Towards a Business-IT Alignment Maturity Model for Collaborative Networked Organizations

Roberto Santana Tapia*, Maya Daneva, Pascal van Eck, Roel Wieringa
Department of Computer Science
University of Twente
P.O. Box 217, 7500 AE Enschede, The Netherlands
r.santanatapia, m.daneva, p.vaneck, r.j.wieringa@utwente.nl

Abstract

Aligning business and IT in networked organizations is a complex endeavor because in such settings, business-IT alignment is driven by economic processes instead of by centralized decision-making processes. In order to facilitate managing business-IT alignment in networked organizations, we need a maturity model that allows collaborating organizations to assess the current state of alignment and take appropriate action to improve it where needed. In this paper we propose the first version of such a model, which we derive from various alignment models and theories.

1 Introduction

In modern organizations, business-IT alignment (B-ITa) is a hard problem that requires continuous attention. There is a considerable literature on measuring and improving B-ITa in single organizations (e.g., [19, 22, 24, 30]) but the problem of B-ITa in collaborative networked organizations (CNOs) has hardly been studied. Yet, the problem is important because improved B-ITa entails a more efficient use of IT in the CNO supporting the integration of enterprise applications and processes across organizational boundaries.

CNOs form the core of a new discipline [9, 10] that focuses on the structure, behavior, and dynamics of networks of independent organizations that collaborate to better achieve common goals. CNOs are characterized by being formed by organizations which have a pre-disposition to collaborate in order to attend a common interest using IT, and by being associated with effective coordination and shared decision making. These characteristics provide opportunities to generate commitment within markets which demand very quick, high-quality and cost-saving services from organizations.

In such a context, maturity models (MMs) are a suitable vehicle for CNOs to gain a deeper understanding of their current B-ITa, and to plan what steps to take toward better alignment. In this paper, we will define a conceptual framework, in the form of a MM for assessing and improving B-ITa in CNOs. Clearly, some other models and theories (e.g., [12, 27, 34, 44]) can also be used to understand aspects related to B-ITa in CNOs. Nevertheless, none of these models and theories covers all the necessary domains that need to be considered by CNOs when achieving B-ITa. This motivated us to adopt the position that these models and theories might be used as starting points in cross-organizational B-ITa initiatives, but they need to be integrated.

The contribution of this paper is twofold. First, we present a systematic approach for the development of a MM in the form of a MM process model. Second, we suggest a state-of-art literature-based MM that can be used in a CNO setting to assess processes related to those B-ITa attempts which integrate multiple perspectives. The paper is organized as follows: Sect. 2 provides background on the concepts we use. Sect. 3 presents related work emphasizing the needs of MMs in CNOs. In Sect. 4 we describe the MM we are developing. Furthermore, we discuss its adoption in CNOs and its preliminary evaluation in Sect. 5. Finally, Sect. 6 summarizes our conclusions and presents our immediate future work.

2 Conceptual Background and Definitions

2.1 Business-IT Alignment

For the purpose of our research, we define B-ITa as the *process to make IT services support the requirements of the business*, whether such services are individually or collaboratively offered. We do not consider alignment as a steady

*Supported by the Netherlands Organization for Scientific Research (NWO) under contract number 638.003.407 (Value-Based Business-IT Alignment).

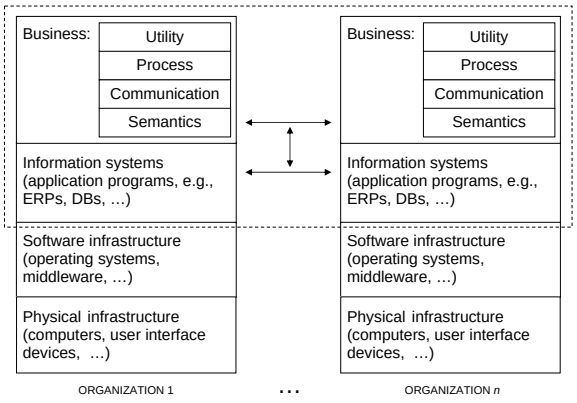

Figure 1. Business-IT alignment framework in CNOs (adapted from [51]).

state but as a process that needs to be performed continuously. By 'IT services' we mean services offered by computerized information systems. By the 'requirements of the business' we mean the systems requirements derived from analyzing the goal(s) of the CNO. We will focus on operational B-ITa, which consists of aligning the operational activities of IT systems and people to each other so that optimal IT support for business requirements is achieved. This contrasts with strategic B-ITa, where business and IT goals and policies are decided without fixing operational details [13, 30, 42].

We analyze the B-ITa concept in CNOs based on the scheme shown in Fig. 1. The horizontal layers classify entities in a service provisioning hierarchy in a business: physical entities provide services to a software infrastructure, which provides services to information systems, which provide services to businesses. In the business layer, we take four views on businesses: businesses provide services that have a utility, they perform processes to provide these services, they communicate with one another as part of performing these processes, and while doing that, they exchange data that has semantics. Participating organizations in a CNO need both to fit the different entities (horizontal arrows) as well as to address B-ITa (vertical arrow). Our interest is in the upper two layers of the framework (area delimited by the dotted line), because there is where business and IT alignment in CNOs takes place.

2.2 Collaborative Networked Organizations

We define a CNO to be any *"mix-and-match" network of profit-and-loss-responsible organizational units, or of independent organizations, connected by IT, that work together to jointly accomplish tasks, reach common goals and serve customers over a period of time* [35]. Virtual enterprises [2], value constellations [46], extended enterprises and collaborative highly integrated supply chains [18] are some forms of CNOs. Our interest is in IT-enabled CNOs, i.e., collaborations that are made possible by IT where the participants interoperate with each other by means of information systems. We believe that IT makes global competition and collaboration possible, forcing organizations to focus on what they can do well and facilitating collaboration between organizations with complementary competencies.

CNOs continue spreading since hypercompetitive environments [6] exist. This kind of environments forces organizations to re-think the way they are doing business by connecting and aligning the business and IT operations among them to meet goals. Participants in a CNO can be seen as distinct loosely coupled stakeholders with commonly conflicting interests and goals [16]. However, if they want to collaborate, they need to formulate a clear-enough common goal(s) toward which they strive together. This goal is not necessarily the goal of all participants. The common goal is an agreement between the customer-facing organization and its direct partners. This goal might include also other participating organizations in the CNO, but not necessarily.

CNOs are dynamic, because their environments are characterized by rapid changes in IT, easy competitors' market entry and uncertain market demands. Having well-defined collaborative work structures as basis [36], participants need to react promptly to customer needs. They will collaborate while an interesting 'business' opportunity exists. When this opportunity is over, the CNO dissolves while, perhaps, the organizations are active in other CNOs or look for new complementarities that allow them to participate in new 'business' opportunities.

