Value-Based Business-IT Alignment in Networked Constellations of Enterprises

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Abstract

Business-ICT alignment is the problem of matching ICT-services with the requirements of the business. In businesses of any significant size, business-ICT alignment is a hard problem, which is currently not solved completely. With the advent of networked constellations *of enterprises, the problem gets a new dimension, because in such a network, there is not a single point of authority for making decisions about ICT support to solve conflicts in requirements these various enterprises may have. Network constellations exist when different businesses decide to cooperate by means of ICT networks, but they also exist in large corporations, which often consist of nearly independent business units, and thus have no single point of authority anymore. In this position paper we discuss the need for several solution techniques to address the problem of business-ICT alignment in networked constellations. Such techniques include:*

- *RE techniques to describe networked value constellations requesting and offering ICT services as* economic value. *These techniques should allow reasoning about the matching of business needs with available ICT services in the constellation.*
- *RE techniques to design a networked ICT architecture that supports ICT services required by the business, taking the value offered by those services, and the costs incurred by the architecture, into account.*
- *Models of decision processes about ICT services and their architecture, and maturity models of those processes.*

The techniques and methods will be developed and validated using case studies and action research.

Paper type: Research position paper

1. Introduction

Business-ICT alignment is the problem of matching ICT services with the requirements of the business. In businesses of any significant size, business-ICT alignment is a hard problem, which is currently not solved completely.

Additionally, most businesses can not be viewed anymore as a single enterprises with precisely one point of authority of decision taking on ICT support for business need satisfaction. Rather, businesses form *networked value constellations* [17] to satisfy complex customer-needs. Well-known examples are Cisco Systems and Dell, but many other constellations exist in practice. By a networked value constellation we mean a network of profit-and-loss-responsible business units, or of independent companies. Networks exist when different businesses decide to cooperate by means of ICT networks, but they also exist in large corporations, that often consist of nearly independent business units. For example, large companies may acquire other companies that must remain profitable; or they may restructure themselves into a number of cooperating business units that are all profit-and-loss responsible. Businesses may outsource some or even most of their activities. In yet other scenarios, companies may join a value chain or start a cooperation with a number of other companies to implement an e-commerce idea.

Networked value constellations place strict requirements

on ICT support, because it is ICT that enables and allows the creation of such a constellation in the first place. Without properly functioning ICT, there can be no networked value constellation.

Networked business-ICT alignment has the characteristic feature that there is no single point of decision taking regarding ICT. In practice, many enterprises are involved, with different and, in many cases, conflicting interests. Because economic value —monetary value— is a well known means to make trade-offs between enterprises with conflicting interests, we propose to deal with the alignment problem of networked constellations using a value engineering viewpoint. Value-oriented techniques need to be investigated by which one can design networks of services and implement these in a network of business processes and systems. In our approach we view a networked value constellation as a set of enterprises exchanging object of value with each other. Here the objects are ICT services that satisfy a business need. In order to facilitate automated reasoning on alignment, we need to conceptualize and formalize such constellations from a customer (business) perspective as well as from a ICT-supplier perspective.

Secondly, the design of ICT architectures for networked value constellations must be done in such a way that expenses related to the architecture become apparent, and can be used in the value engineering viewpoint for assessment of economic sustainability of the chosen architecture.

Finally, to reach a certain level of alignment in a networked value constellation, it is required that processes to do so are in place at the participating enterprises. Obviously, such processes are often not executed by enterprises yet. To arrive at enterprises that have the capabilities to align their business needs properly with offered ICT services in a network, a Capability Maturity Model (CMM) is needed, identifying the minimum set of core capabilities to reach a certain alignment level.

In this research position paper we analyze these research problems and sketch the solution approach that we have embarked upon. We sketch the research framework in section 2 and research questions in section 3. In section 4 we compare our approach with other approaches, and with the current needs of industry. Section 5 concludes the paper with a discussion of the current state of the research.

