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Enterprise Architecture as a Collaboration Tool

Discursive Process for Enterprise Architecture Management, Planning and Development

JYVÄSKYLÄN | YLIOPISTO

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Sic Transit Gloria Mundi –
Soli Deo Gloria.

ABSTRACT

The information and communication technology (ICT) advancements change the role of ICT in organizational use to a central concern, since both business and public enterprises heavily depend on information systems and technological infrastructure. Management, planning and development of the organizational ICT are no more a task for the ICT experts only. The expertise of both business and ICT specialists is needed to align ICT deployment with organizational goals, ensuring appropriateness of related investments with respect to the enterprise resources. However, collaboration between the business and ICT communities of practice is perceived as a challenge. Enterprise architecture (EA) proposes a holistic approach to the management of organizational ICT systems and infrastructure. By structuring the collaboration, it interlinks the contributions from different communities of practice to the decision making process. From both IS and EA literature, a common framework of reference is derived and validated through practitioner experience. Distinct levels of abstraction in the framework accommodate the concerns of different decision makers: managerial overview for the whole enterprise, business operations management at the level of the activity domains, and the systems design and development concerns for the implementers. An understanding of the ICT management and planning in the context of a deploying organization is deduced as a prerequisite for an eligible EA methodology. An EA process meta-model is constructed to guide the overall EA process for well-informed strategies and decisions on the organizational ICT and, as well, for consulting assignments. The study is conducted as an action research effort within an ICT consultancy, for which it develops an EA methodology. Case studies of client projects in different industry domains and various types of organizations provide the empirical basis. The constructed results are validated in practical use along the research effort. Reflective analysis of the series of studies reported on academic fora conveys a discursive process. Establishing a common agenda and giving empowered roles for different expert groups characterize both the research process and the EA process meta-model that logically guides and coordinates the dynamics of the collaborative enterprise development.

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FIGURES

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CONTENTS

1 OVERVIEW

Information and communication technologies (ICT) are a foundational element in organizations today. During the past decade, a revolutionary development has been observed, during which networking technologies have triggered profound changes in the organization of work, transmission and processing of information, models of business and ways of collaboration. In the past decades, organizational change was seen to become a permanent state. Today, business organizations target at being equipped to change proactively and to manage constant changes and transition periods. Unpredictable business environment changes as well as alterations with short notice in the needs, requirements and expectations of the stakeholders call to be prepared for alternative future scenarios.

While the technologies are provided, most organizations face the expectation that accurate information should be available everywhere and at any time. The information should be processed to various information intensive services both to internal and to external stakeholders. There are industry sectors such as finance or insurance where most services can be provided by means of information systems. In other sectors involving material substances, the production and logistics chains over the whole life cycle of products in, e.g., manufacturing or transport, are loaded with information intensive services. Interactive after sales services are asked for when the end products are in use. This means challenges to the management, planning and development of the ICT support for the activities of the organizations, be it private businesses or publicly funded organizations. Rapid development of the technologies multiplies the challenge.

The *enterprise architecture* (EA) approach provides a possibility to collect and manage information about the different elements of the enterprise (Rood, 1994) and consider decisions on its development together with, and related to the ICT that the enterprise is using to support its activities and its developments. This involves managerial considerations at various levels of decision making. Expertise of various business and ICT professionals is involved in the planning, design, development and maintenance of the systems,

applications, tools and infrastructures. The process of managing the ICT as an asset can not be assigned to only business or ICT managers, but requires interaction and contribution from both. This dissertation provides insight into how to enable this collaboration of different communities of practice using their specific language and descriptions of their viewpoint to the planning and management of ICT in the enterprise. The aim is to establish a process for enterprise architecture management, planning and development to serve as a support tool in this enterprise architecture work.

1.1 Concept

The enterprise architecture (EA) is considered to be the information systems and the ICT infrastructures in an enterprise, and the descriptions that record the structure of these. (Please refer to Section 3 for an elaboration of these concepts). The prime concerns for EA are the managing of the actual architecture, planning for changes in it and developing the systems and infrastructure following the plans. The EA descriptions are needed for these activities and take the form of graphical models, textual descriptions, charts and other ways to record and explain the structures of the ICT in use or in the plans.

In the development of large, distributed systems and enterprise applications an architectural approach is essential to orchestrate the development efforts. For this purpose, the EA as a concept was introduced first in the software engineering (SE) discipline. Within the information systems (IS) science, there is a planning phase that takes place prior to the actual life cycle of an information system and is devoted to a broader examination of the system environment in the enterprise That phase is known as the information systems planning, ISP (Olle et al., 1988, 5). In large organizations, this context for the systems usually consists, among other things, of other information systems. The ISP is mostly concerned with business considerations, and is connected to strategic decisions and alignment of ICT related developments with business goals (Ward & Peppard, 2002). The EA concept related to the IS field starts developing on the ISP area.

EA was established in the mid-90's with significant influence from the Federal Government of the USA through legislation. The Information Technology Management Reform Act of 1996 (known as the Clinger-Cohen Act) compelled the US governmental organizations to establish ways to describe and document the IT architectures and the information systems in use in the state government agencies. The motivation was to ensure correct and reliable administrative data processing and transmission. EA is since seen as a tool to provide transparency and coordination in the management and development of ICT systems, management of information, and later also in change management and organizational development.

Besides information systems and information management focused approaches (Earl, 1989; Ward et al., 1990; Robson, 1997; Ward & Peppard, 2002,

McNurlin & Sprague, 2004) the EA approach has since been found a useful tool for private business organizations as well. It is a way to systematically plan the logical and technological structures and technologies used for management, processing and transmission of information. The earliest EA method targeted to private businesses was outlined in the beginning of the 90's (Spewak, 1992). The Open Group Architecture Framework (TOGAF, The Open Group, 2003) has become an institutionalized standard, which the EA work of individual ICT providers, usually consultancies (META Group, 2002; Peyret, 2002; Lapkin, 2003) has been contributing to, but also drawing on.

The changes in technologies bring the need to extend the IS planning to the management and planning of the whole enterprise in a collaborative activity of business and ICT experts. This is what the enterprise architecture work means in the context of this study, as the inquiry is conducted in a collaborative research project with a consortium of three ICT providers. One of them sets the target for the present thesis: the *EA process* for managing, planning and developing of ICT assets in an end-user organization. With the growing significance of the technologies to the organizational activities (Hirvonen, 2005, 11), the consulting approaches on organizational ICT also need to evolve. From the viewpoint of the provider organization, understanding the flow of the decision making process for well-informed EA decisions in any end-user organization is the necessary basis for a consulting methodology for EA assignments.

1.2 The Case Under the Study

Private businesses as well as non-profit enterprises like public sector organizations try to meet information related expectations and to enhance and improve their business with related technologies. ICT consultancies provide services related to the management and planning of the information and information systems for their clients, of the infrastructures supporting the systems and the technologies applied to build these.

The research reported in this thesis is part of a collaborative research effort with an ICT provider that extends its activities from systems development and maintenance to consulting services covering all ICT-related concerns of the end-user organization. This study focuses on the enterprise architecture consulting services. The company, TietoEnator (TE, www.tietoenator.com) is the North European market leader of full scale ICT providers and is currently present in 25 countries including China and USA. For providing solutions to very different domain areas, the company is organized to domain specific divisions: firstly banking, finances and insurance, secondly telecommunications and media, thirdly welfare services and healthcare, fourthly forest industries (forestry as well as forestry related industries such as pulp and paper) and energy sector and as the fifth area, government services together with

manufacturing and retail industries. For all these, both consulting and solution tailoring activities are taking place.

TE has grown with its clientele and the development in technologies by expanding its activities along with the changes in the ICT landscape. TE is now providing a complete palette of ICT related services from management consulting to more technology related ICT consulting services. It is still retaining the systems design and development activities that had grown to the major activity until the 1990's. The company is also providing hosting services, with which the business started in 1968, in a division for processing and network services, together with a digital innovations division as part of the TE overarching cross-industry services.

The current research effort was conducted as a TE Group project with all the industry specific divisions taking part in it. Representatives of all these divisions were involved either throughout the research process or at different phases of the effort extending over three years. The divisions serving public and healthcare organizations, telecom and media industry, and manufacturing and logistics were the most active contributors to the effort. In the review and commenting of the results, all divisions were involved, and the materials covered activities of the whole TE Group in the architecture area.

In the area from which the EA consulting emerged, the management perceived the need to build a method that would more comprehensively cover the context of a client, the portfolio of the client's businesses and the business drivers for ICT as well as the systems and technology portfolio. Since at least some of the IT projects deal with quite long-term investments, future perspectives of the business are an important aspect when planning ICT support. This information is needed to adequately define the business requirements for the systems and infrastructure, or to evaluate the portfolio for these systems and the technologies and developments for them. To provide results with value to the client, information has to be gathered in the client organization on the business contingencies, the systems and technologies currently in use, and the information and data that is bringing or could possibly bring more value and significance to the business activities.

Technology investments for acquiring hardware or software require not only financial resources, but also training, transition times, changes in the organizing and in methods of work. Careful evaluation and consideration of future scenarios is needed prior to investment decisions. This is what the EA consulting provides: a collaborative evaluation and planning of the business, both its current and middle term strategies and the long term development prospective of business opportunities with the enabling ICT solutions that are available. The EA consulting is also to be understood as the approach chosen by the provider, in this case (TE), for the benefit of their clients and their own long term business goals. Instead of small scope solutions the strategy is to plan for a sustainable business infrastructure, in addition to present day technological solutions for the client. The aim is to provide persistent advantages for both the client and the provider.

This type of knowledge is needed for the strategic decisions of the client organization. Thus, the consultants who were commissioned to plan, for example, the integration of systems or renewal of data communications of a large company and similar EA consulting cases, found themselves involved in the strategic planning of the business. They had to derive information directly from the mission and strategy statements of the company to be able to plan technology systems that would match the current business aims and withstand future challenges. A common problem was encountered quite often: the client organizations are quite often unprepared to provide the required information that is to be used in the decisions on ICT planning and development. Thus, the methodology development is not only targeted for the consultants as an in-house, TE-specific tool, but also for the end-user organizations, i.e., the clients, to facilitate project planning and communication between the provider and the client.

Since EA was a relatively new concept, the exploration started by mapping the emerging concept to the then current consulting services palette (Figure 1). *EA projects* are defined as projects where not only one solution (an information system or infrastructure element) to one domain area is developed, but where a larger context is covered concerning several systems in the client organization. Such projects are found, to overlap somewhat with several types of other projects provided (Hirvonen et al., 2004). These include (Figure 1) management consulting, IT or IM consulting, business development, often with business process redesign, or, e.g., developing new business models, system integration and enterprise application planning and development, SOA architecture development and business process management systems planning. Last but not least, also traditional systems development is dependent of the enterprise architecture, and its relationship to EA is considered.
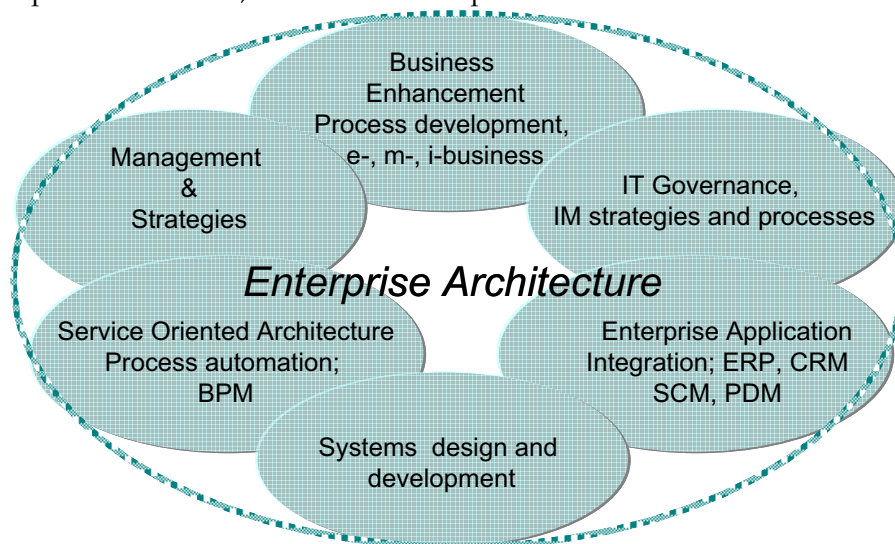
FIGURE 1   The areas joined in end-user organization EA management and planning

Building systems no longer constitutes a major IT activity of large end-user organizations. The ICT department finds itself today in a consulting role, managing a portfolio of system and implementation projects, and secondly, providing ICT related services to the business organization and maintaining or administering their ICT equipment and systems. However, often also external consultancies are hired for these tasks. *Consulting* is seen as a service where no material solution is implemented, and the client is seen as information for decision making and plans for solutions, possibly several alternative ones with evaluation of technical details, cost etc. (Block, 2000).

Further studies (Pulkkinen & Hirvonen, 2005b) find the IT governance (ITG) models as a new approach to organizational IT management and provisioning of ICT related services. Today, systems development is more often an activity of providers specialized in it than an activity of the IT department. Bespoke software systems are less frequently built by providers. The trend is towards systems designed from generic requirements and sold as software packages, together with the service of integrating and adapting them to the specific context and requirements of the end-user organization. However, systems development is still an area adjacent to the EA management, planning and development, since the EA plans lead to the implementation, integration or enhancement of business information systems.

The challenge for EA consulting is to provide an overview to the enterprise ICT while prioritizing and planning increments of EA and for sustained EA management and developing and outlining a managerial collaborative process for the long term planning of the client business and ICT. The day-to-day maintenance and support processes provide valuable feedback to the EA process, but are not designed for long term planning. Bringing up the EA issue was in the interest of the provider also in the sense of making their clients aware of the need and the advantages of a managed EA.

1.3   Strategic Management of Resources

The consulting activity may be involved with the organizing of the core and support processes in the business, the planning of value added services, in the setting of the goals and envisioning of the future scenarios. In all these, the use of resources is in question. However, simply handing over documents on the plans does not change the organization. In consulting activity, the success of the projects is not alone in the hands of a provider. For any development project to succeed, or plans and evaluation results to be valid, they should be aligned with the strategic business decisions. EA aims at long term planning and future success of the enterprise and manages the incremental developments to the EA. Technology knowledge for the long term decisions is, with the increasing significance of technology support for enterprises, needed more often. The ICT consultants find themselves thus involved in the business planning in an earlier phase than the traditional information systems methods suggest. The providers

are reacting to this need with EA methodologies assisting in resource sensitive planning. The company in our case has chosen an evolutionary path, not to obtain business development knowledge through, e.g., an acquisition, but by organizational development and accumulation of EA knowledge to which this research also contributes as EA methodology development.

From the point of view of ICT deployment or end-user organizations, the EA approach is well in line with the resource based view (RBV) in relation to business enterprises. Strategy process (Ansoff, 1965) is in the centre of business management. In this process, the company finds its mission, goals and objectives and based on these defines the strategies it follows. In the resource-based approach the company is relying on the uniqueness of the resources at its use as inputs in its business processes (Conner, 1991). The resource based view looks at the strategies from within the enterprise rather than from the point of view of the arrangements of actions the enterprise is undertaking on the market (Mahoney & Pandian 1992; Barney, 1996; Barney 2001).

Resources like technological capability, the cost structure, or the R&D capabilities that the company can rely on, are the basis for its strategic choices (Oliver, 1997). Institutional resources like incentive programs and knowledge management systems for knowledge diffusion and innovations can amplify the strategic choices in the use of the resources. The capability to innovate, i.e., combine both tangible and intangible resources in novel ways is a key in strengthening the position among competitors (Kogut & Zander, 1992). The EA approach means attending to the management of both the information and data resources, and the organizational ICT the way one would attend to the management of any asset. This ties the EA process to the strategy process of the enterprise. Strategic planning is a continuous process (Robson, 1997, 31) and thus the EA management is continuous as well. Both business and ICT management are accountable for the related resources and their interdependencies as the EA baseline. For developments the EA combining the business and the ICT viewpoints provides a negotiation platform to plan, communicate, evaluate and compare development scenarios for different stakeholder groups at different organizational levels.

1.4 From the IS Process of one System to the EA Process of Enterprise ICT

The researchers encounter in this study the challenge to equip the consultants with a methodic approach for the architecture consulting projects. Software engineering and information systems development methods are the common framework of reference for the ICT professionals who work as consultants at TE and in other similar companies. A central element in the system development methodologies is the *software process* (e.g. Sommerville, 1998; Pressman, 2000) that is the common framework of reference for the individuals involved. In software engineering (SE), software process targets at the construction of a

software intensive system or a software product. In the information systems science, the *IS process* is similarly the central concept: its activities are organized around the target system as the information system development life cycle process (Avison & Fitzgerald, 2003, 27). The IS life cycle is a construct developed from the software process but that takes into consideration broader aspects of the IS design, development and implementation, as well as the system usage that is the maintenance phase for the IT organization.

The emergence of the IS life cycle has been characterized as a shift in the software development paradigm (Welke, 1994), meaning the emergence of the IS paradigm to complement the SE paradigm. Organizational and social dimensions and business issues are included to theoretical assumptions. However, the IS development paradigm maintains, as the conceptual core, the life cycle of one software intensive system from its inception to the phaseout. With this, the present research is binding the EA methodology to the legacy of IS methodologies, but also challenging the limits of the IS development process in EA related activities. Consulting methodologies are also taken into account. The need for an even broader paradigm, the *EA process* as the process for the management, planning and development of the comprehensive ICT support of a deployer organization is argued for.

The consultancy members are mediating in the social interaction of EA management and planning, or discourse between business and ICT experts as the major stakeholder categories. This calls for a method to be used by the provider (see Hirvonen et al., 2003), but due to the nature of consulting activity, also has the goal to give the clientele a model EA management process to follow. There are also further triggers for this EA methodology project. The target is to unify the approach in the consulting projects and to provide a frame for the quality management within this service activity.

Structured ways and means for processing information and managing it, sometimes more sometimes less thoroughly planned, are present in any end-user organization. This is the starting point for EA: if there are computerized systems involved, there is an enterprise architecture, be it ad hoc or knowingly planned and constructed. It is owned by the deploying organization that also makes the related decisions, approves of the plans and development efforts to be undertaken. Consultants provide information or broader contributions to the discourse, and are sometimes triggering the conversations in the first place, to bring the organization to a more reflective and aligned management of their entire ICT as an asset. This is the ultimate aim of introducing the EA approach to a client organization. The consultancy would then have well informed clients to negotiate further EA development projects.

The theme of the inquiry is therefore, how to manage the dynamics of organizational interaction in enterprise architecture management, planning and development in large organizations. This means, firstly, giving structure to the discourse between the consultancy and the client organization. Next, the discourse between different stakeholder groups in the organization is supported with an EA process model. Besides, it means providing a

methodology frame for any kind of consulting intervention related to the organizational ICT management, planning and development.

1.5   The Steps of the Research

The research is reported as significant partial outcomes in the research papers, that, when put together, constructs an overall EA methodology. The main constituent elements are an EA framework and a process model that provide an analytical tool for the coordination and structuring of the interactions and negotiations around ICT management, planning and development. The first step is to create a common understanding of the EA among consultants in the provider organization and its relation to the then current structure of its activities. The first draft outline of an EA process model is aimed to support the evaluation activities that are at the heart of consulting efforts and therefore prioritized as the focus. This is reported in Paper 1.

The EA needs to be defined and developed in partnership with a client organization. It involves decision making, and decisions are the responsibility of the client. A study of the roles of the consultants and the end-user organization members therefore follows (Paper 2).

Given the different stakeholder groups involved, a common framework of reference is an essential starting point to parse the discussion specific to the EA methodology. Different descriptions, models and definitions of the information and ICT assets are used at different decision making levels and varying viewpoints. For modelling an information system, the necessary elements can be described with one modelling language (e.g., UML or a domain specific modelling language). Such a language provides not only the notation but also the analytical structure for the analysis needed to design a system. To describe and model the enterprise ICT, however, several different modelling languages will be used and different description techniques are needed. The framework provides a structure to unite the varying descriptions to a consistent EA and the associations between them. Further, for assessing and evaluating plausible business models, processes and services and ICT solutions, several different methods (e.g., business process re-design methods, cost-benefit analyses or architecture tradeoffs) are deployed in EA management and planning. The EA framework maps the use of these methods to the phases where their use gives the desired input to decisions.

A literature study of the existing EA frameworks and models, supported with empirical work on EA cases, results in an EA framework, i.e., an analytical presentation of the concepts and structures as models and descriptions that comprise the enterprise architecture (Paper 3). The created framework is validated with practical case studies. Further, the framework is extended with more empirical work to cover the needs of a business network, and used for planning enterprise and business network security solutions (Paper 4).

Due to the wide-ranging influence of the EA decisions that also have long-lasting impact to the organization, the EA process should be seen as a part of the overall management process of the business. The next study is conducted on EA process context (Paper 5) and models suggested for EA processes. Supported with the lessons learned with the EA framework, an EA process meta-model is constructed in two phases (Papers 6 and 7) to be a guiding model for the on-going discourse in which an organization manages and modifies its ICT support and co-operatively develops, in parallel, both the business activities, and the supporting ICT infrastructure and solutions. For quality consulting work, the consultant has to understand the decision making in the client organization and interlace their work to achieve the desired results. The EA process in the present research effort is constructed in collaboration with the EA consulting work, but this process metamodel gives also the process elements to define the end-user organization's EA management process.

Both for the EA frameworks and other reference models, and even more for the EA process models, trade literature sources well outnumber the academic literature. However, this thesis is an attempt to tie the discussion around enterprise architecture to the tradition of information systems science and the knowledge on participatory IS life cycle models. As the area covers the information systems planning (ISP) and is occupied by the strategic information systems planning (SISP) methods, the architectural approach or EA is now suggested as a methodology, with an overview and an all-inclusive coverage of enterprise ICT giving for them also a framework of reference.