2.3 Maturity models

MMs describe the evolution of a specific entity over time. Commonly, this entity is an organizational area or function. MMs have been developed to assess specific areas against a norm. Based on maturity assessments, organizations know the extent to which activities in such areas are predictable. That is, organizations can be aware of whether a specific area is sufficiently refined and documented so that the activities in this area now have the potential to achieve its desired outcomes. MMs apply a life-cycle approach where an area develops over time until it reaches its highest maturity level.

The first well-known maturity model was the software capability maturity model[1] (SW CMM) proposed by Carnegie Mellon University's Software Engineering Institute (SEI). This model identifies, specifically for software production, several levels of software process management sophistication.

[1] More information on http://www.sei.cmu.edu/cmm/

Essentially, MMs make it easier for organizations to establish goals for process improvement and identify opportunities for optimization, since these models describe basic attributes that are expected to characterize a particular area for each maturity level. By comparing an organization's characteristics and attributes with a MM, an organization will identify how mature it is in order to increase its process capability: first, establishing goals for the improvement of processes and then, taking action to achieve them.

3 Needs of MMs in CNOs

In the context of a CNO, proper understanding of the domains involved in B-ITa requires the integration of different models. There have been some proposals for assessing B-ITa. However, as these proposals are oriented to single organizations, they fail to take special characteristics of CNOs into account, such as the need for coordination, the lack of centralized decision making or the heterogeneity of IT architectures. Besides such proposals, there are also models that can be used to assess the maturity of one different aspect within CNOs. However, to the best of our knowledge, B-ITa is still not addressed by a single model in a CNO context that addresses all relevant aspects. In this section, we present a summary of different B-ITa MMs and MMs for CNOs that can be found in the literature. We did a semi-systematic literature review using a systematic literature review process [7] to select the related work presented in this section. The performed literature review consisted of a broad search of academic and practitioners' information sources. We approached the literature search using several electronic indexing services (e.g., ACM Digital Library, Google Scholar, Citeseer library, and IEEExplore). A set of key words was used: *alignment, business IT alignment, strategic alignment, IT alignment, architecture alignment, maturity model, assessment tool, measurement guide, networked organization, business network, collaborative enterprises*. We also used some alternative terms for alignment: *balance, harmony, fit*, and *linkage*. We traced the references in the identified papers to get access to other relevant sources. We reviewed the abstracts and the conclusions of the identified documents in order to determine their relevance to our research.

3.1 B-ITa Maturity Models

3.1.1 Luftman's MM

Luftman's strategic alignment model is an approach to determine a single organization's B-ITa based on six domains, namely skills, technology scope, partnership, governance, competency measurements, as well as communications [30]. Each of these domains is assigned five levels of alignment. The level of alignment for each individual domain is determined by means of answers to some questions. Luftman's model has been developed based on his practical experience and research, so this model is a pragmatic model. However, it disregards interrelations among the domains that explain B-ITa and it is focused to single organizations.

3.1.2 CIO Council's assessment guide

The Chief Information Officer (CIO) Council, a consortium of US Federal executive agency CIOs, developed an architecture-specific alignment and assessment guide [24]. This guide provides an overview of the integration of enterprise architecture concerns into the information technology investment planning process. It is useful to determine to what degree a proposed investment aligns with business strategies, and to know how well the technology of investments aligns with the infrastructure architecture. This assessment model is primarily focused on investment studies in federal agencies. It does not identify specific B-ITa domains, and thus it does not provide support to identify opportunities of improvement in organizations on some particular areas.

3.1.3 Duffy's MM

The MM developed by Duffy [22] consist of six domains required to understand B-ITa. The model is based on the premise that a reliable partnership between IT and non-IT executives is fundamental for achieving a successful B-ITa. Duffy recognizes that IT and business objectives are interdependent, and therefore, a division of practices into IT and non-IT areas would generally be unfavorable. Although the six domains reflect this position of the author, the model does not have explicit maturity levels for each of the domains. Instead, Duffy combines the six domains figuring out four B-ITa scenarios where organizations can be categorized. Such scenarios are the maturity levels in the model. Duffy's MM also is only focused on single organizations.

3.1.4 de Koning et al.'s model

Based on the analysis of business-IT excellence in several successful organizations in The Netherlands, and with the help of five hundred managers, de Koning and van der Marck [19] came up with ten questions that can be used to identify the level of alignment in single organizations. Those questions can be answered in a scale from 1 to 10 where the highest score means 'it entirely applies to my organization' and the lowest score means 'it entirely does not apply to my organization'. Although they do not identify B-ITa domains, this simple tool covers several B-ITa-related topics. However, the levels they present are limited to three:

immature, puberty and mature; this restricts the results and it neglects the assessment of the processes that do actually help to achieve B-ITa.

3.1.5 van der Raadt et al.'s MAAM

The Multi-dimensional Assessment model for architecture Alignment and Maturity (MAAM) [49] can be used to assess architecture within organizations. The MAAM helps to identify the current situation of an organization's architecture, and to define improvement points and plans. The authors claim that a correlation exists between architecture alignment and architecture maturity. They claim that when architecture maturity increases, architecture alignment generally increases too (and v.v.). The MAAM consists of six interrelated domains that explain the alignment and maturity of an architecture. However, the model only assess such an architecture considering B-ITa as a stage that can be reached by increasing architecture maturity.

3.1.6 COBIT

COBIT, issued by the IT Governance Institute[2], is a guide to employ management best practices and to measure IT processes. Version 4.0 of this guide provides a clear support to assess the align of IT with the business processes. For example, under the 'Defining a strategic IT plan' process, COBIT outlines how to engage IT managers on alignment with business goals and to develop a proactive process to quantify business requirements. However, (i) the focus of COBIT lies on IT Governance, (ii) it does not address a networked organization perspective, and (iii) COBIT deals with B-ITa from a strategic perspective.

3.1.7 Laagland et al.'s assessment tool

According to Laagland et al. [50], the degree of alignment is mostly stipulated by the degree of maturity of changes on architecture. Managers must then look at the maturity of their organizations' architecture as start point for identifying improvement measures for B-ITa. This assessment tool enables to get aware where an organization stands, what its competencies are, and which measures must be implemented to reach a higher level of maturity. The tool describes the roles of business/IT managers, architects, project managers, and the like, for each of the architecture levels. With the model, it is possible to identify how organizations handle managing architecture and B-ITa.