2. Research Framework

To structure the problem and explain the research questions, we use the research framework shown in figure 1. First we structure a business constellation into a number of service provision layers. From the bottom up, these layers are as follows:

- The *physical infrastructure,* consisting of buildings, computers, cables, wireless access points, radio waves, printers, etc.
- The *software infrastructure,* consisting of operating systems, middleware, network software, database management systems, office software, etc. We define infrastructure (physical and software) as a utility service, required to be present and functioning for all users when and where they need it. Software infrastructure is rapidly growing in functionality; for example, the telephone system is nowadays integrated with the software infrastructure.
- *Business systems,* consisting of software applications and information systems acquired and used for the service of particular business processes and particular users. In contrast to infrastructure, business system design is driven by the needs of particular users, particular business processes, and particular business domains, not by the needs of all possible users, all possible processes and all business domains.
- The *business constellation,* consisting of processes, organizational roles and units that perform value adding activities and exchange physical objects and services of economic value.
- The *business constellation environment,* consisting of other business actors, customers, suppliers and other stakeholders.

We have motivated the suitability of these layers for architecture research elsewhere [23]. Cross-cutting these layers are several important aspects, including the following.

- *Services.* These are useful activities performed by entities at the various layers.
- *Value.* Services are useful, by definition, when they produce economic value for some actors.
- *Semantics.* The services we are interested in are ICT services, and these consist of storing and manipulating data, that have a semantics.
- *Communication channels.* ICT services are delivered by transmitting data across channels connecting actors.
- *Process.* At all levels in the hierarchy, services are delivered by sequences of interactions ordered in time, called processes.
- *Quality.* Service delivery has a certain quality, such as usability, efficiency, etc.

We have shown the relevance of these aspects, except the value aspect, in earlier research in software and systems design frameworks [20, 21, 22]. We added the value aspect

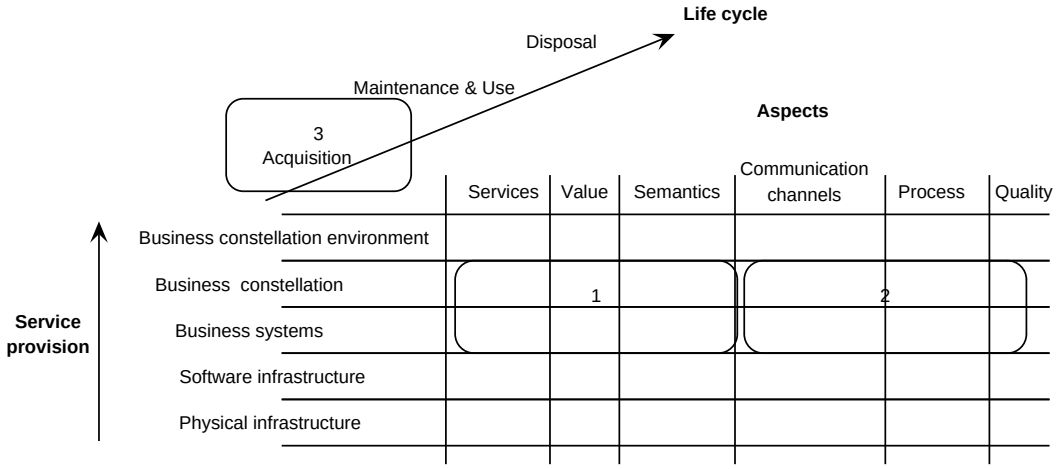

Figure 1. Research framework.

to address business-ICT alignment from an economic value point of view.

Orthogonally to these two dimensions, there is a *life cycle dimension*, which indicates that entities at each of these layers have a life cycle starting with acquisition and ending with disposal. During their life, entities have properties as shown in our framework: They provide services that should be of value and that should have semantics, etc.

3 Research questions

We can explain our three major research questions in terms of our framework. The first question concerns value-based ICT service specification (area 1 in figure 1), the second concerns the realization of these services by networked business processes and business systems (area 2), and the third concerns the architecture processes by which these specification and design activities can be realized (area 3).

Figure 2 explains the relationship between the three areas in terms of a business network (service consumer and service provider) and life cycle phase. Arrow A represents decisions made by the provider and consumer about what services will be offered by whom. The key working hypothesis is that we regard arrow A as *commercial service provisioning*, both in the case of cooperating independent companies, but also within one company. Arrow A corresponds to area 1. The vertical arrows B through E represent the realization of services in business processes and systems, and their influence on the service model. This is area 2. And where areas 1 and 2 study design techniques, area 3 studies the design processes involved in this life cycle phase. Arrow F in the figure represents IT service management, and is out of the scope for this research.