1.6 Qualitative and Interpretive Research

The current study aims at constructing an EA methodology for the consulting activities of an ICT provider. The effort follows the qualitative research paradigm, and there are several reasons for this. Qualitative research, as opposed to the logical-positivistic quantitative inquiry paradigm, attempts to inductively and holistically understand the research target in the full complexity of its context (Patton, 1990, 51). This study is highly context specific. On the other hand, the deep understanding enabled by the qualitative inquiry helps gaining more profound insights from the practice in general, and the action research (AR) approach empirically validates the constructs created. The AR (Jayaratna, 1994; Baskerville & Wood-Harper, 1996) is recommended in the IS field as a suitable approach for method development efforts. AR emphasizes collaborative reflection and learning in groups and organizations (Argyris & Schön, 1978). It compels some change to be undertaken in the organization where the research takes place, and also the changed action to be evaluated during the effort. Thus the results do not remain in the reports but are deployed in the organizational activities as part of the effort. They also find their validation and refinement in the practical work and repeated research cycles.

Action research profits the case organization by allocating space for discursive collaboration and enabling the creation of a body of knowledge through reflection. The changes that are undertaken in the research effort mean enrichment of the activities in practice with external information. In this setting, the EA methodology both grows from within the organization, utilizing its accumulated expertise, and is co-constructed with the academic party that brings in theoretical knowledge. The method introduction and deployment to the organization involved in the study has already been undertaken when the research project comes to an end.

1.7 The Results

The created methodology provided a common framework of reference for the consultants in their effort to unify and develop the EA consulting activities of TietoEnator. The constructed EA framework and the process model serve as common frameworks of reference on EA related information and activities for the various stakeholder groups in a client organization. The framework supports information sharing by establishing the associations of different EA related information, and the process model guides the collaboration in the EA work with anticipated decisions. It gives the stakeholder groups their say in the discussion on the EA developments. The consulting activities related to business planning and IT architectures are unified, and joined as a consistent part to the overall portfolio of activities at TE, including systems development. The clients get a model for a more mature approach in the planning and management of their ICT.

The method elements can also be used as requirements for evaluating and developing tool applications to support EA work. However, this dissertation is concerned with the basic elements of an EA methodology, a framework for the various EA descriptions and deliverables and a process model that stems from the framework to guide the EA management and EA consulting activities. These are offered first and foremost to the case organization, TietoEnator, but also as an EA methodology outline to be adopted by any enterprise for their EA work. The base of several client organizations makes the constructs rather comprehensive. On the other hand, the framework and the process model are kept as simple as possible so that their adaptation to any industry domain should be possible.

The overall aim is to provide a structure for professional communication on the enterprise developments and management issues. Management is here understood as the activity of giving direction and setting goals to the activities, as well as making decisions over resources. The EA process model suggests transparent decision making and due share of attention to the relevant information, the ownership of which is often with a community of experts. Communication across practitioner communities in the enterprise is needed on a forum that gives a say in the discussion on enterprise developments to the

relevant communities. EA can serve as a tool for this purpose in creating the perspective of a specific viewpoint at different decision making instances and taking the perspective of others while providing associated information for the decisions.

1.8 Structure of the Dissertation

Firstly, the theoretical starting points to the thesis are outlined in Section 2 (the Information Systems Science and the IS planning area of study). Secondly, Section 3 gives an account of the concept of enterprise architecture, its different uses and characteristics. Section 4 discusses the research questions under study, and the research approach, methods and techniques used in the inquiry as well as the empirical material used. Section 5 summarizes the research reports published previously, and Section 6 gives an overview of the main results, together with a discussion on the limitations of this research effort. Section 7 concludes the introductory part. After a summary of the thesis in Finnish, the list of references and the appendices, the included research reports follow as addenda.

2 THEORETICAL BACKGROUND

Enterprise Architecture can be examined through different streams of discussion in the applied science field of *information systems* that in general "deals with systems delivering information and communication services in an organization, and the activities … in planning, designing, developing, implementing and operating the systems" (Davis, 2000, 62).

Here, the end-user organization is a central element: the information systems are seen as "support for the *organization* objectives and *organization* rationality" (Davis, 2000, 62). Explicated further, the systems "exist to generate, record, manipulate and communicate data necessary for the operational and planning activities which have to be carried out in an *organization*" (Land & Kennedy-McGregor, 1987, 63).

Information Systems, as an applied field of inquiry, is supported by research in software engineering and behavioural sciences, like sociology or organizational studies, as major reference fields of science (Hirschheim & Klein, 1989). IS studies take paradigms and metaphors of these to consider the activities around the information systems that are seen as "object systems in a set of environments" (Lyytinen, 1987, 6). As Lyytinen (1987) points out, the organizational situation (context) is a major concern in developing information systems. Lyytinen presents further spheres (contexts) concerning the activities of different groups of interest dealing with the system.

The activities around the system (e.g., design, development, implementation, maintenance and use) can be seen from the viewpoints of these contexts, represented typically by stakeholders with their different specific expertise and languages (natural or artificial, i.e., modelling or programming languages) and the domain of the system (Lyytinen, 1987). The domain of a system is the functional space of the system in the user organization, with its domain experts in that organization. For systems work, communication and collaboration between these different stakeholder groups are required. To understand the elements in this interactive effort for the purpose of creating a methodical approach for it, the relevant fields of study within the information systems field can be drawn upon. IS process knowledge is found useful to

organize the goal oriented collaboration of several groups of interest: the system development process.

However, when taking the comprehensive organizational ICT as the activity target for the study of EA methodologies, the prevailing paradigm of *an information system*, or a related IT artefact (Orlikowski & Iacono, 2001), is challenged as the generic focus of this discipline and the scope of studies in it. As a consequence, a broader range of stakeholder groups and their activities will be covered in the inquiry according to their participation in the EA planning and development process. Of interest will be that the decisions in the process are, to a greater extent, made by stakeholders other than system designers or developers.

Study of IS methods and methodologies is the foremost in the related fields since the EA process can be seen as the core of an EA methodology, quite like the IS lifecycle process is the core in IS methodologies. The inspirational ideas delivered by the subfields of IS science, are acknowledged: meta-modelling, study of collaboration and coordination as well as knowledge management, and also user participation. The meta-modelling approach is seen appropriate for a generic method process that is organization and situation independent for the purposes of a consultancy encountering different types of client organizations in a variety of industries. The studies of coordination and collaboration (e.g., in computer supported collaborative work, CSCW and knowledge management, KM) give theoretical insights into situations where different expert groups need to negotiate and collaboratively construct, e.g., the EA descriptions or plans. User participation literature supports the organizational alignment of ICT developments.

The EA work requires, above all, communication (Hoppermann, 2007), and architecture work means making decisions to guide any further effort (Rechtin, 1992) which also means exercising power. The concept of discourse, as a common denominator, is therefore chosen as an integrative frame to reflect on the series of individual studies, to illustrate the phenomena being studied. The discourse can be seen as the locus for the coordinative activity and the negotiations that are required for a collaborative effort in an organization, be it in a setting of a consulting project, or as an own effort of the end-user organization. The challenge is not only to make information systems 'talk to each other' but make people with different backgrounds and viewpoints to the IS exchange information and viewpoints with each other. The EA process provides a tool to orchestrate this collaboration.

2.1 Information Systems Methodologies

Methodologies as collections of methods, related knowledge and practices in the IS design and development make the prevailing common framework of reference to outline the scientific discourse within the discipline of IS (Iivari & Hirschheim, 1996; Lyytinen, 1987; Avison & Fitzgerald 2003). The paradigms of

ISD methodologies, irrespective of the school of thought, seem to support the treatment of one *problem area,* (Jayaratna, 1994; Checkland, 1988), also called the *root problem* (Checkland & Scholes, 1990), the *target system* or the *object system* (Lyytinen, 1987). This means that the enterprise which is a business company or a non-profit institution can be seen as a collection of these systems. The IS methodology is only harnessed to treat one of them at a time. The evaluation and comparison of the systems and alternative technological solutions thus usually does not get much coverage in the IS methodologies, but is seen as a task of IS planning (Olle et al., 1988) that falls to the work area of consulting (Block, 2000) at the ICT provider. In the development of theories, the main focus is on this area since the success of the implementation of a system is believed to be largely dependent on how the system life cycle process is arranged, i.e., what kind of method it follows. The system life cycle phase of maintenance taking, in most cases, the largest share of the entire time span, is quite thinly covered in the methodology literature (Polo et al., 2002). The EA management coordinates the maintenance of all the systems, and guides the planning and development activities of the organizational ICT, including planning and developing further systems.

For ISD, to define the *scope* of the information system within the enterprise is an important first step, and it is seen as an important part of the professional skill to confine the effort to this target area. This is necessary when the aim is to build any functioning ICT supported system. However, with an EA methodology, several systems with different, often partly overlapping scopes are to be treated. The EA methodology also has to tackle the ICT infrastructure of the enterprise as a shared facility for all systems and applications in its various domains. To give a foundation for the EA methodology, a look at the assumptions behind the ISD methodologies shows the way.

The very nature of information systems is human activity and communication (Lyytinen, 1987; Avison & Fitzgerald, 2003, 19) for which computer support is designed in various ISD efforts. Thus the development methodologies are concerned also with the 'language context' as one of the major viewpoints. This context relates both to the design and development activities, and the actual system use, i.e., the information processed with the system. Taking a point of view that emphasizes more the deploying organization, Iivari (1989) suggests a division to the administrative, the conceptual or infological, and the datalogical or technology aspects in the Universe of Discourse (UoD), each with their specific language for the system descriptions. This is an important insight to take into the EA work.

Separating the language to a context per se does not resolve the problem that different context means also different interpretation background (Fairclough 1995, 98). Natural language code is fully decipherable only within a context that gives a shared frame (either inherent or learned) and situational clues for the interpretation. Language practice is a facet of organizational life, as depicted in discourse studies (Phillips & Hardy 2002, 12; Swales 1998, 20), and organizations and their structures are established in discourse. Different language (be it a group language as in the case of communities of practice, an

organizational language usage variant, or a technical language variant) in any case presupposes an interpretation context or a communication paradigm, shared by a discourse community. From the linguistic point of view, these can be called *speech communities* or *networks* sharing a language repertoire (Wardhaugh 1992, 117; 127), an idea coming close to the concept of a *domain* in the IS discourse, with shared concepts and language practices.

Communication between paradigms or domains (in this case the domain meaning the UoD of a system in the ISD) always presents challenges. Interpretations may fail partially or altogether, and communication breakdowns may occur. The ISD methodologies provide guidance on how to cope within one system context between the domains or UoD's concerning administration, information, and technology. The EA methodology requires that the whole enterprise is taken as the context, or the overall universe of discourse to cover. All existing systems in the enterprise are the target of the methodology, with each system covering different functional areas and respective groups of specialized workforce that work with them. Further, within the scope of one system are the system specific UoD's in Iivari's terms of the business administration (or management), of the information in business operations, and lastly, of the technologies used for information processing and transmission (Iivari 1990a & b). Different managerial levels present further needs to refine the use of the language, i.e., the descriptions for various aspects of the EA.

The methodology, and especially the process, has to cover the 'super-context' of the whole enterprise, and even beyond, when opening business collaboration interfaces of the enterprise systems for external business partners. There is a need for a common framework of reference, and EA management and development principles within an enterprise. Their purpose is, firstly, to coordinate the managerial activities of both business and information systems to provide a baseline for planning and development efforts. Secondly, the enterprise should be able to present the principles and negotiate them with their partners for setting up collaborative systems. The process parses the discourse by giving turns to different roles to contribute with their expertise and knowledge about the enterprise from the point of view of their expertise area. Language and description use is guided by the respective audience of the phases in the coordinative process, and the frame visualizes the dependencies of the descriptions and thus distinguishes the decision makers from each other.

The EA methodology fosters comprehensive management of the enterprise ICT. The aim is the effective use of present technologies and resources. Further, the EA methodology directs towards anticipative strategic planning that embraces and evaluates the advances in the enabling technologies profiting the business. Plans of the ICT support developments are intertwined with business planning, meaning a permeated alignment of business and ICT through the EA process.

2.2   Information Systems Planning

It was understood already in the era of standalone systems that the implementation of information systems touches the organization of business activities in a way that needs to be considered in the strategy process. However, even a quite recent account of methodology developments sees IS methodologies stronger in connection with the software development method repertoire (Iivari et al., 2004) than with planning methods belonging to the scope of consulting business. Early methods for the two diverging approaches were Business Systems Planning (BSP) and Business Information Control Study (BICS), both created at IBM (Zachman, 1982). In a review of these methods, the author foresees the businesses in the future employing "enterprise analysis tools that are growing in importance and are likely to become mandatory for any business that continues to grow and evolve." (Zachman, 1982, 31)

The information systems planning ISP was quite early recognized as an activity that should precede information systems development projects (Olle et al., 1988, 5). ISP considers the whole enterprise, as the broad context. This is also the EA target. However, the planning seems to be limited to the purpose of defining the scope of a single IS for a development effort, i.e., the IS project. This scope is the target area that confines the universe of discourse or the object system context, which is then the concern of the IS methodology. For the ISP area, on the other hand, methods have been created for various aspects of the planning.

Strategic information systems planning, SISP, (Earl, 1989; Ward & Peppard, 2002; Robson 1997; Seltsikas, 2000; Weill & Broadbent, 1998; Segars & Grover, 1998) has advanced in this area. It emphasizes in the planning activities the consideration of business strategies. With the business development as well as the risk and benefit analysis of individual systems, the SISP methods are not designed to take a comprehensive, architectural overview to the whole organization. The methods (Earl, 1989, 71) for the strategy work, and further SISP techniques (Ward & Peppard, 2002, 205) can be used for decision making on different aspects of the enterprise ICT assets. They serve well in different areas of EA work, e.g., business process development or portfolio planning of applications or technologies. However, each of them covers some limited area or aspect of the whole scope of the EA planning or development. These focused methods and techniques find their use in the comprehensive EA methodology. The EA management process provides a unifying approach. Such a unifying frame is needed to balance out the corporate ICT investments, services and maintenance expenditure. The literature on the so-called 'strategic alignment' of information systems (Venkatraman et al., 1993) tends to focus in practice on a single system at a time, as a relatively independent unit. The system can benefit the enterprise which is deploying it with so-called competitive advantage in their market. However, this advantage is likely deemed to be short-lived and the IS central to the business becomes an industry best practice shared among all companies in the industry.

The starting point for the strategic planning methodologies is often common with the methodology literature: a defined target for which a system is to be designed. Another area related is the study of requirements, i.e., requirements engineering, or RE (Rolland, 1997) (also known as requirements management). It aims, firstly, at disciplined management of the system requirements for the developer organization, but also emphasizes the methodical transfer of domain knowledge and the needs of the deploying organization to the system development. The EA work resembles in both aspects the RE. However, the approaches assume a system for which the requirements are 'engineered' or managed and the techniques are targeted to projects where system development and implementation takes place. The RE approach is cultivated in the realm of systems development rather than in the IS planning.

The EA is looking for sustainable advantages (CIO Council, 2001, 15-16) that sometimes are not directly related to new IS development. The overall goal of EA is the alignment of the technologies in general, and the alignment of any individual IS implementation with the management intentions. EA is a tool for the work towards convergence of ICT solutions both at logical and technological level. Synergies strived for through, e.g., systems integration and standardization of data are further drivers for EA work. Incremental EA work, i.e., cumulatively adding to a consistent EA information base with each development project, is an agile approach to achieve EA advantages. Together with development efforts and revamping the ICT maintenance efforts it helps companies steering towards a coherent EA management. With existing EA documentation and EA principles, the requirements and system definition phases are disburdened, while, e.g., the system context, interfaces and development principles are readily described in a defined EA. The current business architecture provides a starting point for developments and also transparency towards the possibilities to enhance the business with new technology enablers. Business development can be planned based on current state descriptions and taking into account the existing technological infrastructure. Based on this, new enabling technologies and their costs can be evaluated. Conducted methodically, the EA is an approach to change management in aligned business and ICT developments.

The EA consulting, seeks to answer the problem of the client organization to manage, plan and develop the entire organizational ICT and systems with all possibilities, opportunities and dependencies in mind for the entire enterprise. These are created by the networking and internetworking technologies, and are the present and future business environment challenges. The portfolio based approach to applications and technologies (Weill & Broadbent, 1998) is a step towards comprehensive planning. However, the EA must account for all systems and technologies, not only those systems promising short term business benefit. Long term planning activities and infrastructure investments are part of the enterprise level planning. The methodologies for this area provide support for evaluations and planning, but remain fragmented in the SISP and requirements engineering concepts. An account of existing systems

and infrastructure, and a smooth transition from the planning to systems and infrastructure development is aimed at in the EA approach. An EA method is used, among other things, to balance the costs and benefits of both current and future ICT investments and to ensure that the implemented ICT support is utilized to the full extent.

The EA related consulting activities thus start with an account of the whole enterprise, its environment and resources, to which also the current ICT systems are counted. The ICT consultants find themselves challenged with the need to negotiate and plan not only within one universe of discourse (the scope of one system) and its stakeholders. The method repertoire from the IS field guides the development of individual systems within a defined scope and a confined universe of discourse.

It is not a surprise therefore, that the EA area was found to be a gap in the methodologies of the provider (Hirvonen et al., 2003): for management consulting on one hand, and for systems development on the other, there was a good selection of well founded methodologies that had been tested and modified to suit the company practice. The research activity with TietoEnator was directed towards the EA area activities, to develop methodical support for the projects with the characteristics of EA consulting, i.e., concerning not only one system but several systems with a large scope within the organization, or ICT infrastructure supporting several systems.

2.3 Methodology for Enterprise Architecture

The information systems development literature provides rich resources for work related to information systems development methodologies. The terms method and methodology are either used interchangeably (Olle et al., 1988, 3), or methodology is seen as an organized collection of methods (Iivari & Hirschheim, 1996). The term *methodology* is preferred for EA, firstly, to give room for an underlying set of beliefs and values (Iivari & Hirschheim, 1996), or philosophy (Avison & Fitzgerald, 2003) in the present methodology creation. The aim is to construct a methodology with the underlying principle of enabling discourse across boundaries of communities of practice with different language practices. Further, EA as an approach to ICT planning and development requires a number of methods and techniques for different architectural areas: business process re-design methods, portfolio analysis methods, architecture evaluation methods, methods for systems and technology architecture modeling as well as various description techniques. Many of these are known already from the IS planning or strategic planning for IS method and technique collections (Earl, 1989; Ward & Peppard, 2002).

The method development paradigm has followed two main tracks in the development of information systems: 1) Modelling, or creating descriptive models of the target system, and 2) Process, or describing the sequence of activities and tasks, where the descriptions are inputs and outputs (Koskinen &

Marttiin, 1998). A fully fledged method consists of the deliverables (IS models, designs and other descriptions as well as, finally, the software code) and the process that guides the activities in which these deliverables are created by the designers and developers.

In an exhaustive study of method literature (Leppänen, 2005) captures the essential elements to a framework of information systems development method development. The study depicts the heavy emphasis the study of methods has been given in the IS literature. A counterpoint, the 'amethodic' development has been brought up and the 'method' is found to be a basic, most of the time unquestioned, assumption for the IS scientists (Truex et al., 2000). As recent developments in the software development, like the agile methods and RAD (Abrahamsson et al., 2003) indicate, the ultimate meaning of method is to provide a common framework of reference to coordinate the activities in the development.

The involvement of stakeholders (e.g., system users) from outside the expert community of ICT is common to the recent ideas. This is a major concern in EA methodology in general. The enterprise and all systems as context require the attention of many expert groups, not only that of ICT experts, and maybe not most centrally that of the end-users of the systems. The present EA methodology starts out with explicitly forming a common framework of reference, and outlining in it expertise areas of the different EA dimensions such as business, information, systems and technology. At different decision making levels the concerns of these architectural areas are given a turn in the discourse to allow them to make their knowledge available for the process. The method process outlines the logical order of the decisions and the sources for informed decision making at each level. The major stakeholder groups to be involved are decision makers both at different levels of the enterprise hierarchy and in different expertise areas.

2.3.1 Metamodelling as Method Development Paradigm

To avoid technology-bound methods and to achieve genericity, information systems method development studies have introduced the concept of meta-models (Kumar & Welke, 1992; Rossi, 1998; Tolvanen, 1998; Brinkkemper, 2000), that can be seen as the underlying ontologies that outline the possible set of models from which a specific model is constructed as an 'instantiation' when designing an individual system. The advantage is that the meta-model provides a possible model knowledge base for the use of individual development efforts, thus disburdening the design phase. Supported with the method rationale, the meta-modelling approach seems to provide a flexible and robust base in varying method usage contexts (Rossi et al., 2000). Recently, the concept of ontology has gained more attention. Ontology refers to an analytical cross-section of a domain area that labels the entities within the domain. Both meta-models (based usually on the use of symbols) and ontologies (based rather on lexical units capturing meanings taken from natural languages) serve roughly

the same purpose: they give a set of constituent elements with which all possible models and descriptions of, e.g., an information system for a domain can be created, or the information entities processed by a system in a domain can be described.

Ontologies (Gruber 1993) seem more in use and better suited for modelling the information processed with a system, whereas meta-models are used more often for describing the features and functionalities of systems. For enterprise applications, enterprise ontologies have been created. Frameworks will be discussed later (see below) as organizing tools for the purpose of managing the ontologies and models of all the IS in an enterprise, and the other EA elements as well. The concept of ontology is rarely used in connection with processes, whereas meta-modelling is a possible approach to flexible process construction. For systems development, the Object Management Group has created a software process metamodel (OMG, 2005).