3.2 Maturity Models for CNOs

Since we are developing a MM for CNOs, our literature review also covers some MMs that can be applied in collaborative settings (e.g., EIMM [29], IT outsourcing MM [1], extended CMM [41], E2AMM [44], SCM MM [32], and CollabMM [31]). Each of these models covers a particular domain related to B-ITa in CNOs (e.g. architecture or processes), disregarding other necessary domains that need to be taken in consideration by CNOs when achieving B-ITa. So, none of those models explicitly helps to assess B-ITa. It can be argued that those models could complement each other to assess B-ITa in CNOs. However, CNOs should spend considerable time and effort to understand and apply each of the models, and to analyze how the results could combine to plan B-ITa improvement actions. Therefore, to have a selection of domains in a single integrated model is useful for CNOs.

As no current B-ITa MM addresses alignment in CNOs and no MM for CNOs addresses more than a single aspect of B-ITa, we are filling this gap in CNOs by developing a new MM: the so called ICoNOs MM (**I**T-enabled **Co**llaborative **N**etworked **O**rganization**s** **M**aturity **M**odel) to assess B-ITa in CNO settings. We present this MM in the next section.

4 The ICoNOs MM

Developing MMs systematically is not a topic that is widely covered in the literature. Instead, most of the MM literature presents the resulting models only and does not discuss the model developing process itself. The development of the ICoNOs MM consists of several steps (see Fig. 2). Detailed explanation of most of these steps can be found in our earlier work [38]. Below we present a summary only. We make the note that because Fig. 2 is a high level view of our MM development process, we excluded any discussion on feedback loops needed to keep the MM updated in a dynamic environment. We, however, acknowledge the importance of monitoring the MM and managing the evolution of CNOs when the MM is modified.

The first step in developing a MM is to determine the **SCOPE** of the model, which means to set the boundaries for the model's application and use, and to define the purpose of the model. This is to differentiate the model from existing MMs. The second step is to **DESIGN** the model and covers:

- the specification of the model's type. MMs can be classified as *assessment* MMs and *development* MMs. The first type consists of normative models which serve as assessment tools that target certification, and help improve the organization's image as a reliable partner (e.g., the SEI series of CMMI-compliant models). The second type includes development tools that organizations use as guides for implementing best practices that, ultimately, lead to improvements and better results.

[2]More information on http://www.isaca.org/

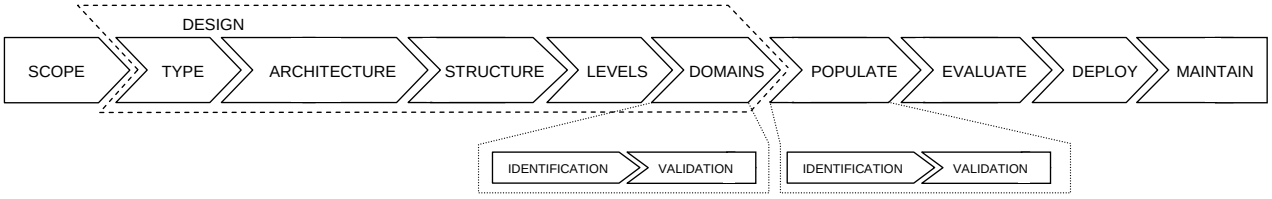

Figure 2. MM development process.

- the determination of the model's architecture. The architecture of a MM prescribes the manner in which maturity levels can be reached. For example, in a *staged* MM, before reaching level 3, an organization needs to achieve successfully what is mentioned in level 2 for all the domains included in the MM. In a *continuous* MM, each domain can be approached separately. This architecture allows selection of the order of improvements that best meets the objectives of organizations.

- the organization of its structure. The structure of a MM presents the organization of the model's components. It defines if the MM does include domains and key areas, and how they are decomposed and used to reach maturity levels.

- the definition of the maturity levels. This step implies to define the number of discrete levels of maturity for the model (typically five or six), and their qualifiers and definitions.

- the identification of the domains. The last step related to the design of the model is the identification of the domains to which the levels apply. A domain is a relevant aspect within the scope of the MM. For example, CMMI for software development [14] recognizes 4 domains: process management, project management, engineering and support. This task is not simple because after identifying the domains, they need to be validated to assure that they correspond to the purpose of the MM.

Once the design of the model is completed, process areas need to be identified for each domain so that we **POPULATE** the model with observable domain assessment criteria. A process area is a group of practices in a domain which, when implemented collectively, satisfy goals considered important for making an improvement in that domain (e.g., a process area in the IS architecture domain is 'IS portfolio management'). After populating the model, it must be validated in order to **EVALUATE** its applicability and generalizability. The objective is to validate the entire MM to test it for relevance and rigor. Following population and evaluation, the MM must be made available for use to verify its generalizability (step **DEPLOY**). To provide its acceptance and to improve its standardization, the MM must be applied in organizations that differ from the organizations that were involved in its design and population. The identification of organizations that may use the model and the application of the model to multiple organizations are the final steps towards its spreading and acceptance. Finally, it is important to track the evolution of (i) the organizational area or function that is assessed using the MM, and (ii) the requirements of the organizations that apply the model, in order to **MAINTAIN** the MM over time to keep it up-to-date. For example, the first MM developed by the SEI was the SW CMM. However, they observed that organizations would like to focus their improvement efforts not only in software engineering but also across different organizational functions. Therefore, the SEI came up with an integrated MM (CMMI) combining models from different disciplines to support the enterprise-wide process improvement that organizations were pursuing.

This paper focuses on the step POPULATE of the MM development process. Therefore, in the remainder of this section we report on the B-ITa process areas included in our model. First, we present the STRUCTURE , LEVELS and DOMAINS for a better understanding of the ICoNOs MM.

4.1 Structure of the model

The structure of the ICoNOs MM is based on CMMI for development [14]. It means that our MM builds on prior work. For example, some CMMI design choices are also present in ICoNOs. This situation avoids starting with the development of the model from scratch, and, most important, it also prevents our future users from starting over when adopting our MM for their B-ITa assessments.

The ICoNOs MM has four layers of aggregation. The upper layer consists of the domains that must be addressed in a CNO when achieving B-ITa, i.e., partnering structure, IS architecture, process architecture and coordination (see Sect. 4.3). The next three layers reflect the overall CMMI structure (see [14, p.30]). For example, in each of the domains we can also find process areas. Process areas are sets of activities that are performed to make improvements in a particular domain (see Sect. 4.4). Similarly to CMMI, the ICoNOs MM process areas have specific and generic

goals, which the activities in the process area are supposed to achieve. The specific goals describe characteristics that must be present to satisfy a particular process area; they are specific for this area. There are also goals, called generic goals, that apply to all process areas, although their instantiation for each process area can differ. For example, a CMMI generic goal is 'the process is institutionalized as a defined process'. Our MM will incorporate the generic goals of CMMI[3]. The goals will be decomposed in specific and generic practices describing what a CNO may implement to achieve the specific and generic goals. These practices will be expected and are not mandatory. This means that it will be permitted to implement alternative practices in substitution for the specific and generic practices that the ICoNOs MM will include. The only condition is that the goals must be satisfied, to perform a process, to reach a specific maturity level.