More in detail, the three areas contain the following research questions.

1. **Value-oriented requirements engineering (RE).** Here our research goal is to specify ICT services from a business value perspective. We will do this by building upon previous research by Gordijn and Akkermans [6], in which the e^3*-value* method for designing a network of value activities and value exchanges was developed. We also developed a supplier-oriented service provisioning ontology, which has been used, as an extension to e^3*-value*, by the electricity and entertainment industries to define bundles of services to be offered by cooperating electricity companies to consumers [2]. What still needs to be done is to design a service ontology from a *customer* (i.e. business) point of view, and to specialize the supplier and consumer-oriented ontologies to the ICT service provisioning domain. Additionally, we need to develop techniques for matching ICT-requirements, expressed cf. the earlier mentioned customer-side service ontology, with ICT services to be offered by suppliers. We plan to address these issues by the following research questions:

   (a) Which ontologically founded concepts are needed to conceptualize ICT services, both from a consumer and a supplier perspective, such that preferably automated matching of consumer's ICT needs and supplier's ICT services is feasible? Additionally, the ICT services ontology should properly relate to the e^3*-value* ontology.

   (b) How can we match supplier-oriented and consumer-oriented ICT service specifications? We need to consider ways to compose supplier

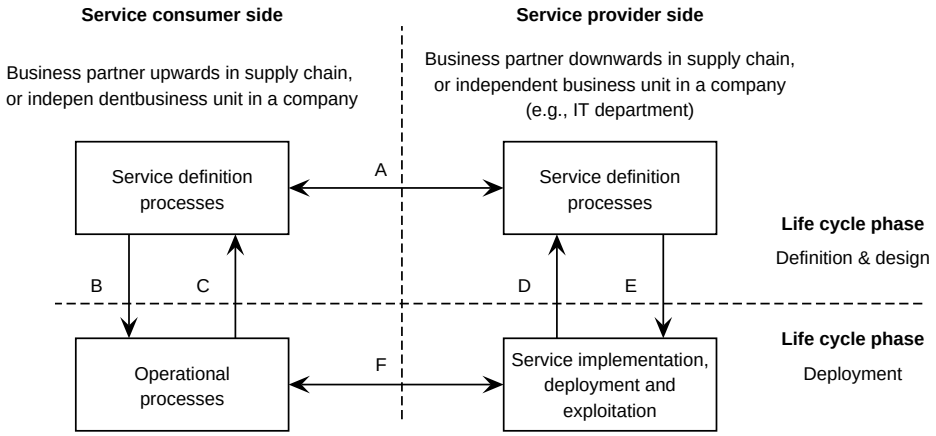

Figure 2. A networked business.

services into bundles that are valuable from a consumer perspective and profitable for all concerned. We intend to deliver software support for solving the matching and composition problem.

(c) How can we estimate the economic value delivered by a service? The e^3-*value* approach and supporting software tool already have facilities for economic value analysis of services. We want to extend and specialize them for the ICT services domain.

We will investigate these questions by using our previous work on service specification and value engineering [2, 3, 6, 7], and by using theories from investment analysis [9] and software engineering economics [4, 19]. We will validate our results jointly with our business partners by means of action research.

2. **Business-ICT architecture design.** In this area we need to investigate how to implement services in a networked business. In terms of our framework, this requires a definition of the business systems (applications and information systems), their external behavior, communication and quality attributes so that they support the desired business services, using as many existing systems as possible. This leads to the following questions.

   (a) How can existing systems be configured so that the desired services are delivered at the required quality of service? We need to link configuration decisions to desired services. Furthermore, we will investigate how to rank the relevant architectures on their support of different required services, and how to make value-based decisions among them. We will validate these techniques in simulated case studies and action research.

   (b) How can we design a network of business systems to provide the services as identified in area 1? Classical methods such as Information Engineering [10, 15] design modular systems by means of CRUD analysis but in a networked context this is not sufficient, as ownership is not taken into account. Modular networks involve decisions about different kinds of ownership (of data, of processes, of systems) each with different cost and revenue structures, communication requirements, and access restrictions. We will investigate the use of value-based techniques to make these decisions in practice by means of case studies, design new techniques and validate them in simulated case studies and action research.