The current effort requires flexibility and adjustability of the resulting process model. The meta-modelling approach brings along these features. It is a collection of possible EA process elements of an unspecified organization. The creation of the process has to incorporate characteristics of a variety of organizations to claim the coverage of a meta-model. This is why several case organizations of different types are investigated for empirical evidence. Additionally, EA process models in literature provide a rich collection of items to be included in the meta-model. Thus the created meta-model ensures better coverage of the needs of diverse types of organizations and also different consulting assignment types.

The so-called software process (Sommerville, 1998; Pressman, 2000) provides - according to recent findings (Ovaska et al., 2004) in the field of software engineering - a common framework of reference for the coordination of the activities in software development, rather than detailed instructions for how to do the work. The same seems to be true for IS development: the method, arranged around the method process derived from the information system life cycle, provides a common framework of reference for those involved in the activities around the target system.

Similarly the construction of the EA process meta-model is aiming at unifying conceptualization of the related activities to enable coordination of the collaborative efforts on the EA. Firstly, this applies for the consultants, and secondly, for the end-user organizations. The provider can use it as a shared map where, e.g., various assignments and project tasks can be pinned down. For an end-user organization, the frame of reference is needed for the negotiations between stakeholder groups and coordination of decisions on the elements of the organization EA, within which again the consulting assignment are taking place. Importantly, the EA process can guide the negotiations on the assignments between the provider and the end-user organization.

2.3.2   Further Support from the IS Related Studies

The concept of professional communities (community of practice, community of knowing or thought community) with their own language and shared frameworks has been seminal for the understanding of the accumulation, creation and evolving of knowledge within organizations (Tuomi, 2000). However, this specialization creates also barriers to communication between the communities, leading to different contexts or universes of discourse. Isolation, to an extent, is necessary for the special interest groups to develop the community specific paradigm and to enrich it with accumulating knowledge (Boland & Tenkasi, 1995). As a negative effect, more effort is required when exchanging information across community boundaries. The EA process provides a platform for the communities of practice for 'making', i.e., constructing their own and 'taking' the perspective of other communities (Boland & Tenkasi, 1995), i.e., expert groups, in the collaborative effort to define and shape the future organization. It means describing the structures, the information, the systems and the technologies that together form the enterprise – and are the elements of the enterprise architecture.

   Further support for the development of the EA approach is taken from a field today known as human-computer interaction (HCI), with roots in the participatory design literature and studies of the participation of end-users in the design and development of organizational information systems or the management information systems. In this thesis, the end-users as 'human beings' (e.g., Isomäki, 2002) are not in the focus, but rather the end-user organizations (e.g., Hirvonen, 2005), since the EA work is the concern of large organizations with complex ICT systems. Management of large organizations and their ICT support draws on management and organizational concepts rather than the user as an individual. However, the contributions of the roles at the ICT provider and with the ICT deploying organization are taken into consideration. This is a key point in a method created for a provider. Last but not least, the organizational change issues relate, firstly, to the provider implementing the methodology for their own use and, secondly, to the end-user organization, where the methodology is used. The division of responsibilities between the provider and the client combine the theme of organizational development and that of a discursive process to outline the collaboration.

2.4   Discourse

Discourse, as the 'locus of language practice in a social setting' (Fairclough, 1989, 20) ties the examination of the phenomenon of communicative interactions to a context. In discourse, participants contribute to, argue for and construct meanings within contextual boundaries (Grant et al., 2004; Phillips & Hardy 2002) that enable them to understand each other, and by interaction around common interests form *discourse communities* (Swales. 1998, 20). Discourse is

also "a site of, and a stake in, struggles for power" (Fairclough, 1989, 15). Regarding IS implementation in organizations, research quite early found the relevance of power in its different dimensions and various embodiments (Bjørn-Andersen & Pedersen, 1980; Markus, 1983). There are different viewpoints, represented by discourse communities or *communities of practice* (Grant et al. 2004, 20; Boland & Tenkasi 1995) to the systems and technologies, having also different interests as regards to the planning, development and implementation as well as the use of them. Conflicts between the viewpoints are possible, and negotiation is therefore needed. Choices and compromises have to be made as well. These are enabled by mutual understanding and coordination, as aptly summarized by Robinson (1991). A transparency of the locus of power, i.e., where a decision is first made and where it is then materialized (e.g., implementation of a policy into a system, or following given policies in the development or use of systems), will contribute to a better management of ICT. Aspects of discourse have been harnessed to serve the ends of private and public enterprises (Grant et al 2004, 4). This dissertation suggests considering the insights gained in discourse studies that examine organizational ICT management.

Thinking about the problem of the ICT support in a large organization, the setting for this negotiation seems overwhelmingly challenging. Different roles with significance in the process have been found in studying IS implementation (Morley 1993). For software architecture alone, six key stakeholder roles have been identified among an even greater number of stakeholder roles (Smolander, 2003). Zachman (Zachman 1987, Sowa & Zachman 1992) proposes six viewpoints for describing IS architectures at different abstraction levels for different stakeholder groups that represent different communities of practice (Smith, 2003). Enterprise architecture management and planning work will mean communication across at least this number of communities or individual experts. These lean on their own frames of reference and by definition use specialized language in their specialist community interactions (Swales 1998, 20). A community with its specialized language (notations, terminology) is a useful unit in setting up the scene for communication on EA. Individual EA descriptions for various aspects are shared and understood within certain expert communities, but both EA decisions and the information for decision makers for the decisions have to be communicated across group boundaries. Individual roles and their capabilities are defined by organization-specific policies and ways of working, whereas the communities of practice with their typical information exchange can be seen as more general. Decisions and EA information have to be communicated in a way that enables their correct interpretation by the practitioners who need to deploy the decisions, or are making the decisions based on, e.g., feedback information on solutions.

To enable communication, both the code (language) and the context have to be understood by the communicating parties to be able to interpret the messages of each other. The language context (Lyytinen, 1987) or the universe of discourse (Iivari, 1989) mark the conceptual background in the IS field for the IS development effort scope, i.e., the domain of the object (or target) system,

and the context for the communication concerning it. So far, discourse analysis has been taken up as an analysis method for office information systems (Auramäki et al., 1992) with the insight that understanding communication is essential for designing support for workplace activities. Discourse analysis has been deployed in recent research for understanding the real world of users in systems development (Sarkkinen, 2006). The research papers included in this dissertation will be summarized and reflected through a discourse lens, and the EA methodology development suggests a discursive approach to EA work.

2.4.1 Discourse at Different Levels

Studies of discourse take numerous approaches from the analysis of discourses at the societal, macro level, to conversation analysis at the micro level of instances of exchange between individuals. The target of the analysis varies from the high level world of discourses to the micro level study of actual natural language use, with numerous levels in-between (Wooffitt, 2005, 156; Grant et al., 2004, 4, van Dijk 2001, 354). For this thesis, the notion of *discourse* in three dimensions seems to be an appropriate way to reflect on the problem area for a number of reasons. These are discussed next.

First, the thesis takes up a discourse that can be seen as a meta-discourse on the information systems in conjunction with the organizational management concerns about ICT in the end-user organizations. In 1982, IBM devoted an issue of the Systems Journal to "Enterprise Analysis" (Systems Journal Vol 21, No. 1). The contributions in this issue 25 years ago focus, on one hand, on the management of the information content (Davis, 1982, 4), and on the other hand, the management of information systems (Zachman, 1982, 31). Both of these are key areas today. Discussion on the so-called business alignment is continued, besides as discussion on the strategic planning of IS (Ward & Peppard, 2002), or IT business alignment, also under the label of architecture: Enterprise Architecture (Spewak, 1992; CIO Council 1999) or (Enterprise) IT Architecture (Gordon & Gordon, 1998; Armour & Kaisler, 1999a&b). In the recent discussions, the service oriented architecture (SOA) approach stresses, among other things, the business alignment of ICT. Technology has enabled business networking and is a further driver for this discussion.

Second, the research undertaking reported in this dissertation can be seen as a discourse within a group of ICT consulting practitioners at the case company, TietoEnator. A collaborative inquiry taking the action research approach is aiming at negotiating a common framework of reference and a methodology as tools in meeting the client organization needs to manage the entirety of their ICT: systems, technologies and infrastructures. The action research setting is enriched by the presence of an academic researcher opening a window to the academic discussion around the topic. She provides information and takes back empirical evidence for research work. At the same time, the research effort serves as a platform for the negotiation, and the researcher acts as a change agent in comparing and challenging the consultancy

practices with knowledge recorded in the literature. The research project serves the discourse within the target organization also by necessitating the discussions among consultants, otherwise too busy with their projects, to exchange ideas and develop a shared understanding on the new area of enterprise architecture. This collaboration is far more intense than, e.g., the collaboration within the regularly meeting Technology Forum of the company, and the annual TE Group Technology Symposium, where among other things the methods to be used company-wide are presented and discussed.

Third, the result of the research is a model to support the discourse between business and ICT professionals in an enterprise, at the strategic and operational management levels, as well as in the information management level of the enterprise. The context of this discourse is formed by large, complex organizations that need to negotiate the management, planning and development of their EA, i.e., the following issues:

- The business, its strategic guidelines, and the arrangement of its activities
- The information in and around their activities
- The systems that support information capturing, processing, storing and transmission
- The technologies used to implement these systems.

This means a process model for the enterprise architecture management that guides an end-user organization in their effort of ICT management and strategic alignment of ICT and business. As importantly, it guides the ICT provider in the consulting efforts for their clients who are aiming at a well-managed EA and undertaking development projects for it. To reach any results, decisions have to be made. Observing the lines of decision making will be critical for the intended change to be enacted in the EA.

The idea of 'context' or that of the 'universe of discourse' that in the IS field can be seen as providing the background for interpretations, can in the terms of discourse be seen as the *context*, or "the mentally represented structure of those properties of the social situation that are relevant for the [language] production or comprehension" (van Dijk 2001, 356). There is a broad range of different representations, produced in different modelling and description languages for different views of various structures in the EA. Their interpretation depends on a context as understood by each group of the EA stakeholders. The enterprise is therefore a super-context. In the overall EA process there is the comprehensive ICT support for an enterprise and the developments within it, which is seen from varying viewpoints of different actors in the organization (the stakeholders) with their sub-contexts. The variegated situational sub-context for the discourse requires a multitude of issues to be taken onto the agenda, and thus differs from working with a single information system.

The *agenda* means the allowed and focused topical areas for the conversations, i.e., what can be taken up as purposeful issues within the

discourse. Those who have the power are capable of setting and influencing the agenda (van Dijk, 1989, 22). The concept of viewpoint frequently used in architecture literature can be seen in discourse terms as the representational structures and the agenda of the different *agencies*, parties whose action shape the discourse (Grant et al., 2004, 3). In an organization, that would mean different roles in different communities of practice, e.g., strategic management, operations management, finances, ICT management or ICT maintenance. Different agencies lean on different structures (Fairclough 2003, 224) in the representations used as the models or descriptions of various EA aspects.

The customarily presented opposition of business and ICT stakeholders managing the enterprise information systems, each with their expertise and goals, can be seen as two different communities of practice, with their respective structures and agendas. Setting up a shared framework of reference for the discussants gives an outline for a possible common agenda and also puts in the focus the acknowledgement of the contributions of other parties. *Power* can be seen as simply the ability to participate in the agenda setting for the discourse and to follow one's own agenda or to overrule in the discourse with one's own goals. There are many different facets to power (van Dijk, 1989, 19ff.), but discussion of the variegated power dimensions in the organizational reality remains out of scope of this dissertation. For methodology and consulting purposes, it is left for the ICT deploying organization to locate the decision making power.

Empowerment as a concept emerges from the critical discourse analysis (Faiclough 2003). It means that a group gains an active role in the discourse instead of being merely subject to measures designed by others. By actively participating, the empowered individuals and groups also contribute to the discourse with their knowledge resources. Each group having the possibility to influence the decisions contributes, firstly, towards a better work environment, but, secondly, also towards the leveraging of the intellectual potential in the enterprise (Drucker, 2006). This is aligned with the philosophy of total quality management, which means inducing profound organizational change through organizational learning (Senge, 1992). Besides, if an individual or a group sees their contribution welcomed and valued by the whole organization that contribution is likely to turn also to a motivational and commitment factor (Drucker, 2006). Commitment to the policies, guidelines and other decisions, in turn, reinforces the agreed negotiating process to be followed for constructing the EA.

2.4.2 Organizational Development

The organization of work and the arrangements of the organizational activities are known to be affected by the implementation of a technological system. Applegate (1994) outlines four areas with interrelations between them contributing to information management infrastructure: technical systems, management systems, organizational structure, and people. Today, the question

is no more of replacing manual systems with computerized ones, but of managing a portfolio of technologies and applications, aligning it to the business strategies and goals, and evaluating alternative solutions accordingly. However, the challenges of organizational change remain. Sharing information is one of the most crucial factors in change management.

In managing the technologies, the underlying issues can be made transparent using various representational artefacts (Lynch, 1991). These represent the cognitive structures of human understanding and support the building of shared views of reality (Orlikowski, 1992, following Giddens, 1984). The people in the organization carry on the discourse, and groups of people construct meanings in social interaction through shared cognitive structures (e.g., frames, schemes, scripts, models and maps), in this way making sense of technologies and taking actions as regards to the technologies and the organization (Orlikowski & Gash, 1994). Structures are needed also for power relations (Markus, 1983) in order to set frames for decision making, to guide and to coordinate flows of information for the decisions and for the actions that follow them. Process models, as scripts for action, guide and coordinate the activities of groups and individuals.

The discourse analysis in general sees the organization as a product of discourse: "generative dialogues create and sustain an effective organization" (Grant et al. 2004, 45). The discussion around critical discourse analysis largely elaborates the power relations in the discourse (e.g. van Dijk 1989, Fairclough 1995:21). However, one should not forget the idea of *reflection* which is crucial in organizational learning and development (Argyris & Schön, 1978, Phillips & Hardy 2002, 2). The discourse, as a social activity, emphasizes the evolution of thinking and ideas. Following the social constructivist views (Phillips & Hardy 2002, 2) organizational development can be seen taking place in, and through, a *learning* process. The organization is established and also modified (developed) through a discourse.

Reflection as social activity amplifies the individual's knowledge. Through the reflection the practitioner, or a group of professionals, are able to spot development needs, consider and create solutions, evaluate them in practice and change the actions for better results. Following a simple behaviouristic definition, learning takes place when a change in behaviour occurs. Applied to groups of people and organizations, learning has taken place when a change can be observed in the way the activities are carried out. *Text* is in the focus in discourse studies (Fairclough, 2003, 10) allowing the examination and explication of phenomena, also in organizational settings. The starting point is the reflection of the current, and composing of texts is also a tool for reflection and learning. Agreements on changing the organization and member behaviour (e.g. adopting a new policy, method) can be articulated in writings on what is targeted, what are the new shared frameworks and models, and what has been learnt. Formulating an issue in writing necessitates reflective thinking.

A large organization negotiates in an on-going discourse its purpose and goals, the strategies to achieve these, and the developments needed within the organization to follow the strategies and to aim at the goals set. Technologies

and systems are inevitably an issue to be treated in this discussion. The discourse includes both negotiation to share information for decision making, and enactment of power to make the decisions. Enterprise Architecture provides the possibility and means to establish a common agenda for the negotiation and decision making. The process in an end-user organization is also bound to be that of learning and developing shared understanding on different interdependent aspects of technology use.

A process model with inputs, roles, decision points and outputs is a way to structure the collaborative effort aiming towards the development of the organization and its activities. The discourse could provide the locus for the reflective action suggested for organizational development (Argyris and Schön 1978).

2.4.3 The Author's Point of View

In the context of interpretative research, the assumption of constructed meanings necessitates a critical self-reflection on the part of the researcher. He or she is, in a way, a tool for the research work and comes with a background and pre-existing frameworks of reference and mental models based on which the interpretation takes place (Schultze, 2000; Phillips & Hardy, 2002, 12).

The author of this work is undertaking professional training to become a researcher in the information systems field, and at the same time moving from one professional career to another. Her previous expertise as a teacher of foreign languages for professionals gives her the necessary insight to context-specific interpretation of professional language use and to mediation between different cultures and ‘*Weltanschauungs*’.

The paradigms, metaphors, practices and the language used in the IS research and consulting practice are likely to be reinforced in the process. However, as an adult learner typically does, the researcher is looking at the encountered phenomena through the previously familiar patterns of thinking from other known disciplines. Knowledge of the learning process of an adult learner helps in self-reflection and facilitates the group effort in the research setting. This in turn helps in reflective construction of shared models and policies. Since the enterprise area is new at the time of taking up the research topic, no EA-specific shared frameworks or models have yet permeated the thinking in academic and practitioner communities. This gives room for a relatively unbiased approach.

The different stakeholder groups build their communities of practice with specific points of view towards the enterprise ICT. In the final stage of this research effort the author sees the need for a ‘boundary spanner’, i.e., a person belonging to different worlds whose paradigms, frameworks and models she is able to share to an extent and thus capable of interpreting them to others. As Checkland and Scholes point out,

> "… this is never a problem for those whose inclinations are towards the arts and humanities, it can be difficult for numerate scientists and engineers whose training

has not always prepared them for the mixed drama, tragedy and farce of the social process" (Checkland & Scholes, 1990, 31).

Several worlds with different viewpoints are encountered during the research process: industry and academia, ICT consultants, ISD method specialists and system developers. During the research effort, individual consultants, architects, method specialists and the researcher find themselves in a conversation aiming at a common understanding of EA and how it can be methodically managed in consulting projects and in client organizations. In end-user organizations, the business organization and the IT organization are quite different worlds, or professional communities, which brings along a risk for communication breakdowns, interpretation failures, or missing discourse between these communities. The experience from this method development effort could well be transferred to a setting in an end-user organization attempting to set up a process for EA management.

The research question this study aims to answer is related to managing of large enterprises in a collaborative action between expert groups: business management, information management, operations management, systems developers and maintenance specialists.

The constructed result as an answer to the research question is a model to facilitate and guide the discourse between different groups of interest in large organizations attempting to manage, plan and develop the ICT support for the organizational activities. This is done for the benefit of the business, and where possible for the improvement of the organizational performance through technology. Given the multi-faceted concept of power (Bjørn-Andersen & Pedersen, 1980; Markus, 1983) and the informal (grapevine) organization besides the formal organization this may seem idealistic or too simple. However, an informal organization only exists relative to a formal one in institutionalized organizations. A frame is needed to start with, to give transparency to the processes and decisions that contribute to the resulting functioning enterprise systems. Unfortunate examples from spectacularly unsuccessful projects stress the need for defined management processes. If there is no organized EA decision making for the management of the enterprise ICT and the collaboration of different parties contributing to this effort, future projects do not have better chances for success.

2.5 Context of the Study: Recent and on-going Research

Internationally, several research groups are investigating enterprise architecture, their topics of interest including approaches for different industry or organizational domains, different methodology proposals and tool support.

The Archimate project in The Netherlands is a leading effort in enterprise modelling and enterprise architecture tool support, especially for enterprise applications (http://www.telin.nl/index.cfm?ID=252&context=253&language =en).

In Sweden, at Kungliga Tekniska Högskolan, the Enterprise Knowledge Development (EKD) method has been put forward in the Elektra-project (http://people.dsv.su.se/~js/ekp/ekd_method.html) and in the EARP program (http://ics.kth.se/Forskning/Enterprise%20Architecture/Enterprise Architecture_Publications.htm) enterprise ICT issues have been investigated from the point of view of the CIO and ICT governance as well as enterprise applications.

In Switzerland, at the Ecole Polytechnique Fédérale de Lausanne, in its Laboratory for Modelling Systems (http://lamswww.epfl.ch/reference/seam) extensive work on EA methodologies and enterprise modelling has been conducted. Government EA initiatives has also been supported by academic research in different countries. A modelling approach is common to some of these. An overall enterprise model is suggested, from which detailed decomposition models are created. Another focus area is the ICT governance and information management function of the enterprise, with the chief information office role as a central issue. The results of the mentioned efforts have been studied and findings from them incorporated into the studies carried out for this dissertation.

The present research effort took place in Finland, and therefore a brief look at the work conducted at both the University of Jyväskylä and other institutions lays out the immediate context for the study. The EA area of study was taken up at the Information Technology Research Institute in 2001 with the initiative of TietoEnator, and the research was continued until the beginning of 2005. (cf. www.titu.jyu.fi/larkki). As a result, the dissertation of Ari P. Hirvonen was defended at the Faculty of Information Technology in the University of Jyväskylä. Further architecture work is taking place at the Information technology Research Institute research projects.

A related doctoral dissertation was defended at Tampere University of Technology, the thesis "A Business Application Architecture Framework in Manufacturing Industry" (Pienimäki 2005) concentrating on the applications and systems dimension of the enterprise architecture. A further dissertation was being written at the same time and there has been mutual support between the authors: the research by Turo Kilpeläinen (Kilpeläinen 2007) on enterprise content management deals with information architecture.

Besides these studies in the information systems area, there are two recently published dissertations in the related field of software engineering at the Lappeenranta University of Technology. One of these is the dissertation of Kari Smolander (Smolander, 2003) on software architecture. It considers the significance of architecting for software development and provides a continuum from enterprise architecting to systems work and vice versa. At the software development level, there are similar problem areas as in the EA work: stakeholder involvement and the significance of architecture in giving structure to past, current and future developments by different expertise groups. The second dissertation by Päivi Ovaska (Ovaska, 2005) has found the software process being a coordinating frame for the software production process of the

organization. This dissertation is a parallel work to the two mentioned SE dissertations.

The present work explores similar issues in the area of IS planning and enterprise architecting, finding its place within the recent academic efforts in the fields of software engineering and information systems. The dissertation of Mauri Leppänen (Leppänen, 2005) provides a comprehensive model for ISD methodology development with covering support from IS methodology literature. This thesis challenges and extends the area of IS methodologies to the organizational ICT management, planning and development.