4.2 The B-ITa levels

The ICoNOs MM has five levels of maturity (see Fig. 3). Levels are used to describe an improvement path recommended for a CNO that wants to improve processes to achieve B-ITa. To reach a particular level, a CNO must satisfy all the set of process areas that are targeted for improvement in a particular B-ITa domain. The levels are:

Level 1: Incomplete. At maturity level 1, processes related to a particular B-ITa domain are usually not performed or partially performed. It means such a particular domain is not explicitly considered when a CNO strives for B-ITa.

Level 2: Isolated. At maturity level 2, processes are the basic infrastructure in place to support a particular B-ITa domain. They (i) are planned and executed in accordance with a policy; (ii) employ skilled people who have adequate resources to produce controlled outputs; (iii) are monitored, controlled, and reviewed. However, such processes are isolated initiatives that are not managed from the entire CNO perspective.

Level 3: Standardized. At maturity level 3, processes are directed to make improvements in the standardization and management of a particular B-ITa domain. Processes are performed from a CNO perspective (i.e., they are cooperation initiatives). They are well characterized and understood, and are described in standards, procedures, tools, and methods.

Level 4: Quantitatively Managed. At maturity level 4, processes use statistical and other quantitative techniques. Quantitative objectives for quality and process performance are established and used as criteria in managing the process.

[3] A detailed list of these generic goals can be found in [14]

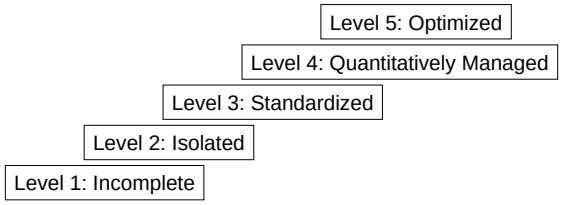

Figure 3. The B-ITa levels.

Quality and process performance is understood in statistical terms and is managed throughout the life of the process.

Level 5: Optimized. At maturity level 5, processes are improved based on an understanding of the common causes of variations inherent in the process. The focus of an optimized process is on continuously optimizing the range of process performance through both incremental and innovative improvements.

4.3 The B-ITa domains

Once the levels are defined, domains where these levels must apply need to be identified. A domain is a group of processes that help to have improvements in a particular CNO area. In previous work [37, 39, 40], we have reported on how we have used a focus group and case studies to identify the domains that need to be addressed by CNOs in their efforts for aligning business and IT. Fig. 4 presents the fit among the B-ITa domains. In the following, we give a short summary of these domains.

- Partnering structure, defined as the CNO work division, organizational structure, and roles and responsibilities definition that indicate where the work gets done and who is involved.
- IS architecture, defined as the fundamental organization of the information management function of the participating organizations embodied in the information systems, i.e., software applications, that realize this function, their relationships to each other and to the environment, and the principles guiding their design and evolution.

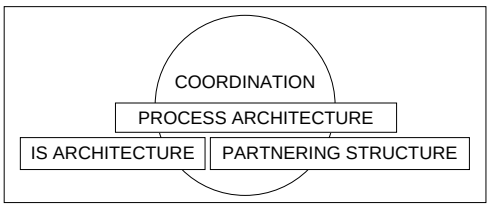

Figure 4. The B-ITa domains.

- Process architecture, defined as the choreography of all (individual and collaborative) processes needed to reach the shared goals of the participating organizations.
- Coordination, defined as the mechanisms to manage the interaction and work among the participating organizations taking into account the dependencies and the shared resources among the processes.

4.4 The B-ITa process areas

Several theories and models, developed elsewhere, are potentially useful to give insights for understanding the processes related to B-ITa in CNOs (e.g., [4, 5, 12, 14, 17, 20, 21, 22, 25, 26, 27, 30, 33, 34, 43, 47, 48, 49]). Our position is that it would be practical for CNOs to have a selection of those processes in a single model. Fig. 5 establishes a map relating several theories and models to the four B-ITa domains introduced in the previous subsection. It must be noted that each theory and model covers much more than the constructs (i.e., processes and process outcomes) we present in the figure. That is, in our research, we take from each theory/model those constructs only, which could have a relation to the four B-ITa domains. Clearly, it can be argued that we do not include all theory/model constructs with a possible relation with the B-ITa domains. However, after an exhaustive analysis of the theories and models, we decided to include only general constructs. For example, the 'Requirements development' process of CMMI covers specific characteristics that are considered, in a general way, by the 'Requirement management' process which we do take into account in our mappings (see Fig. 5). In this figure the acronyms **PS**, **IS**, **PA** and **CO** stand for partnering structure, IS architecture, process architecture, and coordination, respectively.

The leftmost and the rightmost columns in this figure present the theories or models taken from the literature. By 'model' we mean a conceptual model, i.e., a set of constructs used to describe B-ITa or a domain of B-ITa; by 'theory' we mean a model plus claims about empirical relations between some concepts, i.e., correlational or causal relationships. From each theory/model we have selected constructs, assigned these to a B-ITa process area and assigned the B-ITa process area to a B-ITa domain. For example, Gunderson's theory of system safety analysis (depicted in the upper left-hand corner of Fig. 5) is mapped onto the RAM B-ITa process area of the ICoNOs MM, where RAM stands for Risk Analysis and Mitigation. The arrow connecting 'system safety analysis' to the oval labeled **IS** indicates that this is associated to the IS architecture domain. We make the note that the definitions of some constructs made us decide to map them to more than one B-ITa process area. For example, Hoque's theory of portfolio management can be applied to process architecture (PPM B-ITa process area) and to IS architecture (IsPM B-ITa process area). The assignment of process areas to domains is summarized in Fig. 6. It can be argued that the positioning of the processes into a specific B-ITa level seems arbitrary. However, the decisions for such a positioning were driven by the definition of each process and by what we have seen in the three case studies we conducted to validate the design of ICoNOs. Recently, we began to conduct a new case study to identify whether the process areas of the ICoNOs MM are present in a real-life CNO, and to validate their positioning into the model. It is too early to make a conclusion but from the evidence obtained heretofore in the case study site, we can anticipate that the SPD B-ITa process area could fit better in level 3 of the IS architecture domain than in level 2.