   (c) How does ICT-architecture influence the value network? We showed earlier that this influence exists [24]. For example, a decision to outsource ICT services requires enterprises are to be added to the value network; and this may in turn require adding an additional enterprise that assists in outsourcing, introducing additional value exchanges.

   (d) All previous three research questions touch in one way or another on the question when a model of business systems and business processes (the rightmost columns of figure 1) is "correct" with respect to a model of value network (the leftmost three columns of figure 1). The value network

expresses business requirements to be satisfied by an architecture of systems and processes on the right. The research question is what the appropriate correctness notion is, and how we can provide support for proving a correctness relation between the value model and architecture model.

We will investigate questions (b), (c) and (d) by means of action research and simulated case studies, i.e. we will propose techniques, and then validate them in simulations and in consultancy projects.

3. **Architecture maturity model.** Business-ICT alignment can be reached and done at various levels of maturity. There have been some proposals for architecture alignment maturity models [18], but these are oriented to single businesses and do not incorporate the value viewpoint. In this area, we study architecture processes in networked businesses and develop a maturity model for this that incorporates the value viewpoint.

   (a) Which decision processes take place in networked businesses when allocating services to a distributed ICT architecture? How can we use value-based specification and allocation techniques in these processes?

   (b) What is the relationship between these processes and known maturity models such as CMMI, the IT Service CMM and the REAIMS maturity model [11, 12, 16]?

   (c) How can maturity levels for architecture management be defined? What process areas are needed at each level?

   Except for the question how to use value-based decision techniques, these questions are empirical, not normative, and we will investigate them by means of case study research. The normative question how to use value-based specification and allocation techniques in these processes will be studied by simulated case studies, i.e. by showing how these techniques could have been used in the cases that we study. With our business partners we will identify user organizations where we can study the structure of architecture design processes.

Note that the research methods mentioned above are empirical: Very briefly, case study research is the analysis of projects performed by others [25], and action research is the analysis of projects in which the researcher participated [14]. We will also use *simulated* case studies, in which we will explore what would have happened if our techniques would have been used in a case studied by us.

4 Comparison with related work

The combination of value engineering with service-oriented requirements engineering and architecture design is, to our knowledge, new and currently not investigated elsewhere. This approach leads to interesting new insights in requirements engineering that we need to explore further, for example concerning the use of problem frames at the business level [24].

As observed before, our research effort is about business-ICT alignment for networked businesses, and is not limited to alignment in a single enterprise. Classical methods like Information Engineering [10, 15] analyze functions, processes and semantics domains in one business to then design information systems using modularity arguments (i.e. CRUD analysis). In this research effort, we take a network point of view and extend these techniques with value-based techniques to design and implement value networks.

Value-based software engineering extends software project management with techniques that relate decisions to their impact of budgets and business objectives [5, 8]. We do not study project management (although we will look at the architecture process) and we will focus on ICT service provision for networked business.

Asundi used techniques from investment theory in decisions about the mix of architecture styles to be used to support a given set of quality attributes [1], but this does not relate architecture to service requirements in a networked business, as we do.

The RAISA project (`http://www.ifi.uib.no/projects/raisa/`) investigates architecture alignment in a model-driven framework [13]. Although RAISA does allow inclusion of the network view, the focus on networked business integration and the commercial value of architecture decisions, that is at the heart of VITAL, seems to be absent from RAISA.

5 Discussion and conclusions

Current businesses face an architecture integration problem caused by the presence of legacy systems, vestiges of island automatization, acquisitions and mergers of other companies, and the increasing importance of value chain automization and of business networks. These developments facilitate outsourcing of non-core business activities and, increasingly, of ICT development activities. In some cases outsourcing takes the form of offshoring to low-wage countries. This trend is currently very clearly observable. All these developments require a well-integrated and business-aligned ICT architecture. Our research aims to deliver techniques to align business perspectives of various enterprises with ICT-architecture integration and outsourcing

decisions, operationalize this by means of validated techniques for integrated business process and information system architecture design, and facilitate implementation of these techniques by means of an architecture process maturity model.

The research described in this position paper will be done in the coming four years in cooperation with about 10 consultancy firms and ICT service providers, who will act as a sounding board and as a source of industrial case studies. More information can be found at http://www.vital-project.org/. We are actively seeking cooperation with other researchers in this area.