Instead of specializing in any of the focus areas or specific application or role concerns, the aim is, firstly, to define a process around the enterprise information technology management that involves the business strategic management and planning and shows how the decisions at higher level need to be informed by ICT expertise, and how these decisions outline the further work in the organization undertaken in different areas.

3   ENTERPRISE ARCHITECTURE

The Enterprise Architecture (EA) concept was coined less than twenty years ago. Within the field of software engineering, the need to describe complex, multi-system entities (Rechtin, 1992) was raised. On the other hand, with the emergence of networking technologies, the possibility to develop distributed, enterprise wide systems became possible. Related phenomena were discussed as the "global IT" (Ives & Jarvenpaa, 1991, 35) or "horizontal information systems", emphasizing the emergent feature of IT-enabled cross-organizational processes (Braa & Rolland, 2000, 83). Coming to the 90's, the challenges in developing systems in a far larger scope than in the previous decades raised the need for high-level architectural planning and direction (Fong & Goldfine, 1989; Spewak 1992; Malhotra, 1996). Systems integration with the networking technologies and broadly used collaborative systems made the technology landscape even more complex.

The enterprise architecture concept is being used in both the software engineering and information systems paradigms according to their respective focuses. In the software engineering discipline, an *enterprise viewpoint* (Putman, 2001) or *enterprise architecture* (Bernus et al., 2003) finds use in the software systems integration context and in the development of distributed systems (Hasselbring, 2000; Linthicum, 2000; Putman 2001; Bernus et al., 2003). There is a split to two lines of discourse around which new communities emerge. For the ICT consulting practitioners, relevant approaches are closer to the information systems science, following the IS planning concept (Olle et al., 1988; Avison & Fitzgerald, 2003) or the strategic IS planning area (e.g., Ward & Peppard, 2002). The EA work is utilizing the IS planning practices and methods for focused areas to combine them to consistent EA approach (Figure 2, right).

The IS management (McNurlin & Sprague, 2004) and as the latest development, the IT governance (ITG) arising from the corporate governance concept (OECD, 2004), are related to the EA field but focus more on the information management function and the organization of the activities in this organizational function in an enterprise. EA management, planning and development arise from the practical work with organizational EA that ties

together the business development and ICT planning (The Open Group, 2003) to a consistent methodology (Figure 2) that includes partial overlap to systems design to ensure interoperability and compatibility. Along with the ITG, architecture governance or enterprise architecture governance have emerged as related IT-architecture specific concepts (Peyret, 2002; Ptech, 2004).
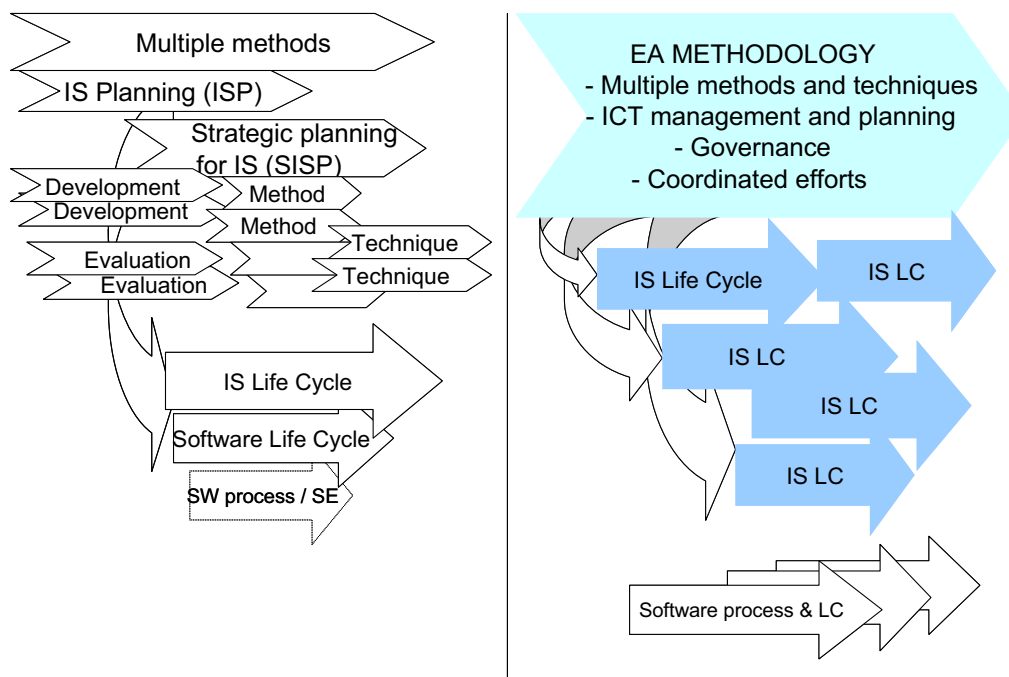
FIGURE 2   Multiple IS planning methodologies converging in EA methodology

To give a meaning to the concepts, the difference in *management* and *governance* could be described from the viewpoints of accountability and decision making power. Management includes budgetary planning that gives decision making power in the use of financial and other resources. Governance takes place in the frame of a given budget and resources. The Open Group provides an architecture governance model in the latest version of the TOGAF framework (The Open Group, 2006). The enterprise EA work is in the hands of the management, and it is giving inputs to the ITG. When these are joined to a consistent methodology (Figure 2) a resource overhead is freed from the individual efforts of ITG and other planning methods, and further, this approach disburdens the individual systems development efforts. In the legacy of IS, the life cycle (LC) of a system or a software application is covered with the IS methodology. The software engineering (SE) treats software similarly, with the software process as the common frame of reference. Together with the ITG

and ISP or SISP, there is thus a multitude of methods which the EA approach simplifies to a coordinated effort.

The IS development and IS planning fields are the starting point for the EA methodology development, but the context to be examined is expanded to the whole enterprise, and involves managerial decision making. The EA methodology gives a unified frame to the methods and approaches to provide consistent guidelines for the ICT related efforts in the organizational ICT management and development. This means a change in the agenda setting: shifting the point of view both from the business and the ICT standpoints to the enterprise management. The consultants, who are the facilitators of development efforts, are also EA methodology users in supporting the decision making and development steps in the end-user organization. The organization should, however, adopt an EA methodology for the management of EA and also for the management of short-term development efforts.

3.1 Definitions

Architecture can be seen simply as "the design of any type of structure whether physical or conceptual, real or virtual" (O'Rourke et al., 2003, 6). Smolander (2003, 17) reflects on the interpretations given to the word 'architecture' in the general language. Taking this analysis a step further, architecture related concepts can be regarded, firstly, as subjects, concerning an architect role. Secondly, they can be thought of as objects of activity, architecture as produced blueprints of something to be built, or as the way the real world constructs are composed. Thirdly, architecting as a verb means activity, i.e., the procedures leading to the production of architecture constructs, either descriptions (blueprints) or constructs existing in reality. In a dictionary definition the role of the architect or architecture as such "often includes … supervision of construction work, and the examination, restoration, or remodeling of existing buildings" (cf. the definition at www.dictionary.com 'architecture').

In the professional language, the term can be defined as the standardization body of the field defines (IEEE 1471-2000, 3):

> "The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution."

Besides this, a rather static definition of architecture, the functional aspect to the concept explicates the activities associated with architecture: compiling different models or descriptions for different viewpoints, layers or dimensions of the architecture to lay out different aspects of a system or an enterprise for the analysis and planning of designs, the evaluation of them, and the documentation of the implemented constructs (e.g., Zachman, 1987; Spewak, 1992; The Open Group, 2003).

Architecture descriptions are used for further specification, design and development work on systems that are within the architecture or adjoin it over an interface. Architecture descriptions are, in the case of the enterprise architecture, likely to be created by roles and people different from those who use them.

The EA approach as the ICT asset management, being a part of the strategy process of an enterprise, stresses the activities around both describing the ICT assets and developing them further. This activity point of view calls for a process to shape and coordinate the actions to be taken. Also, different roles are needed in the case of EA for the supervision and decisions to guide any further work on the systems. These roles are likely to use different languages according to the communities of practice they represent: a business manager or an ICT developer do not describe a business process or other constituent element of the EA in a similar way, simply because the aspects of the processes significant for their work practice are different.

Enterprise can be defined as "a group of people organized for a particular purpose to produce a product or provide a service" (O'Rourke et al., 2003, 6). The Finnish word *yritys* firstly means 'a firm', 'a company', and secondly 'an undertaking' or 'an attempt', all of which are included in the term 'enterprise'.

A synthetic view to the enterprise concept is given in (The Open Group 2003):

> "... 'enterprise' in this context is any collection of organizations that has a common set of goals and/or a single bottom line. In that sense, an enterprise can be a government agency, a whole corporation, a division of a corporation, a single department, or a chain of geographically distant organizations linked together by common ownership."

Although a relatively young concept, *Enterprise Architecture* has already been explained with definitions from several different points of view. From the two fields of study, SE and ISD, different aspects of EA are joined together in a definition of EA and 'enterprise architecting' activity:

> "Enterprise architecture (EA) identifies the main components of the organization, its information systems, the ways in which these components work together in order to achieve defined business objectives, and the way in which the information systems support the business processes of the organization. The components include staff, business processes, technology, information, financial and other resources, etc. Enterprise architecting is the set of processes, tools, and structures necessary to implement an enterprise-wide coherent and consistent IT architecture for supporting the enterprise's business operations. It takes a holistic view of the enterprise's IT resources rather than an application-by-application view." (Kaisler et al., 2005, 224)

A similar synthesis is also presented with a language oriented approaches like the Archimate project (Lankhorst et al. 2005) and further modelling efforts (Lê & Wegmann 2005). EA pioneers define the EA as an object (target of activity) and blueprint of, firstly, the current state and, secondly, of the targeted future states:

> "Enterprise Architecture is a strategic information asset base, which defines the mission, the information necessary to perform the mission and the technologies necessary to perform the mission, and the transitional processes for implementing new technologies in response to the changing mission needs. An enterprise architecture includes a baseline architecture, target architecture, and a sequencing plan" (CIO Council, 2001, 2).

It must be noted that - as EA practitioners regularly point out - this target is a moving target, which moves with the pace new technologies become available and the business environment of the enterprise changes. However, for the collaborative developments, a common goal has to be envisioned even though a complete realization of the plans as such might be reached only partially before the plans need to be changed.

Further, a definition summarizes the purpose of EA in this ever-ongoing activity:

> "A defined EA is ...providing to people at all organizational levels an explicit, common and meaningful structural frame of reference that allows an understanding of what the enterprise does, when, where, how and why it does it and what it uses to do it" (GAO, 2003, 5).

From the point of view of the architect role the enterprise architects are responsible for aligning the enterprise business processes and the structures and their ICT support (Wegmann et al. 2006), a view that is supported by a definition of the EA process:

> "[Enterprise] Architecture is a process of progressive decomposition in which we derive the components of a technology solution directly from the business strategy that it is meant to support". (Lapkin, 2003, 3)

All these definitions together illustrate quite well what the EA and activities around it mean in organizational IS, or rather more broadly, organizational ICT:

- The management of the ICT assets as enterprise resources
- Planning developments of these assets and developments enabled with them, like business models, services or processes
- Collaboration of different groups; first and foremost the business and the ICT managers in the enterprise
- Managerial activity, meaning decision making
- Recording and describing the ICT resources and evaluating them for the decisions to be made
- Scanning for new technology enablers as part of the environment information the enterprise is collecting for its strategic management
- Planning development steps both for the business and the supporting ICT, according to the strategies of the enterprise.

This is undertaken sequentially at managerial levels from the top to the business operations level and finally to the management and detailed development instructions for information systems. A defined process as a

common agenda guides the sequence of activities, so that well informed decisions are made at all levels. Information on EA is managed so that the information on the context and the overall business requirements for the systems development and their management does not need to be collected for each system or project separately.

The EA work guides the use of different methods for different purposes, like, e.g., the business process re-design (BPR) or definition of organizational processes in general, the portfolio models for business, applications or technology management, the information modelling techniques, value chain analyses for business, and information. The EA gives a consolidating framework for applying the analysis of the enterprise resources and cost analysis to the ICT in use. The EA approach aims at balancing out the strategic planning of the whole enterprise and individual projects, but gives also an overall framework for the technological infrastructure and related planning and analysis activities.

3.2   EA Frameworks and Process Models

A framework is a static model, through which the meaning of a range of interrelated concepts, their interdependencies and hierarchies can be conveyed (Jayaratna, 1994). Frameworks are used for the purpose of categorization and to communicate the content of individual concepts. For the enterprise architecture as a broad and complex issue, a *common framework of reference* is essential for enabling communication. This notion emphasizes the use of frameworks to support groups of people in conveying their viewpoints on a certain area of interest.

Besides this, frameworks are understood as collections of issues related to the area (Whitman et al., 2001). This approach has been taken, e.g., in the EA frameworks of the Federal Government of the USA (GAO, 2003), and by The Open Group's TOGAF that is an extensive collection of EA best practices and issues. Common to most EA frameworks is that they are collections of both abstract conceptual models to display the interdependencies of technologies and business, concrete business requirements and detailed technology descriptions. This is to ensure common vocabularies and taxonomies at all levels of decision making.

Many frameworks and models have been presented (Pulkkinen et al. 2007b; Shekkerman 2003; Whitman et al., 2001). In the systems development era, the Zachman Framework of Information Systems Architecture (Zachman, 1987) was put forward. It is a matrix with six rows and six columns, the rows representing stakeholder group viewpoints from abstract to concrete (owner to developer) and the columns the views on data, function, network, people, time and motivation. The Zachman Framework and the National Institute of Standards EA model (Fong & Goldfine, 1989) were largely adopted in the US Government EA work. In their overall outline, both follow the waterfall

principle, where the technologies come to the picture only at the bottom. Illustratively, the tiny top of the NIST pyramid is a small portion of business architecture, and the area for technologies is the large base. In the Zachman framework, the top rows are the owner and the business or enterprise viewpoint with purely logical models of the enterprise activities and information. Technology is touched only at the bottom rows 5 and 6, of which the 6th is marked optional in the original presentation.

In systems development, the early phases of requirements elicitation and definition could be seen as one-way information transfer where the designers were not providing information but interpreting information they gathered from the business for the purpose of modelling the system. As Thomsen (2006) illustrates, the pyramid of early EA models has to be inverted to get a due share of attention to the business. Further, the advancements in technologies have changed the requirements for an EA framework. In the early planning stages, it is essential to give attention to technologies as enablers for business structures, models, processes and services. As the term e-business, a coinage of the late 90's, makes it clear, certain types of business only exist supported by ICT. Many more of them, today the vast majority, are heavily dependent on ICT. Variations of frameworks have been suggested mostly in trade literature. A review of EA frameworks and models (Pulkkinen et al., 2007b) does not find novel initiatives as to frameworks or EA models in the body of the EA knowledge.

In the literature, 14 process models are found (see Table 1, also Paper 6 Pulkkinen & Hirvonen 2005c). The process models vary in their level of abstraction, but the majority of them give support to the idea of different views to the enterprise architecture. A majority of the existing EA process models accommodate the four distinct views: 1) the business view, that is sometimes reduced to business processes or referred to as the function view, 2) the information view, or at a lower abstraction level the data view, 3) the information systems or applications, or simply the systems view and 4) the technology view or more generally infrastructure view. A broader business architecture definition is to be found in the information base giving the best coverage, The Open Group Architecture Framework (The Open Group, 2003), Enterprise Edition.

Most of the frameworks also provide some support to the idea of ICT and business alignment. They embrace concerns of business management either at a higher, strategic level or at the level of business operations planning like designing or redesigning business processes, or business models. Various strategic IS planning methods and techniques may be mentioned as belonging to EA process phases. Even though the Zachman framework has become the prevalent reference model of EA, the process models do not generally seem to follow the setup of the Zachman Framework. As an academic construction, a process model has been put forward based on this framework (Pereira & Sousa, 2004).

The process models do not recognize the hierarchies in organizational decision making or organizational structures in general. The importance of decision making, or strategic decisions, is pointed out in some of the models as

a starting point, to ensure a budget for a targeted development step. 'Manager', 'executive', or 'top management' are pointed to as the managerial level decision makers. Mentions of other stakeholders are hardly to be found. The assumed owner of the process is the IT organization within the enterprise (information management function), or else the ICT provider.

In the overall process design, the EA process models draw on the IS lifecycle models. Broader enterprise information is collected in the definition phase for extensive architectures. For the project process of a solution provider this seems plausible. However, it looks like the EA management as the interest of the client is not thoroughly observed in these models. A systems project seems to be included in some EUP (Ambler, 2002) or BEAM (One World IS, 2004) models. Cyclic process is the most common, and the linear process models like, e.g., in the EAP (Spewak, 1992) are to be understood in the context of a first time effort to define the enterprise architecture.

The system development oriented EA processes start with a problem scope definition or finding of a business case, indicating that some development is to be undertaken for a limited area (Harmon, 2003; One World IS, 2004; Ptech, 2004). In this case, the similarity with the IS process is obvious. The task of the EA process owner is to obtain a management executive 'buy-in' (CIO Council, 2001, Armour et al., 1999a and 1999b) for the intended development. Like the IS methodologies, the EA process models seem to be directed at and to offer support for ICT experts. As the presupposed process owners and with a granted budget these then undertake the intended development involving stakeholders, according to the agenda of the system developers.

However, communication among stakeholders is taken up as an issue in most of the processes presented in the literature (Table 1). Even so, if the stage is set by the ICT experts, the non-ICT staff roles are limited by the ICT-dominated agenda as to when and how to contribute to the decision making. Two of the sources mention *teams* (Spewak, 1992; Armour et al., 1999a). Even though it is not part of the TOGAF ADM process model, The Open Group, in the collection of the EA best practices, also recommends an organizational body for decision making (*architecture board*). This is definitely a step towards more discursive policies. An architecture group opens the possibility to a reflective approach and may develop to an information exchange and collaborative construction of new ideas. With knowledge gained from the EA literature process models, the present effort continues with the research problem, to the construction of the EA process. The challenge is to induce conversations for equal participants from both business and ICT camps. The process should mark the decision making points, following the decision making hierarchies and the architectural viewpoints. Giving a turn in the negotiation to the necessary viewpoints makes it an exchange. Inputs from the stakeholders enable informed decisions. Information comes from both the business and the business environment conditions, and about alternative technology and system solutions. In this model, each group contributes with their expertise following a common agenda.

A common framework of reference serves as a platform of 'making' the perspective to the EA and 'taking' the perspective of the other stakeholders (Boland and Tenkasi 1995), without being limited to the pre-defined models in the language of any particular community. If the descriptions are dictated by one "camp", i.e. community only, the participation of other groups or communities may be constrained by the pre-set mental models of that community. The EA process model coordinates the activities and manages the dynamics of the exchange between expert groups.

TABLE 1   The EA process models suggested in literature

PROCESS MODEL	VIEWS OR DIMENSIONS OF EA				Business Management		Communication mentioned as a phase or an issue
	Business Architecture, BA	Information Architecture, IA	Applications / Systems Architecture AA/SA	Technology Architecture, TA	Strategies	Business Planning.	
NIST (Fong and Goldfine 1989)	BA	IA, Data Architecture		"Delivery systems architecture" = hardware, software, data communication			X
TOGAF 7 ADM (Perks and Beveridge 2003)							X
GiGa EA process (Peyret 2002)							X
META EA process (Meta Group 2002)	Enterprise BA	Enterprise IA	Enterprise Application Portfolio	Enterprise wide TA	X		
FEA process (CIO Council 2001)	BA	IA, Data Architecture		"Delivery systems architecture" = HW, SW, Data communication	X		X
TOGAF 8 ADM (The Open Group 2003)	BA	Information Systems Architecture	Technology opportunities and solutions	TA			X
Armour et al. 1999a and (continued) 1999b)	Function	Information		Infrastructure	X		X
Harmon 2003 (related to META)	BA			IT Infrastructure	X	BPR	X (continues)

EAP (Spewak 1992)	Business model	Data Architecture	Applications Architecture	TA			X (continued)
Rational Enterprise Unified Process (Ambler 2002)	Business modelling					Business. models	
Basic EA Method BEAM (One World IS 2004)	Business problem; Organization, Operations, Resources				X	"Business problem"	
Pereira and Sousa 2004, based on Zachman	Owner or Enterprise view (row 2)	Data in column 2	Planner view (row 1) System model (Designer view, row 3)				
IBM EA Method Lifecycle (Ptech Inc. 2004)	Business scenarios, BA	Information model, Information – Activity matrix	IT Architecture Application function model	X for client			X
Gartner EA related processes (Lapkin 2003)	Multi-Enterprise Grid Processes		Modules, Bricks (functioning applications or parts of them)	X			N/A

4   RESEARCH QUESTIONS AND METHODOLOGY

The researcher was given the task to develop a coherent approach for the architecture consulting activities for the ICT provider, to support the quality management in this activity, and to seamlessly link the consulting efforts to the system development activities. The early results in the research project had put forward the method requirements (Hirvonen et al., 2003) as well as outlined the project types (Hirvonen et al., 2004) and considerations of the continuum of the client ICT management as opposed to discrete projects of the consultancy and IS development (Hirvonen, 2005, 11).

As this preceding work suggests, the EA is managed by the client organization, where different providers conduct discrete projects on strategic planning, systems and infrastructure planning, design and implementation. The discrete projects contribute to the overall EA, on which, however, the decision making power and responsibility is with the client, i.e., the end-user organization. Thus the work of the consultants is intertwined with the EA management of the client. The area within the research effort to be the scope of this dissertation is process for the EA work. To ensure successful projects, the project process context, i.e., the EA management process with the client, should be the starting point. A project has its best chances to bring real benefits if, firstly, the EA is managed and if, secondly, the project complies with and supports the overall EA. The consultancy can aid the client in defining their organizational EA process. Knowledge on a generic EA process becomes a part of its consulting expertise, and different business and ICT development and evaluation tools find their place as part of the EA toolkit. The overall research question to be investigated in the dissertation is therefore:

How to manage and coordinate the dynamics of information and communication technology planning with business management and development in large client organizations in their EA management, planning and development efforts?