4.4.1 Partnering structure process areas

We present the B-ITa process areas (in alphabetical order), grouped into the four B-ITa domains. For each process area, we provide (in parentheses) the level in which the process area is positioned, and the reference of the theory(ies) and/or model(s) from we derived it.

Our model includes 7 process areas in the partnering structure domain. These process areas are:

BMD *Business model definition* (L2). To define a blueprint of how the CNO works, describing how different variables of the collaboration fit together as a system to help creating value for each participant [27].

GSC *Governance structure and compliance* (L3). To structure the priorities and allocation of resources and decision rights to create accountability; and to ensure that activities are performed in conformity with policies and procedures. A successful compliance process will be performed through definition of effective policies and procedures [22, 33, 47, 48, 49].

IoPD *Inter-organizational policies definition* (L3). To define the plans of action, intended to influence and determine decisions, including shared risk and rewards policies to increase mutual benefits perception and shared commitment [30].

MRE *Metric-based exploration of roles* (L4). To employ approaches as relational exchange techniques, organizational communication's mechanistic and system-interaction methods to study organizational communication, structure and roles in the collaboration [26].

OSD *Organizational structure definition* (L2). To define the inter-organizational ties constructing a framework for inter-organizational decision making and placing power and authority in order to regulate the CNO work [30].

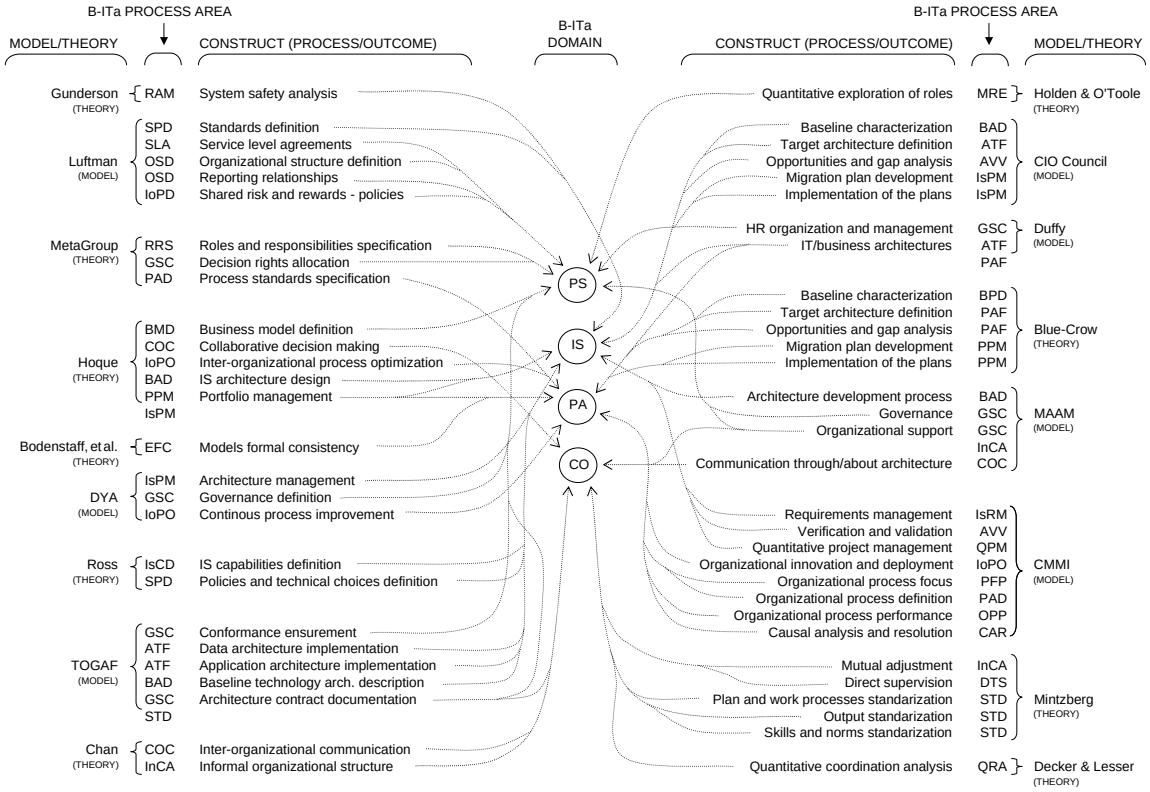

Figure 5. Map modeling theories applicable to the B-ITa domains.

RRS *Roles and responsibilities specification* (L3). To specify the roles and responsibilities, and their related guide principles, of the participants in the CNO after define its organizational structure [33].

SLA *Service level agreements definition* (L2). To describe the agreements on the deliverables, quality, and fitness-for-purpose of services that have an impact on the work of each participating organization. A successful implementation of these agreements will be delivered through effective governance structure [30].

4.4.2 IS architecture process areas

The ICoNOs MM covers 9 process areas into this domain. These process areas are:

ATF *IS architecture target formulation* (L3). To evaluate, select and design ISs needed to support the desired to-be state of the IS architecture taking into account business and IT drivers, and the processes to support [21, 22, 47].

AVV *IS architecture verification & validation* (L3). To perform periodically gap analysis to make sure changing IS requirements are managed in consistent fashion with IS architecture targets. A successful verification & validation will be performed through an effective IS target formulation [14, 21].

BAD *Baseline IS architecture description* (L2). To create a snapshot of the existing ISs and data, assessing what the current status of the CNO is concerning ISs [21, 27, 47, 49].

IsCD *IS capabilities definition* (L3). To define the ability of the collaboration to achieve new forms of competitive advantage by ISs to achieve congruence with the business environment where it works [43].

IsPM *IS portfolio management* (L3). To create the right mix of information systems investments to properly use limited resources while providing the maximum business benefit. A successful IS portfolio management will be delivered through the execution of the other IS processes effectively [21, 27, 48].

IsRM *IS requirements management* (L2). To manage the changing IS requirements during their engineering process and the development of the required ISs [14].