References

[1] J. Asundi, R. Kazman, and M. Klein. Using economic considerations to choose among architecture design alternatives. Technical Report CMU/SEI-2001-TR-035, Software Engineering Institute, 2001.

[2] Z. Baida, J. Gordijn, A. Z. Morch, H. Sæle, and H. Akkermans. Ontology based analysis of e-service bundles for networked enterprises. In *Proceedings of the 17th Bled International e-Commerce Conference*, page to appear, 2004.

[3] Z. Baida, J. Gordijn, H. Sæle, A. Z. Morch, and H. Akkermans. Energy services: A case study in real-world service confi guration. In A. Persson and J. Stirna, editors, *Advanced Information Systems Engineering. 16th International Conference, CAiSE 2004*, volume 3084 of *Lecture Notes in Computer Science*, pages 36–50. Springer-Verlag, 2004.

[4] B. Boehm. *Software Engineering Economics*. Prentice Hall, 1981.

[5] B. Boehm and L. Huang. Value-based software engineering: A case study. *Computer*, pages 33–41, March 2003.

[6] J. Gordijn and J. Akkermans. Value-based requirements engineering: Exploring innovative e-commerce ideas. *Requirements Engineering journal*, 8(2):114–134, 2003.

[7] J. Gordijn, J. Schildwacht, V. Kartseva, R. Wieringa, and H. Akkermans. A domain-specifi c cross-organizational requirements engineering method. In *12th IEEE International Requirements Engineering Conference*, sept 6–10, Kyoto 2004.

[8] W. Harrison. Economic-driven software engineering research. `http://www.grabpage.org/~edser/`.

[9] C. T. Horngren and G. Foster. *Cost Accounting: A Managerial Emphasis, sixth edition*. Prentice-Hall, Englewood Cliffs, NJ, 1987.

[10] J. Martin. *Information Engineering*. Prentice-Hall, 1989. Three volumes.

[11] F. Niessink. *Perspectives on Improving Software Maintenance*. PhD thesis, Vrije Universiteit Amsterdam, Division of Mathematics and Computer Science, 2000. `http://www.serc.nl/people/niessink/publications/PhD.Niessink.pdf`.

[12] F. Niessink. Perspectives on improving software maintenance. In *Proceedings of the International Conference on Software Maintenance*, pages 553–556, 2001. `http://www.serc.nl/people/niessink/publications/ICSM01.Niessink.pdf`.

[13] A. Opdahl. Model-supported alignment of information systems architecture. In K. Kangas, editor, *Business Strategies for Information Technology Management*. Idea Group Publishing, 2003.

[14] C. Robson. *Real World Research*. Blackwell, 2002. Second edition.

[15] W. v. d. Sanden and B. Sturm. *Informatiearchitectuur: De infrastructurele benadering*. Panfox Holding, 1997.

[16] I. Sommervile and P. Sawyer. *Requirements Engineering: A Good Practice Guide*. Wiley, 1997.

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

[18] H. van der Zee, P. Laagland, and B. Hafkenscheid. *Architectuur als managementinstrument: Multi Client Study*. Ten Hagen Stam, 2000. In Dutch.

[19] C. Verhoef. Quantitative IT Portfolio Management. *Science of Computer Programming*, 45(1):1–96, 2002. Available via: `www.cs.vu.nl/~x/ipm/ipm.pdf`.

[20] R. Wieringa. *Requirements Engineering: Frameworks for Understanding*. Wiley, 1996.

[21] R. Wieringa. A survey of structured and object-oriented software specifi cation methods and techniques. *ACM Computing Surveys*, 30(4):459–527, December 1998.

[22] R. Wieringa. *Design Methods for Reactive Systems: Yourdon, Statemate and the UML*. Morgan Kaufmann, 2003.

[23] R. Wieringa, H. Blanken, M. Fokkinga, and P. Grefen. Aligning application architecture to the business context. In *Conference on Advanced Information System Engineering (CAiSE 03)*, pages 209–225. Springer, 2003. LNCS 2681.

[24] R. Wieringa, J. Gordijn, and P. v. Eck. Value framing: A prelude to software problem framing. In *1st International Workshop on Advances and Applications of Problem Frames (IWAAPF)*, 2004.

[25] R. Yin. *Case Study research: Design and Methods*. Sage Publications, 2003. Third Edition.