Architectural approach is chosen for the comprehensiveness and better overview of all ICT assets. In managing change, viewing the enterprise through the architecture lense, helps in discerning what remains stable within a time frame, and what is being changed. This guides development efforts in decisions that cover a defined area, either the whole enterprise, some domain, or domains within it, or the work on one or more information systems with their dependencies to parts of the enterprise.

The first step in approaching the architecture methodology is to divide the research problem to sub-areas and respective sub-questions.

Subquestion 1: How to establish an understanding of a complex, multidimensional entity, the enterprise architecture?

To conduct a collaborative inquiry with the aim to establish a shared understanding on what the EA is and what the EA planning and development means, action research as the research approach is chosen. This means facilitating a discursive, reflective inquiry, as well as sharing knowledge between professionals who are engaged with the EA assignments for clients also during the research process. In a joint effort, across boundaries of different communities of practice, the experts of architecture consulting and the researcher explore the EA and related activities to compare the accumulated knowledge of the experts, at the same time informing the inquiry with academic as well as trade literature concepts, ideas and findings on EA. Research on IS methodologies has proven the action research approach to be usable and helpful in methodology development efforts with a strong involvement of end-users. The research seeks further to verify the action research as an approach for the EA method construction and implementation. To involve different stakeholder groups and to construct a shared understanding, a similar effort will be required in the ICT end-user organizations establishing their own EA management methodologies.

Subquestions 2a and 2b: What are the elements of the EA to be managed, planned and developed? How can the relevant and required elements and their interdependencies be managed and communicated between the relevant stakeholder groups?

The two-part Subquestion 2 takes an analytical approach to the enterprise architecture. Through a study of EA frameworks and models and a reflective comparison to empirical evidence from the practical EA work in the provider organization in its project consulting role, the study is directed towards a general EA framework and process applicable in any organization. The framework captures the elements of the EA for the construction of a meta-level process.

The enterprise architecture questions are a managerial concern. Enterprise wide questions are decided on at the strategic management level, and concerns of the operations management at the level of the domains. Therefore, the next subquestion is raised on the process context.

Subquestion 3: How does the EA process relate to other managerial processes for aligned business and ICT planning and development?

This directs the exploration to the approaches available for enterprise ICT management, and the network of processes in which EA management, planning and development take place. To understand the context where these decisions are made, and also how the EA management relates to other approaches suggested for the organizational ICT management, the process context for the EA process to be created is analysed. Having the elements appearing in the EA management analytically organized in the EA Grid, and the context for the process, the next question to ask is:

Subquestion 4: What is the generic, or meta-level process in an end-user organization to which the EA planning and development contribute?

The meta-level management process that involves both business managerial decisions and management of ICT is the so-called EA process. Following this process the enterprise (the end-user organization) and also the ICT provider can align the ICT planning, design, development or maintenance operations in the enterprise. The process should guide to interactive development of both business and its ICT support. A metamodel offers the elements, and the due course of the respective activities, for the constellation an organization specific EA process. The EA planning and development process needed in the consulting projects can be actualized from the metamodel to align the developments in individual projects to the overall goals of the organization and, as importantly, to the existing ICT support. The consultancy can contribute for the benefit of the client with incremental planning and development steps if the projects take inputs from and provide outputs to the EA management process that is keeping the oversight. With the Subquestion 4, the actual goal of the effort is targeted: the construction of an EA planning and development process metamodel for the needs of the EA work of a consultancy.

This model should support the management of the consulting services in the EA area, but due to its generic nature, its roots in end-user organization processes and the metamodel character it is also applicable to the end-user organizations. The process is designed to outline the multi-faceted EA work and to give support to the quality of consulting work. It ensures that necessary preliminaries are taken into account, and that the deliverables of a consulting effort provide the client with trustworthy answers to their acute problem that evoked the need for consulting. To meet these requirements, an understanding of the management of EA in the end-user organization is needed. A process metamodel suited for this purpose comprises all the elements of the EA work. Still today, end-user organizations may not have a defined EA process, or even EA management principles that would be the first step towards a process. Often a process is under development or remains fragmentary. The consultancy can profit their clients by bringing methodology knowledge with their EA methodology and by incrementally introducing an EA process derived from the

metamodel of the process included in the methodology. An organization specific EA process is always an adapted process, i.e. an instantiation from a process metamodel.

Further, the process should also take into account the subsequent work on the systems in the enterprise, which means that it produces deliverables to be applied for systems development work. The target is to bridge the gap from the business development to systems development, and not only for one target area, but aiming at the overall development of the whole enterprise through its ICT. The process should provide sufficient overlap with system design so that the EA decisions would be adequately conveyed to system implementers.

4.1 The Target of the Research and Research Methodology

The driver for the overall research effort in the target organization is to create a unified, methodical approach for the EA consulting projects. This is needed to unify the approach to ICT architecture consulting and create a consistent methodology for client cases in all services from consulting to systems development. The target of the research effort is to construct an EA methodology, and for the present effort specifically, the EA method process. As a prerequisite for the method and the process, a shared understanding of the EA area is needed.

With these starting points, qualitative research as the research strategy (Patton, 1990) with a flexible research design (Robson 2002, 163) seems to be well suited for the construction effort. It allows for gaining a thorough understanding of the related phenomena, the activities and processes in the research target area both in the environment of the deploying organization, i.e., the client, and the consultancy. Further, it gives the possibility to influence the research target, i.e., to trigger a change in the organization researched, and to accumulate knowledge of the area. A change is aimed at in unifying the architecture consulting activities and deploying a common methodology. Action research, AR (Baskerville & Wood-Harper, 1996) as an approach in IS research, provides guidance for conducting research efforts aiming at methodology development.

AR is seen in empirical settings as successful in developing and deploying new policies and methods in an exploratory and collaborative manner (Jayaratna, 1994). The underlying principle in this strategy and approach is the acknowledgement of the limited understanding the researchers have about the research target. In interaction or in a discourse with persons representing the target area, the researcher is led to take their viewpoint ('perspective taking', Boland and Tenkasi 1995) and build up knowledge and his or her own mental models of the area. In action research, this is the case also within the group that participates. Pre-set models, paradigms and frames are not enforced to begin with, but are allowed to emerge and show their strength in the negotiation and collaboration between practitioners and researchers (Robson 2002, 217).

4.2   Research Method Selection

This research effort is an attempt to create a validated EA methodology for the provider company in case. Literature on empirical EA research has only started to appear during the effort reported in this thesis, thus the EA method development was present in literature as theoretical constructs or method fragments. In AR, the validation and verification of the method construction takes place through the construct evaluation as part of the AR cycles (Baskerville & Wood-Harper, 1996; Jayaratna 1994). This is best done within individual case organizations. The AR frame encourages using both literature resources and accumulated practical knowledge of the case organization. The consultants in the AR group take the constructs created in their practice and bring back evaluative information to the group on constructs created in the AR effort. The required genericness of the methodology is aimed at the diversity of client organizations where EA cases are studied. They represent end-user organizations in different industries, and also non-profit organizations. The aim is to find the generic elements of EA work, not to study the specificity of any one client organization or EA case.

Literature survey, both on EA frameworks and models (Paper 3, Hirvonen & Pulkkinen 2004; Pulkkinen et al. 2007b) and on the EA process models (Paper 6, Pulkkinen & Hirvonen 2005c; Pulkkinen et al. 2007b), corroborates the coverage of relevant elements for the meta-model. The high number of variegated case organizations from which practical evidence is drawn adds to the reliability of the model. Further, gaining insights from several different case organizations will help to find and understand the generic factors of EA management and development in the ICT deploying organization, and distinguish the relevant elements for the EA process metamodel from situation-specific organizational factors.

4.3   Evolving Method

Besides a suitable approach for constructive methodology development, AR is also mentioned as a methodical approach for introducing new ways and policies into organizational activities (Wadsworth, 1998, Robson, 2002, 215). For the consulting projects in the EA area at TE, there had been no shared framework or method prior to the current research effort. The introduction of a methodology involves revising or even giving up some individual approaches and working procedures. Some of the advantages of a shared method are, among other things, the support for any communication and exchange on work issues, and a better insight to the activities in general. Applying consultancy quality policies to EA projects is also enabled by the method.

However, having to change the own way to carry out the tasks usually causes some resistance. Action research helps to reduce this resistance, because

the method users are involved in its development and their expertise is exploited by the composed methodology. The staff already working in the EA area may influence the method development and contribute with their own ideas and constructs. Further, they become familiar with the method already in its creation. Action research is thus also a way to lead to completion the organizational change process that is needed in the introduction of new policies or methods (Zuber-Skerrit, 1995).

At TietoEnator, the provider with which the research was conducted as an AR effort, a group of consultants and IT architects built an action group within the company that was developing an activity they themselves were working with. The researcher participated as a peripheral-member-researcher (Adler & Adler, 2000). Applying and adapting the AR approach in this setting is discussed next.

4.3.1 Action Research

The basic AR cycle model consists of five subsequent phases that are repeated, so that the results of one process cycle are fed back as inputs into the cycle started next (Figure 3). The phases of an AR cycle are:

- Reflection on the work or the work environment, raising a question (recognizing and specifying a problem area to be researched and treated with changed action).
- Learning about the problem and planning for a change.
- Change in the ways the work is being carried out (implement the change).
- Assessment of the effects of the change: evaluation of the new situation and the success of the change.
- Reflection on what is learnt and reporting the whole effort (specify learning). If the research continues, from this phase emerges the next focus area for the effort.

Slight variations of the cycle, for example with more fine-grained phases have been brought up (e.g., Robson, 2002, 218) but the five steps above contain the essence: inducing change to tackle a problem in an organization while being supported by research that informs the decisions on what to change and how.

The approach seeks to tackle the problems in the work environment with the grip of a researcher, taking an objective point of view to the environment and taking in information from sources with external validity, e.g., academic literature. For the organizational change efforts, this means a possibility to learn and extend the knowledge base beyond practical expertise, and also to lessen the possibility of biases in the effort. The perceived problem area in the organizational activity is formulated to research questions, and the solutions to be created in later phases are tested and evaluated with a similar scrutiny and rigor as academic research results.
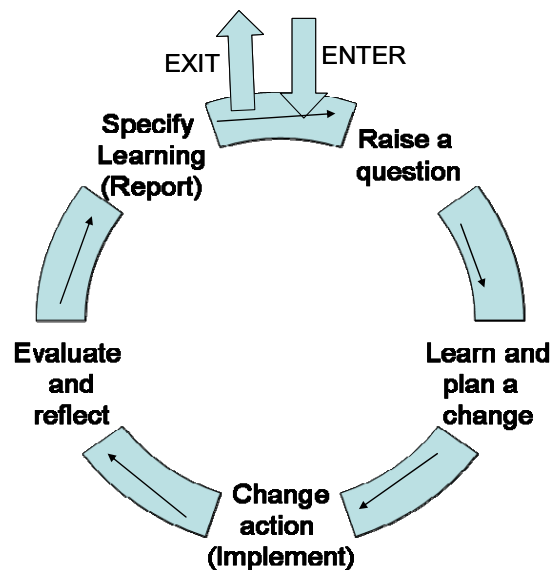
FIGURE 3   The Action Research Cycle

Thus an AR effort can produce, as a by-product, also research reports meeting academic standards. The last phase of the cycle recommends writing as a tool for reflection. Presenting the collected information, gained insights and the results constructed to the organization is essential in the AR procedures. With this activity, the subjective knowledge building as individual learning, and learning in the group are reinforced. A continued effort and reporting in writing builds a base of knowledge in the area that is recorded in the texts. With a group being involved in the method creation and introduction, the diffusion of the new knowledge to the whole organization is also accelerated greatly.

For the research, the action group provides the possibility to test the method versions in a small scale. The test bed for a methodology needs to be real use (Baskerville & Wood-Harper, 1996). A similar procedure is proposed for a method adoption with an evaluative approach (Jayaratna, 1994). The present method development effort follows these principles, putting emphasis on the learning process of the method users and facilitating the process for a collaborative construction as well as organization wide method introduction.

Both source material and preliminary constructs are evaluated during the research process. As soon as the method constructs are presented by the researcher, they are taken into the consulting work. The consultants evaluate the constructs and provide comments and further material for the iterative work. With this effort, the method users, i.e., the consultants, are also introduced to the AR approach, which they can utilize in assignments supporting the end-user organizations in the adoption of an EA methodology. There is similarity to the quality circles and the cyclic quality improvement approach (the PDCA, or plan-do-check-act) with the AR methodology. Common roots have been pointed out in reviews of the AR historic streams of

discourse (Noffke, 1997; 2007). This is in harmony with the study context, where a quality follow-up for the consulting activity with a defined methodological approach to it is sought.

With only one action group in the company, a possible danger in this AR effort is that the group involved does not get enough critical feedback. However, in the present effort the method is validated by collecting feedback from the method users in the whole organization, including consultants and IT architects who are not directly involved with the method development. This is done to avoid the so-called group think effects (Janis, 1983), or the AR group not having a sufficiently critical view on their own work. The progress of the work is documented in research project intermediate documents (cf. Appendix 1), from which the final research papers are written as reflective work and the final method is produced as incremental development.

4.3.2   The Knowledge Management Issues in Methodology Creation

The activity area of EA projects had entered into the services offering of the provider through an organic organizational development of the company. Thus, experiences have been collected in this activity area and expertise is accumulating with those involved in this activity. Both to take advantage of this existing knowledge, and to make the threshold low for adopting the method, the EA methodology is being developed in collaboration with the experts in the company. This means, in knowledge management terms, externalizing and leveraging the knowledge, both tacit and explicit, already existing in the organization (Nonaka, 1994). In the process, tacit knowledge of the company experts is collected and externalized by the thesis author and presented to the AR group for reviews. This has allowed the company members to learn and, through applying it in their own work, to internalize knowledge from each other's expertise. Through the activity, the recorded expert knowledge is made explicit, and can be shared with further groups within the company.

The way of working is a shared knowledge process between the AR group and the university member. In this type of a setting, the boundaries of different communities of practice are crossed (Boland & Tenkasi, 1995). The EA framework (Hirvonen & Pulkkinen, 2004) could be seen to become for the participants a type of a boundary object (Star & Griesemer, 1989). The purpose of a boundary object is to transfer and translate information between different groups of interest. During the research, the major communities were those of the academic world and the world of practice. In the case of EA work, the major orientations are business (operations and development) and technology (development and maintenance) and administration. The framework facilitates the perspective making and perspective taking (Boland & Tenkasi, 1995) needed for the process of creating a novel, shared perspective and collaborating in the further work on the method. Similarly, a common frame of reference works for the parties involved in the EA work, taking their perspectives into account and visualizing the interdependencies of each element in it. As a type

of boundary object, an EA framework is needed in the ICT deploying organization for the collaboration of business and ICT managers and other stakeholder groups, and the coordination of their decision making.

4.3.3   Collaboration of the AR Group and the Researcher

Combining the action research principles and the knowledge management approach of perspective taking and perspective making gives a new stance for the research method used in this study (Figure 4). The collaborative action and study of the own activities at the company can be seen as a *participative action cycle* depicted as the inner cycle in the figure. The cycle begins with the raising of a question, the research problem. It goes on with the planning, in this case developing the method components and implementing a change in the ways of working, i.e., taking the constructed method elements into practical use in the consulting projects. In the evaluation phase, the validation and verification of the results takes place by both its developers and other parties in the company.

The fifth and last phase in the AR cycle model is called specifying learning (Baskerville & Wood-Harper, 1996). As a concrete outcome from this phase in this project are the academic papers and other reports written and published.

The research cycle is depicted with the outer circle in Figure 4. It follows the participative action cycle. The researcher and the practitioners are making their perspectives to the subject matter. In exchange, they are taking the perspective of the other, whereby new knowledge is created by questioning and enriching with the other perspective (Boland and Tenkasi, 1995).

The chosen action research approach creates a setting where the construction of the results is not a one-shot effort, but an interactive, iterative process. The study findings, eventually the constructed results and their validity, rest on the evidence that forms an accumulating knowledge base rather than a set of data collected at one point in time. The individual study reports (Appendix 1) present the work at individual steps and phases. A set of evidence is collected for each of these steps, and it is presented in the scientific reports for publication.

In the academic papers following a strict format it is not possible to account for all the recorded and documented information supporting the resulting constructs. A base of evidence recorded in the intermediate reports is accumulating along the way as a knowledge base. This knowledge is mutually challenged by the researcher, the practitioners and the evaluators in the company. In this way of working, the true meaning of interpretive research (Patton 1990) is stressed. The results are based neither on the first interpretation of the results, nor on the interpretation by the researcher alone, but on reflections in a group and on challenging the constructs and the previous evidence in the evaluation phase during the AR cycle.
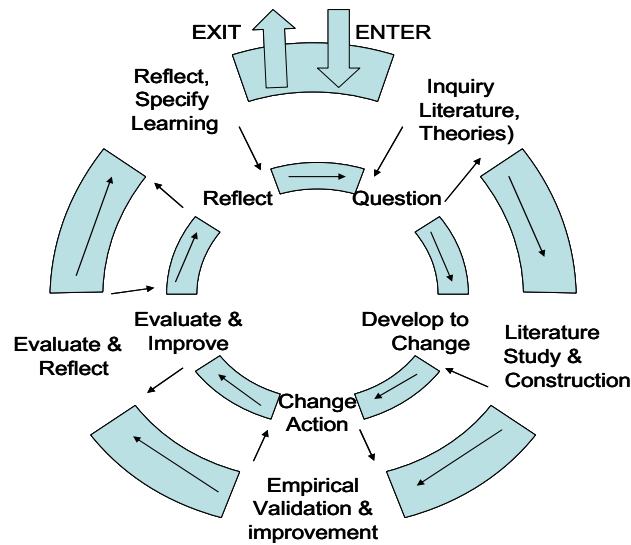
FIGURE 4   Interactions in the constructive research and participative action research

4.3.4   Research Techniques

For action research, various research methods and techniques can be chosen that fit the goals and the setting in which AR is undertaken. Looked at in the large, the present effort is conducted with one ICT provider and falls in this respect into the case study category (Yin, 1994): the methodology development is undertaken in one company that is examined thoroughly in the respect of EA work. However, the aim is not to be descriptive, but constructive. The aim is to construct the EA process model together with other necessary elements to enhance the consulting practices in the company in case. However, the construction is informed by the cases, and is validated through the study of cases.

As techniques for data collection, interviews and group interviews (Fontana & Frey, 2000) and document analysis (Hodder, 2000) were chosen, as these together will give more information to reconstruct the process of conducting the EA work and examine different aspects and their interplay in it. The knowledge intensive study involves also some participatory observation (Adler & Adler, 2000) and reflective knowledge building (Schultze, 2000). However, the observation data was provided by TietoEnator company members because of the confidentiality of their client cases. The researcher was able to study these consulting cases by examining the client project documentation.

The study aims at a construction, the process meta-model, and its validation through the consulting practice in EA related projects and organizations conducting EA work. Thus this is an interpretive, constructive effort. Another aim of the thesis is to position the enterprise architecture work

within the field of information systems studies. For the theoretical basis, this work draws on the IS lifecycle process knowledge and the IS methodology literature. It attempts to establish a bridge from the academic discourse on information systems to the practical consulting work in and with organizations deploying ICT. The challenges presented by rapid changes in the end-user organization business environment, the changes in information and communication technologies as a part of it, and the organizational changes due to ICT implementations point to organizational development in the context of IS. Another literature base is the EA literature, the beginnings of the project only starting to appear in academic publications. The models, frameworks and processes available are presented in trade literature or academic publications of lower rank. The approach to the EA literature is that of document study, to collect elements of the EA process meta-model. The main elements found are presented in Section 3.2 (see Table 1).

4.4   Data Collection

This section gives background to the collection of data for the construction of the results and to the elicitation of the evidence used in the studies reported as the included research papers. The background information from the empirical work includes the following main parts:

- A list of the intermediary deliverables through which the reflective, collaborative construction process is carried on (Appendix 1).
- A list of interview and group interview questions, which was initially used in collecting the information (Appendix 3). The topics to investigate the individual EA cases are derived from this list containing basic method issues.
- For the reference case study outside of the TietoEnator organization, (the Metso Paper case), the document management system (DMS) user interface with list of files in Appendix 2.
- For the explication of the evidence, a mapping of the research papers to the research cycles (Table 2, p.63). It should be noted that the time needed to publish a paper varies, as it depends on the publication process at a conference or a journal in question.
- A list of the EA cases that were drawn on for evidence in the individual studies presented in the research papers (Table 3, p.64).
- A coded list of the company members contributing to the research with their roles in the company (Table 4, p.65).

The project documentation was saved to a document management system. Appendix 2 shows the user interface of the DMS. Files listed in Appendix 1 were stored in several similar units. The actual document files are appended to the DMS unit, and metadata is saved automatically when the system is used.

The exchange between the practitioners and the researcher was, to a large extent, taking place through emails. In the email database, the correspondence and also attachments were preserved for later reference. Through this, the progress over time can be followed.

A straightforward research process implies that the researcher collects a set of data, analyses it against some explicit or implicit theoretical background, with an applicable technique, and presents the analysis as the result. Those who inform him or her on the topic area in the data collection phase may never have the chance to check back on the information they were providing, e.g., in interviews or questionnaires. The interpretation by the researcher is not challenged, and the interviewees won't have the possibility to complement or correct their statements if there is no further communication about the matter between the researcher and the interviewees. The reflective way of working, following the AR approach, does not rely on the interpretations and intuition of the researcher only, or on any one person, or something said at one point in time. In the effort, the researcher does not have the freedom to interpret the collected data solely according to his or her own mental models. Also, the incompleteness of the information conveyed in a single interview situation is not allowed to distort the interpretations and results.