QPM *Quantitative IS portfolio management* (L4). To use quantitative techniques to analyze, assess, and control

	PARTNERING STRUCTURE		IS ARCHITECTURE	
5			Risk analysis and mitigation	RAM
4	Metric-based roles exploration	MRE	Quantitative IS portfolio management	QPM
3	Governance structure and compliance Roles and responsibilities specification Inter-organizational policies definition	GSC RRS IoPD	IS architecture target formulation IS capabilities definition IS architecture verification and validation IS portfolio management	ATF IsCD AVV IsPM
2	Business model definition Service level agreements definition Organizational structure definition	BMD SLA OSD	Baseline IS architecture description Standards and principles definition IS requirements management.	BAD SPD IsRM
1				

	PROCESS ARCHITECTURE		COORDINATION	
5	Inter-organizational process optimization Causal analysis and resolution	IoPO CAR		
4	Organizational process performance Event logs formal consistency	OPP EFC	Quantitative coordination relation analysis	QRA
3	Organizational process focus planning Process architecture target formulation Process architecture definition Process portfolio management	PFP PAF PAD PPM	Standardization Communication-oriented coordination	STD COC
2	Baseline process architecture description	BPD	Informal communication adjustment Direct supervision	InCA DTS
1				

Figure 6. The ICoNOs MM.

IS portfolio assets, managing such a portfolio from a quantitative perspective [14].

RAM *Risk analysis and mitigation* (L5). To identify sources of flaws and other problems (e.g., requirements inconsistencies, poor portfolio management, lack of IS principles) in the IS architecture domain, and to take action to prevent such situations in the future [25].

SPD *Standards and principles definition* (L2). To define technology standards, policies and development principles stating direction or practice on how the collaboration should deal with the ISs [30, 43].

4.4.3 Process architecture process areas

Our model includes 9 process areas which refer to this domain. These process areas are:

BPD *Baseline process architecture description* (L2). To create a snapshot of the existing processes, identifying and analyzing what the current status of the CNO is concerning processes [4].

CAR *Causal analysis and resolution* (L5). To identify sources of flaws and other problems in the process architecture domain, and to take action to prevent such situations in the future [14].

EFC *Event logs formal consistency* (L4). To use event logs for checking traceability of execution processes during collaboration, and for controlling whether profitability estimates are realized [5].

IoPO *Inter-organizational process optimization* (L5). To evaluate the process architecture in order to deploy incremental and innovative improvements to gain inter-organizational efficiency and competitive advantage. A successful process optimization relies on effective process focus planning and process architecture definition [14, 27, 48].

OPP *Organizational process performance* (L4). To establish and maintain a quantitative understanding of the performance of the standard processes set in support of quality and process-performance objectives [4, 14, 21].

PAD *Process architecture definition* (L3). To establish and maintain a repository of CNO processes, assets and work environment standards. A successful process architecture definition depends on an effective baseline process architecture description [14, 33].

PAF *Process architecture target formulation* (L3). To evaluate, select and design processes needed to support the desired to-be state of the process architecture taking into account business and strategy drivers [4, 22].

PFP *Organizational process focus planning* (L3). To plan, implement, and deploy process improvements based on a thorough understanding of strengths and weaknesses of the collaboration's processes and process assets. A successful process planning will be performed through effective process architecture definition [14].

PPM *Process portfolio management* (L3). To direct limited resources in terms of funds, people, etc., into the processes to create a holistic process orientation [4, 27].

4.4.4 Coordination process areas

The process areas covered by the ICoNOs MM into this domain are:

COC *Communication-oriented coordination* (L3). To agree on communication channels, sharing knowledge and learning in order to respond effectively to immediate client's needs and to determine what future markets will require [12, 17, 27, 49].

DTS *Direct supervision* (L2). To supervise the work by specific persons who take the responsibility for the processes, providing instructions to others and monitoring their actions [34].

InCA *Informal communication adjustment* (L2). To adjust and control the work among the participating organizations by informal communication among the actors outside the imposed hierarchical constrains for day-to-day operations [12, 34, 49].

QRA *Quantitative coordination analysis* (L4). To use techniques (e.g., causal model analysis) to link the interrelationships, called coordination relations, to the local scheduling constraints of the participating organizations [20].

STD *Standardization* (L3). To coordinate work and interactions by standardizing the processes, outputs and/or skills among the participating organizations [34, 47].

5 Discussion

5.1 Practical adoption of the ICoNOs MM

A key design decision that impacts adoption in practice of the ICoNOs MM is the decision to assign separate maturity level to each participant in a CNO. In other words, each single participating organization within a CNO can have a different level of B-ITa maturity. Although ICoNOs is being developed to assess the alignment of the entire CNO, the decisions concerning achieving, or assessing, B-ITa in a CNO can be made by one participating organization. Thus, not all participants in a CNO have to adopt the ICoNOs MM, or do so at the same time. While this design decision facilitates adoption, it is not the case that B-ITa maturity levels of each participant in a CNO are completely independent. Instead, the maturity of one participating organization influences the maturity of the alignment between business and IT of the entire CNO. For example, a participant with a specific level of B-ITa maturity as single organization can impose other participants to collaboratively achieve the same maturity level as a networked organization.

We consider chief officers of the partnering organizations in a CNO as the key users of the ICoNOs maturity assessments. This assumption is motivated by published results of researchers (e.g. [8, 11, 23, 28]), which show that the most powerful initial step to achieve B-ITa is to build strong organizational support through strong commitment of CIOs and/or CEOs. If chief officers want to improve B-ITa, they need first to assess the processes related to B-ITa, and commit as B-ITa catalysts and sponsors. Applying these findings to our work, chief officers must be actively involved in the CNO B-ITa project in at least three ways: (i) influencing the CNO to use the ICoNOs MM, (ii) choosing the best team to manage the B-ITa improvement effort, and (iii) monitoring the assessment and improvement process in each B-ITa domain. As the ICoNOs MM is a continuous MM [38], it lets chief officers assess each B-ITa domain separately (see Fig. 7). This feature of the model will let CNOs focus, for instance, on the domains with a low level of maturity. Those domains that are associated with higher maturity can, then, be candidates for inclusion in later improvements efforts.

5.2 Preliminary Evaluation

At this stage of our work, we do not have empirical evidence for the correlation between the ICoNOs MM's domains and process areas, and the business-IT alignment success in CNOs. Such a validation of the model is only possible after evaluating its design and population. However, we did an early evaluation of the question whether our approach is capable of dealing with any type of CNOs and for which type of CNOs its results will bring most benefits (i.e., the results would be most insightful). When conducting case studies to validate the design of the MM, we made sure to study different case study sites. We chose CNOs from different countries, one international and two of national nature, one entrepreneur-led and two government agencies, and one with a large amount of participants and two with only 2 or 3 participating organizations. We must also note that the B-ITa key drivers they have are different. The key drivers of one of the studied CNOs are to control costs and to manage risk, while the B-ITa key drivers of the other sites are to improve quality and to increase effectiveness.

