented approach also requires sensitivity to both qualitative and quantitative changes in an organization and its information technology. By describing and understanding the details and dynamics of business and IT processes, it is possible to isolate critical elements, find bottlenecks or build and analyze different types of scenarios. Some specific statistical analysis and simulation essays (what if) were performed in order to evaluate the level of alignment between business and IT. Process simulation involves experimentation on a computer-based process model of some system. In this case, the model was used as a vehicle for experimentation, often in a trial and error way, to demonstrate the likely effects of various inputs (answering “what if” questions). Sometimes these experiments may be quite sophisticated, involving the use of statistical design techniques. Such sophistication is necessary if a set of different effects may be produced in the results by several interacting variables (costs and cycle times for a big set of business and IT process, for example).
INTRODUCTION

REFERENCES


48. IT Governance Institute (2005), Governance of the Extended Enterprise, Bridging Business and IT Strategies, NY USA: Wiley.

49. IT Governance Institute, The VAL IT Framework, ITGI, 2007.


101. Reich, B.H., Y. E. Chan, and G. Bassellier, Investigating IT Competence in Business Managers, SIM Workshop, Atlanta, Georgia (December 1997).


140. www.lplazaola.uni.edu.ni/luftman_app.html; www.lplazaola.uni.edu.ni/AMAM.html

141. www.lplazaola.uni.edu.ni/luftman_td.html


Related Publications not Included in the Thesis


**Paper III:** Leonel Plazaola, Johnny Flores, Enrique Silva, Norman Vargas, Mathias Ekstedt, An Approach to Associate Strategic Business-IT Alignment Assessment to Enterprise Architecture, in the proceedings of the CSER, New York, USA, 2007