The *collective reflection* associated with the AR approach (that is why it requires *a group* to conduct the inquiry!) is materialized in this effort, firstly, in the group of consultants, *including* the researcher, even though her participation is peripheral, i.e., she is not conducting consulting work during the time of the research. Secondly, the AR principle of reflection through writing is followed. Writing is a process that induces learning. The collected data and information together are reflected on in the intermediate documents (research project deliverables, see Appendix 1). The writing of the research papers concludes the process on individual study areas, presenting the core results of the effort.

The focus of the research is the management of comprehensive ICT in the organizations, and improvements in it planned in the consulting assignments. For the consultancy, of importance is all information that serves the methodology development. The set of questions (see Appendix 3) asked in the information collection reflects these targets. However, the elicitation of information is not restricted to answers to these questions only; the interviewees were interacting with the researchers and bringing up their conceptions and experiences broadly. This information was analyzed for the EA methodology development. The collected information was presented in a structured way in the project deliverables for further elaboration.

The interactive, discursive work was documented in several types of documents. The way of working changed somewhat with the progress of the work. The types of documents are (see Appendix 1 and 2):

- Plan documents were written for each research cycle (lasting approximately a year), fixing the detailed work plan for the project in the case of TietoEnator. Information is included on the starting points, the goals of the work, and the persons to be involved in the action group and

as evaluators from outside of the group. More effort was spent on plans in the beginning of the project.

- Preparatory documents were provided by the researcher for the meetings or interviews with topic areas or the questions to discuss.
- Memoranda from the working group meetings were written by the researcher. These record the agenda and discussions in the meetings, workshops, seminars or in some cases telephone or video conferences.
- The AR group members were taking the pieces of the emerging methodology directly into their work along the way, and brought feedback to the group. Feedback from this on-going evaluation was included in the intermediate reports.
- Project reports collect and accumulate the evidence and present summaries of literature, empirical evidence and preliminary constructs. In the later cycles, the project reports developed towards a complete methodology. In the 3rd cycle, the integrated EA methodology document is the main deliverable.
- Evaluation reports were written based on expert reviewing by both the AR group members and the evaluators appointed for this purpose. Evaluation by appointed external evaluators, and the AR group is reported in the evaluation reports.

Individual documents were exchanged frequently with essential summarized information for quick information exchange. The list in Appendix 1 follows approximately chronological order. Those project deliverables that contribute to the dissertation area are listed. There were further research papers written and issues dealt with in other documents in the same project. To compile the list, the research project document databases and the database of emails exchanged during the project time are included. The metadata provided in the databases and the time stamps in individual office document properties were checked. The AR cycle activities are pointed out in the appended list. It is to be noted, that the completion of a document and saving of the last version into the database might have other triggers (e.g., project administrative events like board meetings, or presentation of the results in other contexts). As a result, there may be some timing inconsistencies. However, the documentation follows the AR cycles in its chronological emergence rather consistently.

In the initiating phase, the group was interviewed by the researcher. In the action planning and evaluation phases, the researcher got reflective feedback on the constructs presented to the group as theoretical inquiry results and similarly, feedback on the constructs created to be used in the action. In the memos, the current work practices in the area defined as EA consulting were described and synthesized by the researcher, to serve as knowledge made explicit to be shared and reflected in the group and included to the targeted method constructs. These syntheses were approved of by the group members to ensure common understanding. This work was done iteratively.

The evidence referred to in the individual studies, e.g., the EA project case studies (with information collected in interviews and from project case

documents), and the interviews or group interviews with experts on EA work in general are mentioned in the list in the Appendix 1.

In project reports, the approved synthesis of the current work practices was merged with literature models to incrementally construct the EA methodology. The constructs are reviewed in the group along the way, and the ultimate result emerging, the process metamodel, can be followed from the first draft presented in the first research paper (Paper 1, Hirvonen and Pulkkinen 2003) included in this dissertation over continuously evolving draft models in the intermediary project documents. The final metamodel is presented in the last papers, with details in the large final methodology documentation (unpublished work in TietoEnator internal use). The constructed methodology parts were taken into use by the consultants, who brought feedback from the practice to the process already during the iterative construction. In the AR cycle evaluation phases, systematic evaluation was undertaken by appointed evaluators who were not members of the AR group.

Over the time the way of working evolves towards more informal information exchange and actual deliverables that are more extensive. This is due to learning and trust building in the process: less administrative and plan documentation is produced; the effort is put into the work substance instead. In the beginning, a common understanding has to be established, and short documents are exchanged often, to ensure correct interpretation and to get early reviews in the group for corrective measures. Explicit concept finding and building is undertaken (work on terminology) to achieve common understanding and common language. Later, when the work relies on a shared framework of reference, and there is an agreement on both the substance and the working methods, there is less need for frequent approvals of small pieces of work. With increasing trust in the later phases, also more information is provided to the research effort, and the researcher is allowed to conduct data collection within the company on her own.

Besides this documentation on information exchange, the EA process meta-model is based on the literature on EA methodologies, frameworks, models and processes as a source for the meta-model elements. This, to a great extent trade literature material, is used in the construction process, to collect elements for the metamodel and to reflect and discuss the actual work practices (see section 3.2, Table 1 for this data). The consultants are aware of the trade literature, but no model, framework or process is shared or used as such. These models are rather used as reservoirs of ideas and material for work.

The resulting construct is thus based, firstly, on evidence from related frameworks, models and process data from EA methodologies largely found in trade literature, secondly, on expert knowledge made explicit by the researcher in intermediary project documents. As a third source, the iterative validations in the evaluation phase of each AR cycle bring comments and refinements to the constructs, adding to their coverage. The results are evaluated by the AR group in a table test manner during their construction and also introduced as working tools as soon as they are available to get feedback from practice. Appendix 1 details the point in which a larger piece of work (methodology part,

and in the third phase the complete methodology) is released in the company intranet for free access and use by everyone engaged in consulting work. The evaluation phase brings feedback from actual use (by not only the action group, but other consultants as well) that is then introduced to the further research work.

In Table 2, the questions are explicated, and the research papers answering them are assigned to the questions that are included in this thesis. The relatively long time span (2002-2005) allows for a sustainable organizational change to take place, meaning that the organizational learning on the EA consulting area has good chances to be permeated by and become part of the work practices in the company.

Those evaluators who did not participate in the work of the AR group, undertook the evaluation of the finalized result of each cycle. Further, the researcher was also informed by the materials, comments and evaluations in the university project group, and by the other companies (IBM and Yomi) in the research project consortium. This gives both an academic reflection background to the researcher, and also a chance to think with the perspective of other companies so as not to obscure her objectivity within one company case.

The extent of the evidence that was directly collected from the EA case work by TietoEnator can be explicated by the number of EA cases studied in each reported part of the research effort (See Table 3). An EA case means a consulting project conducted in a client organization on the client enterprise architecture, producing either plans or both plans and developments in the EA.

The case study paradigm is subdued to the AR inquiry, following the strategy of interpretive research and a flexible research setting (Robson, 2002:163). The exchange with the AR group of consultants and architects brings broader and deeper insights to the issues studied. By only studying one or few client cases, the information on EA work could remain shallow and fragmented. The material to construct a meta-model is richer with multiple client cases studied.

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TABLE 2   The research cycles, the questions addressed and the results produced

Phase	Sub-question(s) addressed	Results
First cycle 2002	The main research question - how to manage and coordinate the dynamics of information and communication technology planning efforts with business development in large client organizations? - is studied through consulting projects. Understanding the dynamics of organizational change and ICT planning & developments in EA consulting projects.	1st paper EA defined as an emerging area in the consulting activities First draft of the process model. 2nd paper, Organizational change framework and the roles of the actors in EA work
Second cycle 2003-2004	What are the elements of the EA to be managed, planned and developed, and how can the relevant and required elements be managed and communicated between the relevant stakeholder groups?	3rd paper The EA Grid 5th paper The EA process context EA related to other approaches in ICT management
Third cycle 2005-2006	How does the EA process relate to other managerial processes? What is the generic, or meta-level EA process, for EA management, planning and development?	4th paper Testing the the EA Grid 6th paper First version of the process meta-model 7th paper: The completed process model

One of the papers that reports on research conducted outside TietoEnator, gives the researcher the possibility to put the thinking patterns gained within the provider organization into a test outside of it in a fresh setting and get feedback from the client organization and fellow researchers who were not a part of the AR effort. The intermediate documentation for this case is shown in the DMS example view in Appendix 2. This study was conducted as a part of the research process closing-up reflection.

The total count of different client organizations in these EA project cases is 19. There are some overlaps between the research papers, since the aspects studied about the projects and organizations are different in each paper. In some of the organizations, subsequent consulting cases were examined so that the number of client organizations does not increase in them even though the number of cases does. Due to confidentiality, the researcher did not have a full access to all individual organizations and does not know all of them by name.

TABLE 3   The EA case evidence used in the individual studies

Study report	Phase of the study	Number of cases	Data collected by
Paper 1	Defining the EA consulting area and understanding the EA concept	9 cases	Ari Hirvonen
Paper 2	Comparing the organizational change phases to EA consulting, and participation in the projects	9 cases	Mirja Pulkkinen Ari Hirvonen
Paper 3	Constructing the EA Grid framework for enterprise architecture	9 cases	Mirja Pulkkinen Ari Hirvonen
Paper 4	Testing the EA Grid framework in an enterprise security case	1 case (Metso Paper)	Mirja Pulkkinen Anton Naumenko
Paper 5	Defining the role of EA management in the context of organizational management processes	3 primary cases 3 secondary cases	Ari Hirvonen Mirja Pulkkinen
Paper 6	Constructing the process model	7 cases	Mirja Pulkkinen
Paper 7	Refining the process model	3 cases	Mirja Pulkkinen

On some of the cases, the information about the organization was only provided as information shared in interviews and in discussions during workshops. In most cases, however, also project documentation was made available at least for viewing during group sessions, and often was even left with the researcher. If the case organization wanted confidentiality, the client was made unidentifiable by deleting cues identifying the client from the documentation. For the studies reported in Papers 4 and 7, and part of the cases in Paper 6, the organizations examined are presented to the researcher with the name.

The persons informing the AR effort, collaborating as AR group members in it, or evaluating the results of the research are listed in Table 4.

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TABLE 4   The action research participants and other informants

PERSON (CODE)	POSITION OR ROLE	BUSINESS DIVISION
TIETOENATOR / Participation in research and evaluation		
Person 1 AR group member	Senior Consultant	TietoEnator Processes and Logistics
Person 2 AR group member	Chief Architect	TietoEnator Telecom and Media
Person 3 AR group member	IT Architect, Object and Component Technology Specialist	TietoEnator Public Sector and Healthcare
Person 4 interviewee, commentator	Consultant	TietoEnator Digital Business Competencies, Production & Logistics
Person 5 AR group member	Consultant	TietoEnator Public Sector and Healthcare
Person 6 Commentator	Senior Consultant	TietoEnator Public Sector and Healthcare
Person 7 Commentator, materials	Chief Technology Officer	TietoEnator Processing and Network Services
Person 8 AR group member	Consultant	TietoEnator Public Sector and Healthcare
Person 9 AR group member	Consultant	TietoEnator Public Sector and Healthcare
Person 10 AR group member	Chief Technology Officer, Senior Consultant	TietoEnator Public Sector and Healthcare
TIETOENATOR – Evaluation of results		
Person 11 Method specialist	Senior Consultant	TietoEnator Telecom & Media
Person 12 Method specialist	Senior Consultant	TietoEnator Public Sector and Healthcare
Person 13 Method specialist	Senior Consultant	TietoEnator Public Sector and Healthcare
Person 14	Chief Technology Officer	TietoEnator Banking & Finance
Person 15	Chief Technology Officer	TE Group
Person 16	Senior Consultant	TietoEnator Processes and Logistics
Person 17	Senior Consultant	TietoEnator Public Sector and Healthcare
Person 18	Chief Technology Officer	TietoEnator Telecom & Media
Person 19	Consultant	TietoEnator Public Sector & Healthcare
The TE Group Technology Symposium attendees (~150 persons)	Technology managers, method specialists, Architects, Senior and chief consultants	TE Group
METSO PAPER		
Person 20	Manager, responsibility in Process Analyses	Process Technology Metso Paper Ltd
Person 21	Product Development Engineer	Product Management Metso Paper Ltd
Person 22	Manager, responsibility in Maintenance Development	Life Cycle Services Metso Paper Ltd

5 ARTICLES

This section gives a brief overview of the research papers included in this dissertation. The preceding sections present the research setting, the approach and the methods used for the research reported in these papers. The papers report the individual studies published during the research effort. The papers are:

1. Hirvonen . & Pulkkinen M. 2003. Evaluation of IT Architecture Solutions - How can an ICT consultant tell what is best for you? In E. Berghout & D. Remenyi (Eds.) Proceeding of the 10th European Conference on Information Technology Evaluation. London: Management Centre International Limited, 327-337

2. Hirvonen A. & Pulkkinen M. (2005a) User Participation in Consulting Projects: Client and Provider Role Profiles. In D. Bartmann, F. Rajola, J. Kallinikos, D. Avison, R. Winter, P. Ein-Dor, J. Becker, F. Bodendorf, & C. Weinhardt, (Eds.) The Proceedings of the 13th European Conference on Information Systems (ECIS 2005). Regensburg, Germany: University of Regensburg, 74.

3. Hirvonen A. & Pulkkinen M. 2004. A Practical Approach to EA Planning and Development: the EA Management Grid. In W. Abramowicz (Ed.) BIS 2004. Proceedings of 7th International Conference on Business Information Systems. Poznan, Poland Poznan: Wydawnictwo Akademii Ekonomicznej w Poznaniu, pp. 284-302.

4. Pulkkinen M., Naumenko A. & Luostarinen K. (2007) Managing Information Security in a Business Network of Machinery Maintenance Services Business – Enterprise Architecture as a Coordination Tool. Journal of Systems and Software, 80(10). Amsterdam: Elsevier, 1607-1620.

5.	Pulkkinen M. & Hirvonen A. (2005b) Organizational Processes in ICT Management and Evaluation. Experiences with Large Organizations. In D. Remenyi (Ed.) Proceeding of the 12th European Conference on Information Technology Evaluation (ECITE). London: Academic Conferences Limited, pp. 385-395.

6.	Pulkkinen M. & Hirvonen A. (2005c) EA Planning, Development and Management Process for Agile Enterprise Development. In R.H. Jr Sprague (Ed.) Proceedings of the 38th Annual Hawaii International Conference on System Sciences (HICSS). Los Alamitos, CA: IEEE Computer Society, (Abstract book p. 223).

7.	Pulkkinen, M. 2006. Systemic Management of Architectural Decisions in Enterprise Architecture Planning. Four Dimensions and Three Abstraction Levels. In R.H. Jr. Sprague (Ed.) The Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS), Los Alamitos, CA: IEEE Computer Society, (Abstract book p. 179).

The reflection and cumulative learning in the AR approach allows for an incremental development of the final result. The deliverables of the previous phases are taken as inputs to the next cycles. The appended papers show the learning during this research, and the evolution of the ultimate target, the process meta-model. Related issues are solved as seen relevant, e.g., the roles and task divisions involved in the EA consulting projects, the EA framework and the context of the EA process as a map of managerial processes. Further insight into the use of the EA as a structuring frame for IS planning is gained in a business network setting with security architecture as the focus.

5.1 First Paper: Evaluation of Enterprise IT Architecture Solutions – How Can an ICT Consultant Tell what is Best for You?

With this study, the research area is outlined. At that time, the then novel EA concept and its relation to the more traditional consulting and systems development activities was established. The projects that deal with EA questions are marked off. These are consulting projects on ICT planning issues concerning more than one information system. There are infrastructure and telecommunications questions that are of concern to the whole enterprise. There is also the implementation of an enterprise information system (ERP, MRP, CRM, SCM) and another type of core IS that requires broader considerations on enterprise ICT. Another type of concern are the system integration projects, with a broader range of dependencies within the enterprise.

With the clients, the term EA is not well known. The clients rather look for a solution to a current problem, or seek to enhance their business with solutions

on the market to keep up with the competition. However, in the context of architecture consulting projects, where more than one system is planned, replaced or enhanced, or infrastructure developments are planned, the projects are seen as EA projects. The methodology development is defined for this area within the consulting activity.

The progression of the first action research cycle within the whole process is illustrated by this paper (Hirvonen & Pulkkinen, 2003). It serves as the background for the evaluation model that was created and also gives the first results of the collaborative inquiry. Case studies of EA projects in client organizations are used to give shape to the concept and to reflect on the literature.

For the target organization of the study, the role of the paper in this phase was to pave the way for the introduction of the enterprise architecture as a concept, both in the ICT consultancy and for their clients as the end-user organizations. The consultants had been approaching the assignments of the new type, firstly, with their existing repertoire and experience with information systems development and planning, and, secondly, by acquiring information, e.g., from consulting literature and Internet forums like The Open Group's Architecture Forum. The research project served well the end of creating a unifying frame and for comparing the ways the projects were conducted by individual consultants. Further, the research group was a forum to enable information exchange on existing literature between experts involved in this type of assignments.

For the research process, this is a landmark in creating a common understanding and a common framework of reference within the group of people involved in the EA area consulting assignments. The first version of the EA process cycle presented in this paper (Figure 1 in Hirvonen & Pulkkinen, 2003, 328) heavily relies on the TOGAF ADM model. The reflection on practice leads to the modification of the TOGAF ADM process model that is already in this phase revised with expert information from the EA consulting practice. Although not recorded in the paper, the idea of levels of abstraction taken on in the final process model was already adopted in this phase of the study. This was pointed out in the project report on the first cycle, and the next research cycle was supposed to explore the different levels of decision making (Pulkkinen, 2002). The levels are already present in the paper in the evaluation framework.

The paper summarizes information on evaluation issues in EA projects, which is a core issue in ICT consulting. The consultant's role is often to provide information on alternative solutions to problems by evaluating them in the context of the client, thus helping them in making decisions (Block, 2000). Argumentation for suggested development plans can be provided by estimating how the suggested systems, architectures, or implementation technologies affect the business and what their financial implications are. Therefore, evaluation is an essential part of the consultant work for providing high quality consulting results. That is why the study of evaluation was conducted in the early phase of the research undertaking. It provided the

consultants with a relatively simple frame to place their evaluation efforts into and find some coordinates for the evaluation in EA type projects. The reported study introduces the EA concept, which at the time of the publication of the paper was still rather unknown within the consultancy and also in the academic world. At the same time, the evaluation framework provides some immediate value to the consulting work.

5.2   Second Paper: User Participation in Consulting Projects: Client and Provider Role Variations

Although this study was actually published rather late in the research process, it was written earlier and the concerns taken on in this paper were worked on from the beginning on. The client and consultant role variation was, like evaluation, one of the first things necessary in the EA consulting and to be included in the methodology. EA management is the concern of the end-user organization. Decision making remains in any case with the client, as the saying that 'a company can outsource everything else but their decision making' indicates. In the study, different possible variations in the roles of the consultants and respectively the client representatives were analysed based on nine EA consulting assignments considered typical, for which information was available on client participation. The information was collected by interviewing the consultants and reviewing the project documentation. An earlier study (Hirvonen et al., 2003) with consultant interviews had already brought into discussion the client's role and the problems caused by, e.g., organizational maturity issues and the significance of the client capabilities to collaborate in an EA project.

This study brings into the focus the end-user organization, the organizational change issues and what is known in the information systems science even today as the so-called 'user participation'. Understanding the social phenomena in organizational change, and understanding the changes triggered by information systems has been a topic of discussion in the IS field of research early on. This study emphasizes the managerial concerns on EA issues and organizational change: decision making, decision information, and evaluation to gather information for decisions. For this, the contribution of different stakeholder groups is seen necessary. This means empowering also the communities of practice at different levels in the decision making to allow them to contribute with their expertise. Managers making decisions on the use of resources have to be involved as the project requires. The consultant's role is not to be underestimated, but on the other hand, the quality of the consulting work is also to a great extent dependent on the capabilities and decisions of the client. Managerial decisions should be obtained at the required level according to the scope and dependencies of the change, and the managers should also have the necessary foresight to what is going to change.

The paper discusses the considerations on the part of the client organization, i.e., the end-user of the ICT, and the management of these technologies, infrastructure, systems and applications, and information management. In this paper, against an organizational change framework, the phases of the EA work are presented, reflecting the organizational change and the cycles in this change process. This is significant also in defining the roles of the consultants and the end-user organization in making decisions on the organizational ICT, for which the paper provides further aid. The framework for the organizational change guides the end-user organization in anticipating and preparing for change management in cases of significant development efforts in their enterprise architecture. It is a responsibility of the client to provide the capabilities needed from their side for the project. The EA method should help to negotiate between the client and the provider to build a common understanding on that.

A point to be made on this paper is that it introduces the EA approach through the IS planning concept to the IS research community. The rhetoric used especially in introducing the topic of the paper is chosen for the publication outlet, because consulting projects and IS planning issues are, or at least used not to be topical in the IS research. Major events like the EA Summit or the EA Forum of The Open Group dealing with EA do not meet the criteria of academic publication fora. Only quite recently, major conferences and journals are taking on EA as a research area.

5.3 Third paper: A Practical Approach to EA Planning and Development: the EA Management Grid

The third paper lays the foundation for the process model targeted in this thesis. The EA Grid presented in the paper was created during the second year (second cycle) of the action research together with the TietoEnator action research group. Whereas the first cycle had brought results that were not yet fully developed (see Paper 1, Hirvonen and Pulkkinen 2003), the third one (Hirvonen and Pulkkinen 2004) illustrates the shared understanding created in the group.