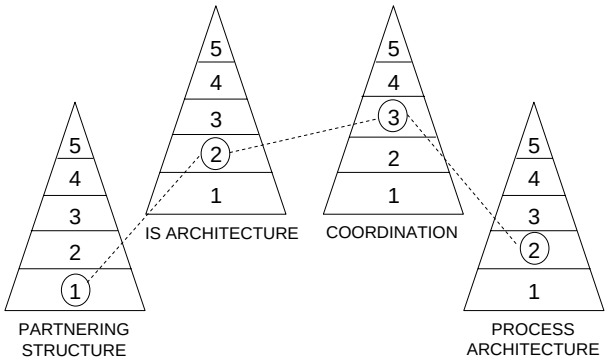

Figure 7. The pyramid view of the model.

So far, we claim that the ICoNOs assessment results are useful for CNOs that meet the CNO characteristics reflected in our definition of CNO (see Sect. 2). That is, collaborations where (i) participants pool costs, skills, and core competences to provide world-class solutions that could not be provided by any of them individually; (ii) information systems are able in each of the participants to respond dynamically to meet the ever-changing customer needs and to communicate and share information among them; (iii) participants have a clear understanding of the common goal(s) and the functions of each of the participating organizations in order to know what is expected from each of them.

5.3 Open Issues

Some interesting open matters remain to be addressed to produce a complete MM. First, we acknowledge that despite the fact that we associated each process area to one B-ITa domain only, these B-ITa process areas have an effect on each other regardless of the domain in which we included them. For example, the process area of 'Process architecture target formulation' is an input to the process

area of 'IS architecture target formulation' when addressing a design of the information systems required to support the CNO processes. We note that 'IS architecture target formulation' is a process area in the IS architecture domain and 'Process architecture target formulation' is a process area in the process architecture domain. To identify the possible relationships among the different process areas is part of the work required to provide a complete MM. We also want to provide a clear picture of the relations among the B-ITa domains, as the MAAM [49] does.

Second, to have a complete MM, the ICoNOs MM must incorporate specific goals and practices (see Sect. 4.1) describing characteristics that must be present to satisfy the B-ITa process areas. These specific goals and practices could be seen as the results to be achieved and the activities to be performed in each of the process areas included in the model. Third, validating a MM by means of a comparison with another model is considered a difficult task, as there is no reference model in practice. Therefore, for the EVALUATE step of the MM development process presented in Fig. 2, we plan to use expert panels [3], focus groups [15, 45] and testing pilots (where sponsorship from CNOs would be necessary in order to use a prototype of the model to appraise the maturity of their B-ITa).

6 Conclusion and Future Work

The goal of this paper is to present (i) a process model that can be used as a guide for developing maturity models, and (ii) the first version of a maturity model to assess processes related to business-IT alignment in collaborative networked organizations (CNOs): the ICoNOs MM. Based on an analysis of the potential applicability of several theories and models in the area of business-IT alignment, we present process areas grouped in four domains: partnering structure, IS architecture, process architecture and coordination (see Sect. 4.3). These domains should be addressed by networked organizations in their efforts to achieve business-IT alignment. Unlike maturity models for assessing alignment in single organizations, the ICoNOs MM is applicable at the CNO level. This maturity model is a promising attempt to properly understand the domains involved in collaborative business-IT alignment in terms of process maturity.

We stress that the ICoNOs MM is a work in progress to be further developed, revised, and eventually modified. Details remain to be worked out in the future as more knowledge becomes available from a case study we are conducting in a CNO to empirically identify whether the process areas included in ICoNOs are present in the investigated case study site. Our work for the immediate future includes identifying the specific goals and practices for each of the process areas (see Sect. 4.1). Future work also includes validating the maturity model as a whole. We plan to use testing pilots, expert panels and focus groups to address this validation.

References

[1] O. Adelakun. IT outsourcing maturity model. In *Proceedings of the 13th European Conference on Information Systems, The European IS Profession in the Global Networking Environment, ECIS'04*, 2004.

[2] F. M. Barbini and A. D'Atri. How innovative are virtual enterprises? In *ECIS*, 2005.

[3] S. Beecham, T. Hall, C. Britton, M. Cottee, and A. Rainer. Using an expert panel to validate a requirements process improvement model. *Journal of Systems and Software*, 76(3):251–275, 2005.

[4] Blue-Crow. Business process modelling and analysis, 2007.

[5] L. Bodenstaff, A. Wombacher, and M. U. Reichert. On formal consistency between value and coordination models. Technical Report TR-CTIT-07-91, Enschede, October 2007.

[6] W. C. Bogner and P. S. Barr. Making sense in hypercompetitive environments: A cognitive explanation for the persistence of high velocity competition. *Organization Science*, 11(2):212–226, 2000.

[7] P. Brereton, B. A. Kitchenham, D. Budgen, M. Turner, and M. Khalil. Lessons from applying the systematic literature review process within the software engineering domain. *J. Syst. Softw.*, 80(4):571–583, 2007.

[8] M. Broadbent and E. Kitzis. Interweaving business-driven IT strategy and execution: Four foundation factors. *Ivey Business Journal*, 69(3):1–6, 2005.

[9] L. M. Camarinha-Matos and H. Afsarmanesh. *Collaborative Networked Organizations: A Research Agenda for Emerging Business Models*. Kluwer Academic Publishers, 2004.

[10] L. M. Camarinha-Matos and H. Afsarmanesh. The emerging discipline of collaborative networks. In *Virtual Enterprises and Collaborative Networks*, pages 3–16. Kluwer Academic Publishers, 2004.

[11] B. Campbell. Alignment: Resolving ambiguity within bounded choices. In *Proceedings of the PACIS 2005*, pages 1–14, Bangkok, Thailand, 2005.

[12] Y. E. Chan. Why haven't we mastered alignment? the importance of the informal organization structure. *MIS Quarterly Executive*, 1(21):76–112, 2002.

[13] Y. E. Chan, S. L. Huff, D. W. Barclay, and D. G. Copeland. Business strategic orientation, information systems strategic orientation, & strategic alignment. *Information Systems Research*, 8:125–150, 1997.

[14] CMMI Product Team. CMMI for Development, Version 1.2: Improving processes for better products., 2006.

[15] D. R. Cooper and P. S. Schindler. *Business Research Methods*. Boston, [Mass., etc.]: McGraw-Hill, 8th edition, 2003.

[16] D. Damian. Stakeholders in global requirements engineering: Lessons learned from practice. *IEEE Software*, 24(2):21–27, 2007.

[17] M. Daneva and R. Wieringa. A coordination complexity model to support requirements engineering for cross-organizational ERP. In *RE'06: Proc. of the 14th IEEE Int. Requirements Engineering Conference*, Minneapolis, MN, USA, 2006.

[18] E. W. Davis and R. E. Spekman. *The Extended Enterprise: Gaining Competitive Advantage through Collaborative Supply Chains*. Financial Times Prentice Hall, 2003.

[19] D. de Koning and P. van der Marck. *IT Zonder Hoofdpijn: Een Leidraad voor het Verbeteren van de Bedrijfsprestaties*. Prentice Hall, 2002. In Dutch.

[20] K. Decker and V. Lesser. Analyzing a quantitative coordination relationship. *Group Decision and Negotiation*, 2(3):195–217, 1993.

[21] DOC Enterprise IT Architecture Advisory Group. Information technology architecture: What is it, why should you care, and how do you do one?, 2004.

[22] J. Duffy. Maturity models: Blueprints for e-volution. *Strategic and Leadership*, 29(6):19–26, 2001.

[23] B. A. Edwards. Chief executive officer behaviour: The catalyst for strategic alignment. *Journal of Value-Based Management*, 13(1):47–54, 2000.

[24] Federal Architecture Working Group. *Architecture Alignment and Assessment Guide*. The Federal Chief Information Officer Council, 2000.

[25] S. Gunderson. A review of organizational factors and maturity measures for system safety analysis. *Syst. Eng.*, 8(3):234–244, 2005.

[26] M. T. Holden and T. O'Toole. A quantitative exploration of communication's role in determining the governance of manufacturerretailer relationships. *Industrial Marketing Management*, 33(6):539–548, 2004.

[27] F. Hoque. *The Alignment Effect*. FT Press, 2002.

[28] G. S. Kearns and A. L. Lederer. A resource-based view of strategic IT alignment: How knowledge sharing creates competitive advantage. *Decision Sciences*, 34(1):1–29, 2003.

[29] T. Knothe, K. Schneider, D. Böl, T. Kahl, S. Schuster, F. Lillehagen, J. Krogstie, and H. G. Solheim. Framework for the establishment and management methodology, 2005. Deliverable A.1.4.1, ATHENA, Integrated Project Contract Num. IST-507849.

[30] J. Luftman. Assessing IT-business alignment. *Information Systems Management*, 20:9–15, 2003.

[31] A. Magalhaes, R. Araújo, and M. R. S. Borges. Designing collaborative processes. In *Proceedings of the 8th Workshop on Business Process Modeling, Development and Support (BPMDS'07) in the 19th International Conference on Advance Information Systems Engineering (CAISE'07)*, 2007.

[32] K. McCormack and A. Lockamy. The developmentof a supply chain management process maturity model using the concepts of business process orientation. *Supply Chain Management*, 9(4):272–278, 2004.

[33] META Group. Architecture maturity audit: Part 1. *META Practice*, 4(4), 2000.

[34] H. Mintzberg. *Structure in Fives: Designing Effective Organizations*. Prentice Hall, Englewood Cliffs, NJ., second edition, 1993.

[35] R. Santana Tapia. What is a networked business? Technical Report TR-CTIT-06-23a, University of Twente, Enschede, The Netherlands, 2006.

[36] R. Santana Tapia and N. Zarvić. Value-based partnering structure design for networked businesses: A multi-method approach. In *Proceedings of 21st Bled Conference "eCollaboration"*, pages 263–276, Bled, Slovenia, 2008.

[37] R. Santana Tapia, M. Daneva and P. van Eck. Business-IT alignment domains and principles for networked organizations: A qualitative multiple case study. 3rd International Workshop on Enterprise Integration, Interoperability and Networking. EI2N'08. Submitted and under review.

[38] R. Santana Tapia, M. Daneva and P. van Eck. Developing an inter-enterprise alignment maturity model: Research challenges and solutions. In C. Rolland, O. Pastor, and J.-L. Cavarero, editors, *Proc. of the 1st Int. Conf. on Research Challenges on Information Science (RCIS'07)*, pages 51–59, Ouarzazate, Morocco, 2007.

[39] R. Santana Tapia, M. Daneva and P. van Eck. Validating adequacy and suitability of business-IT alignment criteria in an inter-enterprise maturity model. In *Proceedings of the Eleventh IEEE International EDOC Enterprise Computing Conference, Annapolis, MD, USA*, pages 202–213, Los Alamitos, October 2007. IEEE Computer Society Press.

[40] R. Santana Tapia, P. van Eck and M. Daneva. Inter-organizational business-IT alignment maturity: Validating the domains of an alignment assessment instrument. International Conference on Information Systems, ICIS'08. Submitted and under review.

[41] N. Ramasubbu, M. Krishnan, and P. Kompalli. A process maturity framework for managing distributed development. *IEEE Software*, 22(3):80–86, 2005.

[42] B. H. Reich and I. Benbasat. Development of measures to investigate the linkage between business and information technology objectives. *MIS Quarterly*, 20:55–81, 1996.

[43] J. Ross. Creating a strategic IT architecture competency: Learning in stages. *MISQ Executive*, 2(1):31–43, 2003.

[44] J. Schekkerman. *Extended Enterprise Architecture Maturity Model Support Guide v2.0*. Institute for Enterprise Architecture Developments, 2006.

[45] Y. Simmons. Using focus groups as an applied research tool. *Howe's Now*, 6(2), Apr 2000.

[46] D. Tapscott, D. Ticoll, and A. Lowy. *Digital Capital - Harnessing the Power of Business Webs*. Nicholas Brealy Publishing, 2000.

[47] The Open Group. *The Open Group Architecture Framework TOGAF –2007 edition (Incorporing 8.1.1)*. Van Haren Publishing, 2007.

[48] M. van den Berg and M. van Steenbergen. *DYA: Stap voor stap naar professionele enterprise-architectuur*. Ten Hagen & Stam uitgevers, 2004. In Dutch.

[49] B. van der Raadt, J. F. Hoorn, and H. van Vliet. Alignment and maturity are siblings in architecture assessment. In *CAISE '05: Proceedings of the 17th International Conference on Advanced Information Systems Engineering*, volume 3520/2005 of *LNCS*, pages 357–371, Porto, Portugal, 2005. Springer.

[50] H. van der Zee, P. Laagland, and B. Hafkenscheid. *Architectuur als Managementinstrument: Beheersing en Besturing van Complexiteit in het Netwerktijdperk*. Ten Hagen Stam Uitgevers, 2001. In Dutch.

[51] P. van Eck, H. M. Blanken, and R. Wieringa. Project GRAAL: Towards operational architecture alignment. *International Journal of Cooperative Information Systems*, 13:235–255, Sep 2004.