The framework was constructed as a synthesis of the available literature models and empirical evidence collected from practicing consultants. A lot of research effort was put for completeness of literature search on EA models and frameworks, to a point where new sources brought no more new information. Interviews with consultants (Hirvonen et al., 2003) and group interviews had been conducted to collect information during the first cycle. The first cycle results guided the analysis of the literature on EA frameworks and models as to those suitable for the defined EA area (and e.g. not for enterprise system development), and the evaluation of their suitability as a basis for the EA methodology. In workshops the previous work was presented to the group and discussions were carried out to build a consensus and to explain the

constructed model and compare it with the mental models of the group members and the practical needs they had in their work.

From the notes of the researcher, two highlights from the discussions in the AR illustrate how a construct is finally accepted as a shared model. First, the four viewpoints of EA: after long discussions on different occasions on, e.g., the Zachman Framework, and the company legacy to divide the architecture to logical and technical views, the consensus is reached to comply with the four as a suggested set. Later this set was beginning to emerge also in the TOGAF framework and in most commercial EA methods.

Even more discussion took place on the hierarchical structure of the EA framework. A need was perceived for a middle managerial level, or the level of business operations. A tentative name was the level of 'business area'. The consulting practice in the analysed cases pointed to the crucial role of middle manager involvement in materializing the strategic guidelines for the enterprise. Only when combined with the knowledge from the business operations, the business and ICT developments can be planned in a realistic way, paying heed to the business operations requirements and constraints for the architectural solutions. Decisions in business units or within a limited domain like a business process are more accurate than general manager or the IT department decisions. Illustrations of the process hierarchy were prepared by the researcher and the discussion went on between group workshops. Free drawing was frequently used as a technique in the workshops. Finally, in an email exchange an agreement was achieved to present, in the basic framework, the division to three distinct abstraction levels, to illustrate the hierarchical decision making. In various organizational settings, both enterprise and domain levels may split to further levels, but the three abstraction levels for different levels of decision making seem to be the meta-levels of abstraction in large organizations. Respectively, enterprise architecture descriptions to be used at these levels can be divided to enterprise, domain and systems level descriptions.

Such descriptions created at different abstraction levels for different dimensions of the EA (business, information, applications and technology) are needed for the different roles involved in the planning and decision making. As a novel approach, compared to previous hierarchical frameworks (e.g., the Zachman Framework or NIST model), the EA Grid takes the technology questions to both the top management level and the domain level. This updates the EA framework to the requirements of the present age: ICT decisions must be considered together with the basic strategic questions of an enterprise and the business itself. Descriptions at the three abstraction levels in all of these dimensions can be seen as a continuum from the strategies to the implementation of systems. The EA methodology aims at such continuum to ensure the adequacy of the implementation of any ICT. No less important is the consideration of the possible business enablers in technologies, systems and information when strategic decisions are made.

5.4 Fourth paper: Managing Information Security In a Business Network of Machinery Maintenance Services Business – Enterprise Architecture as a Coordination Tool

Business networking means a challenge for the planning of enterprise information systems. The networking technologies that enable rapid and accurate information exchange provide novel business opportunities. The idea of the common framework of reference for the enterprise architecture work is adapted for enterprise security architecture planning in the study reported in the fourth paper. For the services business expansion, Metso Paper Inc. needs to provide trustworthy data protection in the process of provisioning maintenance services to their clients. To diagnose the operation of machinery at a client site on any continent, the services staff of Metso Paper accesses the control systems of the machinery. This makes diagnosing faster and the service provisioning more accurate and efficient. By distance diagnosing, scarce expertise can be made available to the clientele around the globe. The first step is to plan identity and access management solutions for heterogeneous networking environments.

The EA Grid and the management of EA decisions, descriptions, project tasks, their inputs and outputs are tested with security issues in the study reported in the fourth paper. The challenge is to present plans for the necessary issues and developments in the ICT support for the case company aiming at establishing a trustworthy data security solution in a business network setting.

The approach proves to be suitable tool for the planning effort. To extend the planning to a business network setting, the Grid is extended with a super-level on top of the enterprise level: the business network level where agreements are made and standards set to enable secured information exchange between business partners. The EA of the enterprises in the business network provides defined interfaces to further partners to join the network and establish collaborative processes and systems that cross enterprise boundaries. In this case study, the provider company, TietoEnator, was not involved. The study was conducted in direct collaboration with the end-user organization, Metso Paper.

5.5 The Fifth Paper: Organizational Processes in ICT Management and Evaluation. Experiences with Large Organizations

The paper outlines the process context for the enterprise architecture management process, and the EA planning and development processes that are conducted as discrete projects. During the research period, not only the area for EA consulting but also the adjoining services areas kept evolving. As an information management consulting approach, ITIL (Information Technology

Infrastructure Library) and other models for information technology governance (ITG) got the attention of both service providers and end-user organizations. The ITG approach gives sound models for the ICT-related services processes and the service quality management. As the need for comprehensive management is great, this model is put in stead of a framework for ICT infrastructure and applications management. However, it does not fulfill this purpose because it is not this type of construct but a collection of best practices for the information management function (van Bon, 2002). There are also other quality models (e.g., CMMI, Capability Maturity Model Integration) that belong to the SE area, but with no better model available, are used also as general quality models for the ICT function. As these models are developed, their scope can easily be expanded to where the need for process descriptions and quality policies is perceived. An EA process understanding would provide a clear context for the ITG and SE quality models and an interface to the management of application and technology portfolios and infrastructure management.

There is a simultaneous stream of discussion on large and distributed enterprise systems development, and the EA concept is also in active use in this context (Bernus et al. 2003). This paper presents the profile of the EA as a managerial tool in the context of strategic planning and organizational development. The business architecture component in the EA is defined as the interface between business management and ICT management. The evidence from secondary sources in this paper illustrates the significance of an on-going exchange between ICT management and business management. The case organizations presented as good examples in the trade press have in common the active engagement of the CIO in organizational or business development.

The paper (Pulkkinen & Hirvonen 2005b) contributes with a high level process map for the EA management, planning and development processes, that points out the significance of these processes as part of the management in the end-user organization. The case studies and the example organizations bring out the need for a coordinated management of the business and the ICT through the elements of the EA. In this paper, the technique of narrative study broadly in use in studies of discourse is used to point out to the emerging consciousness within the ICT expert communities of comprehensive ICT management, short: EA thinking. As outstanding factors, the discursive exchange at managerial level and the understanding of the profound dependence of business and ICT are highlighted in the studied narratives of awarded chief information officers. The inclusion of these secondary cases brings fresh information to the overall effort to support the elaboration of EA issues in the case consultancy (TietoEnator) and in its client cases.

5.6 The Sixth Paper: EA Planning, Development and Management Process for Agile Enterprise Development

The construction of the EA process metamodel started out already with the first action research cycle. The draft was enough to understand the nature of the cyclic or iterative process in the EA work, but did not give a solid basis for defining the EA project process. The main reference for the first attempt to outline a process for EA work was the TOGAF 8 ADM model from which a modified model according to the consulting work needs was presented.

With the second research cycle, the major elements to be included in the model are shaped with the common framework of reference (Hirvonen & Pulkkinen, 2004). The construction of the process model starts with reflecting on the preceding studies that give the elements of EA collected from frameworks, models, methods, and the context of the EA work. As input, specifically for this study, EA process models from literature are presented that lean on various EA frameworks or models. Most of these process models are constructed for EA work in end-user organizations and are therefore not directly applicable to consultancy use. Prevalent scheme is cyclic, iterative model (Cf. Section 3.2). Most models are development oriented, i.e., targeting the implementation of a system. The abstraction level in different process models vary, some of them are closer to IS planning or SISP, others resemble system development process.

However, to effectuate developments and changes, there should be a continuum from higher abstraction level outlines and plans to the level of organizational functions or business units, where more concrete plans are made and materialized. Taking a different model for planning and development at each level may cause extra effort and a possible mismatch in deliverables of the former level as inputs to the latter level. Further, the EA development plans need to be communicated to the systems design and development to ensure that the implementation follows the intentions. This has always been a weak point in IS development, even though a lot of effort has been put to, e.g., work on requirements elicitation. The paper (Pulkkinen and Hirvonen 2005c) presents the main idea to follow: a continued process from high-level strategic planning to domain level managerial decisions and systems level plans and designs. This aims at the materializing of the managerial intentions in systems and the infrastructure. The approach may also prove beneficial in other respects: reducing complexity and saving costs. This means to simplify the infrastructure or the portfolios of systems and technologies. A good example is to take one IS for some functionality (e.g., CRM) into use in the whole enterprise, or to replace a multitude of technologies with one thus saving in maintenance costs.

5.7 The Seventh Paper: Systemic Management of Architectural Decisions in Enterprise Architecture Planning. Four Dimensions and Three Abstraction Levels

As the last piece of the study, the report (Pulkkinen 2006) completes the overall process model for the Enterprise Architecture work. The first version of the process model gives the hierarchy levels followed in the process, but does not elaborate the levels in very much detail. To complete the model, the levels are explicated with more empirical work. Further, the EA process context - as the preceding phase for systems projects - is clarified, and the significance of EA work for the systems development is pointed out. The enterprise level has a role as a unifying set of rules for the whole enterprise, and also in ensuring connectivity for external stakeholders. The domains diversify according to their function and scope, and the systems level again collects the information for the system maintenance and development, the architectural decisions coming from the upper levels.

The empirical work consists of examination of three case organizations, with which the provider has a history of partnership and has been conducting several projects, thus observing the developments for a long period of time. The cases are examples of successful work both by the provider and the case organizations. The results deserve to be turned into methodology knowledge for further use. Supported by the living systems theory (Wegmann 2003) this study helps to clarify the concept of domain and brings up the types of domains: a domain can be permanent (like a business unit, a business process, or a group of interrelated processes that use the same information). Or else, the domain can be defined for a specific EA development step as a development-time domain. This is the case, e.g., in conducting integration projects. Systems are assigned to the permanent domains (units of organization) as their owners. The ownership is significant for responsibility questions in, e.g., system maintenance and master data management. Domains are generally managed by business operations managers or by those in other middle level management roles.

The logic in the process metamodel is to add to the IS planning and development legacy process flow from business to information, applications and technologies at each level of abstraction, another information flow to the opposite direction. From the technology, the information and the applications viewpoint should be an exchange back to the business architecture. The information viewpoint should also be checked for e.g. leveraging the existing databases and other business information for further business use.

This means coordinated, collaborative planning of business developments and the technology developments. The information flow from technology and applications viewpoint brings to the business decision making the current status of enabling technologies in the enterprise or the business unit, and envisions the technology developments. As the innovation studies suggest, new

ideas are bred at the boundaries of communities. The EA process provides thus besides the coordination of developments at each side, also a boundary crossing point for new business idea creation, where both existing systems and information or data in the systems and also new technologies are reviewed for business enhancement.

From the process metamodel presented in this paper, an ICT end-user organization can derive the EA management process, and also the project process for discrete planning and development efforts. The organizational reality involves rapid changes and many overlapping projects in different phases, as well as information systems in different stages of their life cycle. The EA management provides the overview and constant input from enterprise management to ensure the right direction for planning and development. Besides scanning for enterprise environment changes and technology advances, feedback from the operations management (domain level) and the information management (systems level) is taken into the EA management process.

The services provider defines, with the help of the model, the process for EA consulting projects, ensuring the quality of the consulting work. The model acts as a guide in taking into account all the factors necessary as inputs into the consulting work. Thus results produced are fitted to the business and technology context of the client. If the client organization already has a defined EA process, enterprise level principles can be simply taken out of the EA information base. This means a quick start for any development project.

The levels enterprise, domain and systems must be seen as general abstraction-level descriptions for the definition of the EA process. Depending on the size and management structure of the organization, there can be domain hierarchies and some management levels. It must be decided by the end-user organization itself (and in external projects, the provider) how and at which level the architecture decisions are made for its ICT developments.

6 THE RESULTS

ICT in organizations requires intensified attention from stakeholder groups also other than that related to the information management function of the end user organization. At the same time, this organizational function is also gaining gravity. Analysis of the client organization cases of enterprise architecture consulting reveals that a genuine need exists for analytical approaches and tools to master the complexity and challenge of organizational ICT. This type of methodology is needed both by the enterprises themselves and by the consultancy.

An understanding of the need for an iterative approach is agreed on in both the evolution of several IS methodologies (Checkland & Scholes 1990; Iivari 1990a&b; Jayaratna 1994; Sohlenkamp et al. 2000; Avison & Fitzgerald 2003) and the EA processes (Section 3.2, Table 1). For the EA, there is a general agreement that different viewpoints have to be taken into account and described. Further, stakeholder involvement is emphasized in many methods both for IS and EA. However, the underlying IS paradigm is built on the concept of one system (Avison & Fitzgerald 2003; Iivari et al. 2004) or an IT artefact (Orlikowski & Iacono 2001). The system or the artifact may be an application with a small scope or a large scale enterprise system, but in any case it is not meant to be the comprehensive ICT support, covering all the systems and the whole infrastructure for a large enterprise as end-user organization.

High quality consulting work on ICT architectures, and other questions requiring consideration of the EA, not only offers solutions to defined business problems, but also appends the case to the enterprise ICT context. Project by project, a base of enterprise architecture information can be incrementally built for the end-user organization. The chosen approach embeds the EA work into individual consulting cases. This is an agile and resource saving way to accumulate the information on organizational ICT assets to a consistent EA base. Further, the management principles, ICT policies, system development guidelines and other EA management information can be reviewed, and updated as required, when new projects take place or as part of regular EA management.

A central idea in the EA work is to accommodate business development alongside with the ICT architecture planning, as the strategic IS planning concept suggests (Earl, 1989; Ward & Peppard, 2002; Robson 1997; Seltsikas, 2000; Weill & Broadbent, 1998; Segars & Grover, 1998). The suggested EA methodology broadens this to cover the whole organizational ICT. Utilizing an analytical frame of reference, the EA enables the exchange of information between different stakeholder groups and communities of practice. This is done by the use of a framework, with which any description of architecture element becomes also the context in which this description is to be understood (Paper 3, Hirvonen & Pulkkinen 2004). The dependencies of planning are indicated by the EA process (Paper 6, Pulkkinen & Hirvonen 2005c; Paper 7, Pulkkinen 2006). The questions of enterprise strategies for the business and for the technology are discussed as interdependent issues (Paper 5, Pulkkinen & Hirvonen 2005b). Solving of problems in the business development and in the ICT investments is done in a coordinated manner (Paper 5, Pulkkinen et al. 2007a). Coordination is also needed between domains, i.e. business units and processes, and last but definitely not least, with systems development (Paper 7, Pulkkinen 2006).

An IS development method is sometimes understood as identical with a language for designing and modelling systems (Brinkkemper, 2000,125). In the case of EA, many stakeholder specific and viewpoint specific descriptions and modelling methods and techniques are used. The challenge in EA is the interpretation of different viewpoints and languages between different communities of practice. The EA information is coded with the customary description languages or models of these stakeholder groups throughout the process (Paper 6, Pulkkinen & Hirvonen 2005c, Paper 7, Pulkkinen 2006). The first step is to organize this information, to make transparent the interdependencies of business, information, systems and technology issues (Paper 3, Hirvonen and Pulkkinen 2004). Secondly, the change is managed through the coordinated EA work (Paper 2, Hirvonen & Pulkkinen 2005a), with assigned roles for different decisions in the process. The evaluation methods are also specific for the levels (Paper 1, Hirvonen and Pulkkinen 2003) and are deployed as guided by the process. Thus the EA methodology simplifies and balances out the employment of different development and evaluation methods.

The stakeholders represent various organizational levels, thus the analysis of the enterprise and its information and applications is taking place at varying abstraction levels. In terms of discourse, in the negotiations on enterprise development, there may be different agendas. On the agenda of the top managerial level is the setting of the strategic guidelines and policies for the business as well as for the ICT. The operations management for both needs explication for the consequential measures to be undertaken in their area of responsibility. This is maybe the most neglected point in the management and planning of organizational ICT. On the agenda of systems implementers is to elicit coherent and specified requirements, based on which, it is hoped, systems design and development can rely on successful outcomes.

An understanding on the end-organizations needs in EA management helps to provide tools for managing the ICT assets as resources. Thus also the benefits of EA can be achieved as reasonable use of both existing ICT and resources for further ICT investments. Overlapping investments into new hardware, software, tools or related services can be avoided and existing complexities in systems and technology portfolio can be solved. Non-managed EA is likely to eat up resources, cause problems in the daily use of ICT and make planning for the future uncertain. With small incremental steps the EA can be developed towards a target state. The outcome of an EA development effort may indeed be negative; decreasing the number of applications (software products) the enterprise is forced to buy licenses for, or infrastructure elements representing varying technology standards.

Reducing the complexity in infrastructures and scanning the systems portfolio for possible overlaps is another result that may lead to a reduction of resources needed for ICT maintenance. A neutral EA process owned by the deploying organization (not, e.g., a solution vendor) guides the evaluation of the current state and can produce unbiased results in this respect, leading indeed to cost savings. The strength of the legacy in strategic ICT investment planning (ISP and SISP approaches) is in assessing the benefit of an investment, often meaning a new system to be developed for a limited scope, i.e., domain. EA work should give a balanced view to the whole enterprise and to the comprehensive ICT support with infrastructure and technology portfolio, thus providing also a solid basis for the evaluation of individual systems and projects.

For the academic community, this dissertation presents a view to the spectrum of EA approaches, frameworks, models and processes both in scientific and in practice oriented literature. It is a contribution to an on-going discussion on the management of EA and on developing support for business processes and services. Among other benefits, a comprehensive management of the ICT in the use of an enterprise readies both the end-user and the provider organizations for embracing advances in technologies. An example par excellence is the service oriented architecture (SOA) approach as the new paradigm of organizational and inter-organizational information processing. One of the reports in the series of case studies for this dissertation proves EA management a valuable asset in building ICT support for processes crossing corporate boundaries. Business networking today means seamless secured information flows between the systems of networking partners.

As a further outcome of the study, the action research approach in a collaborative research project setting between industry and academia was further enriched with the considerations of knowledge management concepts of communities of knowing with different perspectives. The research process model following the participative action cycle can be applied in further collaborative research undertakings. In fact, in a small scale within this effort the approach was copied to the work with Metso Paper (Paper 5, Pulkkinen et al. 2007a).

The effort started out with the following problem:

How to manage and coordinate the dynamics of information and communication technology planning with business development in large organizations?

This problem was divided to four subquestions. In the following, to explicate the results, the subquestions are looked at and the results of the research are assigned as answers to the questions.

Subquestion 1: How to establish an understanding of a complex, multidimensional entity, the enterprise architecture, and how to conduct a collaborative inquiry to establish a shared understanding on the EA and the EA planning and development in large organizations?

In this research undertaking, the collaborative inquiry in an industry-academia setting was experimented with an ICT provider, following the principles of action research as an organizational development tool. The aim was to develop a methodology to be followed in the consulting projects concerning enterprise architecture questions of any client organization. The first result is the validation of the action research model as a tool for method development and organizational change. The EA method was created and simultaneously introduced in the TE consulting organization. At the same time, the AR model was enhanced in a setting of "perspective making and perspective taking" (Boland & Tenkasi, 1995, 356) across different communities of practice. This is depicted as the inner and outer AR cycle in Figure 2.

The action research approach is suggested to have a cyclic model, meaning similar phases are repeated over time. Three such cycles were undertaken. During the three years the effort was going on, a common understanding was built on EA, the elements of it and the place of the EA in the palette of ICT services and in the ICT management of end-user organizations. The 1st paper shows with the first results how this work started, the 2nd paper extends this idea to the end-user organizations, and in the study for the 5th paper similar approach is used.

In the second paper, the participation of the end user organization stakeholders is considered from the point of view of consulting projects. This is a novel area, since the user participation literature mostly deals with development of a single system or similar entity, and the participation of end users of the system. The EA work as placed into the organizational change framework and its relation to the consulting and different types of consulting area is a result of this study.

Subquestions 2a: What are the elements of the EA to be managed, planned and developed, and 2b: how can the relevant and required elements be managed and communicated between the relevant stakeholder groups?

To establish a common framework of reference, first, for the consultants conducting the EA projects and, secondly, for the end-user organizations, the existing frameworks and their use was examined. Starting with the early models and frameworks (Fong & Goldfine, 1989; Zachman, 1987), and considering the trade literature models, the EA Grid is established as a covering, but not too detailed, schema to serve as an analytical basis for the EA work. The practical cases examined following the case study paradigm show which viewpoints are essential, and which elements need to be included to this type of framework. The inclusion of the level of operations or unit managers and business process owners (those who are responsible for processes crossing unit boundaries) seemed to be missing in the existing EA literature.

The managerial level is populated with commercial EA methods. The systems development paradigm is prevalent in ICT development efforts, for which the systems level collects the decision information. The contribution of the EA Grid (Table 5) is to establish the continuum in the decision making hierarchy from the managerial to the systems level. The study draws on the consulting projects, the case organizations where the project is conducted, and the consultancy experiences in these cases. The Grid serves the purpose of enabling the analytical presentation of information necessary for the planning and the decisions under work in the enterprises also at the operations management or unit management level. Here, the idea-level strategic decisions should be materialized and adapted to concrete business organization plans and plans for actual systems implementation. Moreover, the Grid guides the planners and decision makers to take into consideration adjoining elements (other units, processes, systems and information in these). This is needed to avoid, e.g., contradictory decisions on, or overlapping investments in different systems - in other words: to achieve the benefits of a managed EA.

The bottom level of the Grid, the systems level, collects all information needed for systems designers and developers and provides this information in modelling and description languages, the accuracy and detail of which is needed for systems development. In many cases, the systems level descriptions cannot be used in communicating the related issues to the higher level decision making. However, the presence of the technology viewpoint at the enterprise level and the domain level ensures essential information on technologies at all levels for informed decisions, with descriptions that can be interpreted for the decision making purposes.

TABLE 5   The EA Grid Framework for EA work

	Business	Information	Systems and Applications	Technology
Enterprise Level	Business and management decisions, Portfolio of businesses, Mission, Business strategies and visions	Strategic information management considerations; Information value chain	Strategic systems portfolio (Application portfolio)	Strategic technology portfolio; Vendor relationships, Enterprise technology guidelines and policies
Domain Level	Services/ products in the domain, Business processes for their production	Information management of the domain, Data models, mapping information to processes and systems	Domain systems map, Interoperability, System-process mapping	Technology Infrastructure: Platforms, Networks, Data Communication
Systems Level	Business requirements for the systems and data management	Data architectures Data harmonization principles Data storages	Systems architecture; ISA, Application patterns; Developer guidelines	System-level Technology Architecture; Technical implementation guidelines

The study of Metso Paper Inc., (Paper 5), as a single case study, brings validation to the EA Grid as an analytical approach to the decisions that have to be enacted to achieve a protected environment for the services business. The study examines a practical business case, how to build trust between Metso Paper and its clients, so that in the delivery of maintenance services, the experts would have the possibility to immediate access the machinery control systems at paper plants. When enabled, this would mean saving in paper machinery downtime for the clients, and saving travel costs and time (significant in the literally global services business, with the experts travelling on all continents).

Data protection and security are issues that require centralized control and decisions. Not only are the security measures on a solid ground when embedded in a managed EA, but also, e.g., implementing a single sign on solution, or aiming at management of master data provide tangible benefits also to end-users. By explicating and extending the Grid, the 5th paper establishes i) the incremental development in a real organization ii) the usefulness of the Grid in communicating the necessary issues in EA development iii) the extension of the Grid for a business network and iv) the extension of the Grid to accommodate enterprise security architecture.

Subquestion 3: How does the EA process relate to other managerial processes for aligned business and ICT planning and development?

The process context for the EA process and the relations of the managerial processes is an essential result, if a parsing of the discourse structure is to be given. The managerial activities take place often as loosely defined processes that are mostly carried out by human agents. Most of management work consists in fact of communication, within groups or between individuals. The network of processes where the architectural work takes place shows how it is to be intertwined to the other management activities. The research also considers other approaches to corporate information management like the IT governance models derived from the corporate governance concept. ITG, however, emphasizes the smooth running of IT services rather than the architectural overview of systems and infrastructure as well as their alignment to business goals.

Subquestion 4: What is the generic or meta-level EA process, set up from the elements, from which are actualized, firstly, the process of EA management, planning and development, and, secondly, the EA project process for incremental planning and development steps?

The EA process meta model gives a parsing of the discourse that is carried on in an enterprise to manage, plan and develop the ICT infrastructure and systems together with the business itself and its organization in processes, services and organization structures. The knowledge extracted from the consulting cases essentially brought the understanding of the dynamics involved in the EA assignments. There are numerous stakeholder groups participating in this discourse, and their views to the enterprise (the organization) are different as are their views to the technologies that support the activities. The process model gives an outline to the decisions to be made. It follows the ideal flow of information for informed decision making in questions of ICT at any level of the enterprise. The starting point (Figure 5) is always the business (the first box on the left) and its needs, but equal attention is paid already at the start to the technology (the fourth box) enablers and business opportunities made possible by, e.g., new application types. The information (the second box) is derived from the business, but also treated as a resource for possible new business opportunity. The system and applications (the third box) are at the enterprise level treated as a portfolio of business assets.

To ensure completeness of the meta-level process elements, existing EA process literature is studied. Paper 6 gives a summary of the EA process models available, and a preliminary answer to the subquestion by combining some ideas of the EA process models with the existing knowledge of IS development processes. A hierarchical spiral structure is outlined, where the empirical findings of previous research cycle are utilized: the meta-level process utilizes the arrangement of elements in the EA Grid. The process model creation is based on continued empirical work consisting of seven case studies of EA projects.
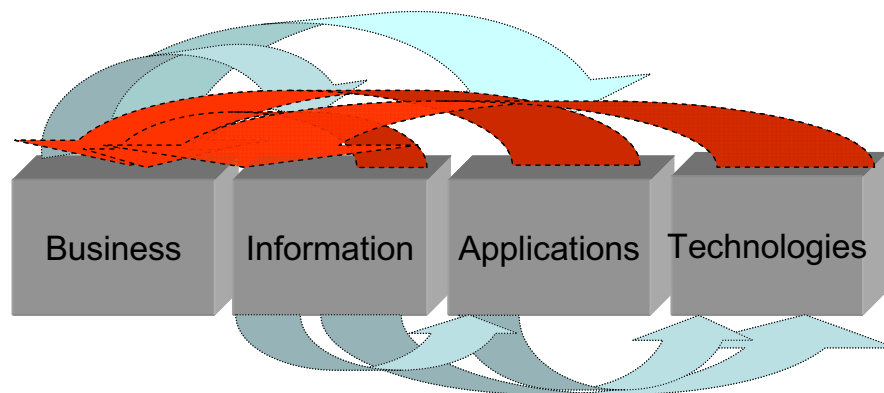
FIGURE 5   Flows of information exchange in EA decision making

The high-level construction of the EA meta-process model is shown at an overall level in Figure 6. The exchange depicted in Figure 5 is to take place at each level and in each domain. Feedback is provided and taken from the operations and systems to the decision making. Support for the model gives the living systems paradigm (Wegmann 2003) that has been found to be well suited to understand the complexities of EA management. The middle level of the EA grid, the domain level, is elaborated further with empirical case studies, where its significance is pointed out.

The detailed process phases were described in an extensive document that explicates the deliverables used as inputs and outcomes in the process at each level and project phase following the EA process metamodel (Pulkkinen 2005). This document remained confidential since the information on description techniques and focused methods was largely internal to the company. Each of the three decision making level was treated separately by recording and describing preliminaries, tasks and deliverables, and also considering the roles to be involved. The overall metamodel of the EA process is published in the academic report (Paper 7, Pulkkinen 2006).

An organization specific EA should in any case use internally known and accepted techniques for describing EA information. The descriptions are often bound to the use of specific tools. Considerations regarding the project business, e.g., the project initiation activities, and different project types were included in the project report. Further work in the AR group concerned deliverable categories and templates according to project types and project ending activities and project work quality.

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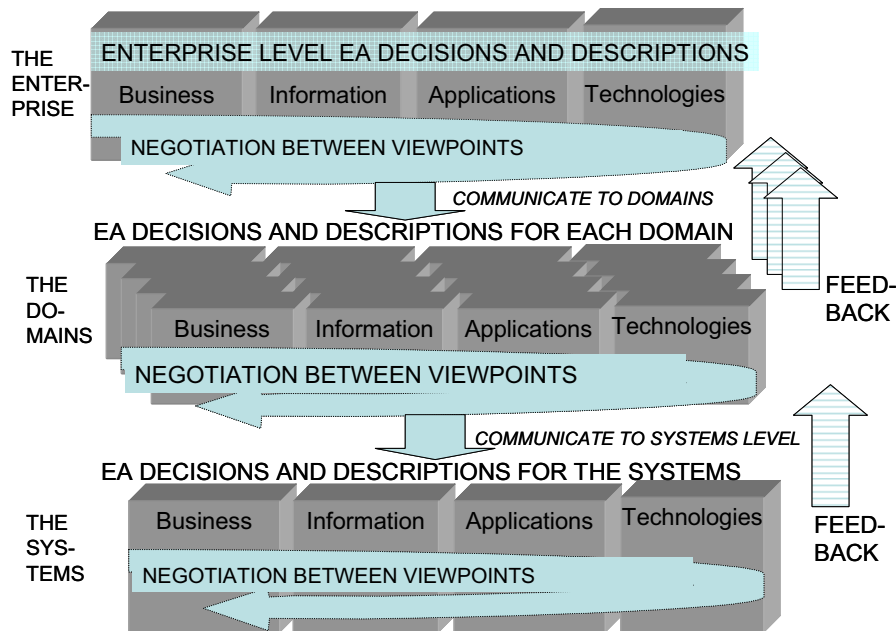
FIGURE 6   The process meta-model for EA management, planning and development

6.1 Contributions

This thesis presents as contributions to the organizational information systems area of research:

The EA process metamodel, that guides the conducting of consulting projects, and is also applicable for defining an organizational EA process for EA management, planning and development.

The information system life cycle models and IS process and ISD methodologies are acknowledged as well as the IS planning or strategic IS planning approaches. The suggested process model provides an analytical frame for the different IS planning methods to link them to an EA process for coordination of activities on ICT. The EA process provides triggers to IS development and systems maintenance, i.e., to the lifecycle of the systems in an enterprise.

As a foundation for the process, and all efforts in the EA area, the 'EA Grid' framework for enterprise architecture.

The metaphor of discourse was used for the EA methodology creation. In a discourse, a common framework of reference is an essential starting point for understanding the perspectives another stakeholder group is taking. The framework provides also a frame for collection and retention of information on the enterprise and its ICT assets for taking up a management process of EA.

For a validation of this framework, an enterprise security framework is outlined. Besides, the framework extension is sketched to a business network level for the use in a multi-enterprise setting.

Business networks and business processes crossing corporate boundaries are an emerging field for industry and academic interest (Smith & Fingar 2003). As first point, the enterprise has to manage its internal assets (systems and architectures). The second step is to provide interfaces for internetworking with partners. For both internal information processing and especially for connecting to systems of partners, security of information and data has to be ensured. This contribution provides an example of an enterprise security architecture.

Because the organizational processes build a network of processes, the process context for the EA process in the organizational management is outlined. This is to be understood as a further contribution.

The process context illustrates the enterprise activity hierarchies and concerns of different stakeholder groups. Reflecting against the concept of IS life cycle, it becomes evident that the scope of systems development, as compared to the whole enterprise architecture management, is narrower. System maintenance is part of the EA management as portfolio based review of systems and other assets. The underlying paradigm of one system or IT artefact limits the IS process and underlines the need for the EA process.

As a further result:

The activities in EA consulting are mapped to an organizational change framework

The organizational change can be seen as happening in different manners, but the coarse grained phases can be observed in real world change efforts. In an organization, especially a large one, with different parts or functions there may be partially overlapping or sequential change processes underway all the time. Comparing the EA work to the change framework shows points where EA related efforts could be triggered. Instead of managing only one development project, e.g., a system or a system integration effort, a more comprehensive look at the ICT assets could be taken.

An enhanced action research model is presented that depicts the interactions between two communities of practice, the consulting practitioners and the researchers. The exchange between the knowledge creation cycles between the groups enables both to enrich their knowledge.

Action research has become a routinely deployed research method in IS research. The AR as research approach and its constituent elements are explicated in this study, as it provides an example of a discourse shared between different communities. It takes place in an organization for the purpose of developing this organization. In the case of this study the organization is TietoEnator where the consulting services are improved. AR is a group activity to provide peer support and also reflection background for both people with a similar background (the group of consultants and IT architects) and for the researcher as a representative of the academic community. Also, other communities of practice and broader audience at TE were providing a reflection surface for the development of ideas. Both the immediate academic

community and the scientific community at large were the groups for the researcher's reflection.

Reflection through writing, e.g., in writing research reports and deducing the next problem areas from the previous results in the cyclic activity characterizes genuine AR. If it is done only for organizational development purposes, this point may be neglected: as soon as the results are available as a spreadsheet or a set of slides the case is closed. However, writing process triggers thinking processes in a human brain that otherwise would not come about. Text and textuality as concepts in discourse studies point to the writing aspect also, and allow for the knowledge creation in the maybe more mature 'second thoughts'. Reporting the results as written documents is thus an essential point.

Changing the activity that is taken as a focus area for the study and evaluating the changes make the core of an AR undertaking. Constructing theoretical models or reporting descriptive case studies do not make an AR process, only implementation and follow-up with evaluation complete the cycle. The consequential studies of the present effort were evaluated and taken on as inputs for the next cycle, thus introducing the constructed method fragments to the organization and finally the whole methodology. The ideas were introduced in a stepwise manner, and by the end of the effort EA had become an integral part of the services. The method was ready to be used, and knowledge of the method deployment was available. Thus it does not remain an academic exercise but is validated along the way in the research cycles.

The ultimate contribution of this research effort is the meta-level process that can be used as a model for any organization adopting enterprise architecture management, or more generally ICT management policy. From this process model, the project process can be derived for individual EA planning projects conducted by either external consultants or the IT organization of the enterprise. The requirement of the provider organization involved in the research effort was, among other things, to find ways for improved quality assurance of consulting projects.

The process meta-model follows the possible logical process of organizational ICT planning taking into consideration all aspects of it. The provider ensures good quality of consulting if it manages to gather covering information as input to the project, and provide as outputs project deliverables that take into consideration the necessary next steps in the organization. Thus the process model as a background for all consulting project types provides the EA process elements of an end-user organization. The provider places each project to this process regarding the dependencies to preceding and following work thus ensuring the quality of their work and a real benefit for the client.

The extensive literature base that was examined for the process model should make the model flexible and generally applicable. Along with the study of the literature models, the creation of the process model relies on documented empirical findings in a variety of end-user organizations that represent different industries as well as pubic sector organizations. This supports the construct

validity and gives practical credibility to the resulting implications for EA management in general.

The foundation for the process model is the EA framework (the EA Grid), the construction of which is derived not only from literature, but also from empirical cases. The main constituent elements of the EA Grid are derived from existing frameworks and validated by empirical work. The contribution compared to many existing frameworks is the explication of the levels of abstraction in a practically applicable way and the definition of the interface from consulting services, i.e., EA and IS planning work, to the system work. The level of the domains is developed in the most recent report included in this dissertation (Pulkkinen, 2006).

The study of the EA frameworks and models illustrates the development of information systems planning and the evolution of the role of technology and information systems in organizations. This should contribute to the study of information systems methods by extending the method development to the IS planning area, and further join it with the studies of organizational development studies.

The research approach chosen in the present effort provides insights to the organizational development and gives an example of how a method can from its creation on serve as a common framework of reference, to unify the approach of independently working experts or groups of experts, enable information sharing between them and give the necessary foundation for quality controls, which is a sign of maturity in the activity.

6.2 Joint Articles

The research reported in this dissertation is conducted as action research that is characterized by collaborative group activity. Thus six of the altogether 7 papers written to report the study phases are co-authored with other researchers. The specific contributions of the author of this dissertation in these papers are as follows:

Paper 1
The collection of the case data and the preliminary draft for the process model.
Defining of the EA area and the related services areas of the provider.
Paper 2
The collection and analysis of the case data.
The revising of the organizational change framework with considerations on EA consulting and the development to it.
Paper 3
The study of the EA literature and the existing EA frameworks and models.
Collecting and analyzing the evidence from the cases jointly with Ari Hirvonen.
The EA Grid was constructed jointly with Ari Hirvonen and supported by the action research group at TietoEnator.

Paper 4
Providing the EA framework as a starting point for the work.
Analysing the security case needs with the help of the EA Grid, and contributing to the roadmap with the EA viewpoint.
Adapting the EA Grid to an enterprise security architecture framework for the case in joint effort.
Paper 5
Collecting and analyzing the secondary data, analyzing the primary data.
Construction of the process context for the organizational EA management process
The planning and development processes as related to the EA management, and their relation to systems development
Paper 6
Synthesis of the literature on EA process models.
Construction of the EA process meta-model.
Paper 7
Adding the living systems theory as theoretical support for the EA process model.
Refinement of the EA process meta-model.
Explicating the concept of domain and refining the EA process meta-model.

6.3   Limitations of the Study

The research effort was undertaken in Finland together with an international services provider in a research project with two more companies. One of them is an industry leader and based in the USA, the other a local, growing software development oriented provider. The researcher was informed of the architecture work in the other two companies in the research consortium. These companies provided some deeper insight and background for reflections.

However, the action research took place in collaboration with only one company, and the consulting cases studied were geographically limited to end-user organizations based in Finland that were clients of this provider. The provider is active worldwide in over 25 countries currently, and the consulting work is supported by a company-wide forum (The TE Group Technology Symposium) that meets together to exchange information and to decide on, e.g., methodologies and other industry developments. Some of the case organizations are international corporations.

The limitation is compensated by the variety of the client organizations taken under scrutiny as case studies. Since there are distinct business areas with consultants serving different industries, it was possible to have a variety of client organizations in the cases. Through the action research work, the accumulated expertise of the consultants with large organizations gave far more than only the case studies could have given. Even though the action research partner was one company, the model accumulates and combines knowledge

from the base of organizations where the consulting cases were conducted. Additionally, one of the case studies was conducted without the involvement of TietoEnator at Metso Paper Ltd. As a large company with worldwide operations and the world leader in its industry Metso Paper provides a good example case for EA work.

The EA process meta-model is further not based only on empirical evidence, but also on all academic and trade literature that could be found and accessed. Limited resources restricted the time and access to literature, the coverage being the best possible that could be reached.

The qualitative and interpretative research does not rely on quantities in the empirical evidence but on a profound understanding of the context and the contributing factors. Further, in the results, the long term reflection and collaborative construction is significant. In the action research, the primary target is to improve the organization conducting the AR effort. Taking a research approach means that the knowledge produced can also be applied to other organizations. The findings of this research may not be generally applicable to any consultancy or ICT deploying organization, but similar consulting organizations may benefit from the findings. Large organizations can use the process meta-model and the other findings in defining their EA process. A meta-model lays out a scheme and provides the elements for their own process model. The discourse idea and the constructivist view suggest anyway that new knowledge has to be de- and re-constructed in another organization wanting to implement the results. The suggested contributions provide a sound starting point for organizational learning on EA.

7 CONCLUSIONS

The early EA considerations in the mid-80's did not fall onto a very fertile ground among the practitioners. The research scientists in their communities were adopting *a (software intensive) system* or *an information system* as the core of their paradigms. The research interests were organized around *the system* to be designed, developed, used and maintained. The adopted terms reveal the thinking patterns in the IS methodologies, where the attention is focused around a *problem* area for which a *solution* is to be developed. Illustratively, the latter word is, in the IS field, labeled with the new meaning 'software application'. That label carries the semantics of the original word 'dissolving of a problem' (ignoring the fact that software applications may also be found to cause problems when implemented in organizations). The strategic planning for IS emerged for considerations of the business viewpoint to the systems, and the word *alignment* adopted in the collocation *strategic alignment* was in the IS field to become to mean the aligning of IT systems, distinct 'IT artefacts' with business goals.

The challenges of increasing technological complexity on one hand, and on the other, the business opportunities the technologies bring about, are driving a more consistent management of information systems, organizational information, and the technological infrastructures in business enterprises and public organizations. The resource based view to the enterprise points to managing the information and the ICT as assets. Their alignment with the business goals of the business enterprise or the public organization is an inherent principle in the EA process. An overarching management process accommodates the concerns of different decision makers and ensures the availability of information for both the business and the systems and technology related decisions. The consequence of lacking coherence in decision making are, e.g., overlapping investments to ICT, gaps in information flows and poorly planned use of resources, be it human, technology or monetary resources used for ICT developments, deployment and maintenance of systems and technologies.

An overall view that extends the planning of a single IS to managing complete enterprise infrastructures, systems and information with a portfolio approach balances out the organizational ICT spending and benefits. The SISP approach tries to spot system investments as promising competitive advantage with a single solution. The balanced EA approach acts as a guide to weigh such advantages against the costs and benefits, from the point of view of the enterprise, in the management and developments of its portfolio of businesses, business models and business processes, as well as in the organizational development with a view to the internal activities. As importantly, the EA directs the consideration of organizational ICT towards the extended enterprise, which means the networks of business partners and other stakeholders. With the enabling ICT, the enterprise can offer interfaces to its relevant systems and services, or automated business processes crossing corporate boundaries. Collaboration with partners or customers can take place via dedicated systems over secured channels of information exchange.

The EA work can be understood to be conducted discursively between different expert groups in the enterprise. An EA methodology supports professional and target-oriented exchange both between consultants conducting consulting assignments and representatives of an ICT deploying organization with different stakeholder groups. It orchestrates the usage of various viewpoints and stakeholder specific methods and techniques for managing, planning, development and evaluation. Information on the EA is given as descriptions (models, charts, tables, textual descriptions) that can, firstly, be related to the area of responsibility of the viewer, and, secondly, depict the interdependencies and causalities, i.e., how the alterations of any element reflect to the other areas and elements. Formerly maintained main division to business and IT experts can be broadened to a number of specialist groups contributing to the EA work using different description techniques. Examples might be, e.g., business analysts, enterprise and domain level managers, infrastructure specialists, system owners etc. – here, each corporation names their expert groups.

The process model constructed in this study aims at producing rational actions with the complex organizational ICT in large enterprises, and informed, timely decision making. The process can be seen as a coordination tool and a medium to communicate different interests, both from the point of view of the organization activities and goals, and the ICT enablers for it. In the process phases, the resources are analyzed and the requirements and constraints for the ICT are examined. Assessment methods can be deployed as specific to a level and to an architectural aspect. The process model gives the floor to different parties involved to contribute with their specific knowledge in the enterprise management and its information management. The exchange is structured with a common framework of reference that conveys the interdependencies of the elements of the ICT support and business. It provides a coordinating outline for different groups and roles that are engaged in the EA work. It also includes the feedback from the present organization to the decision making processes. In the EA process, limited management models (e.g. for projects or processes) and

discrete development efforts are put to serve the enterprise development. With an EA approach, the likelihood of unsuccessful ICT projects should be reduced.

Setting a common agenda for a dialogue between business and ICT is the first step towards managed enterprise architecture. In the example organizations, active CIOs initiated and supported the exchange. However, EA requires collective attention and acceptance. A framework remains the essential core of EA methodology to enable the building of a shared understanding of the EA and interdependencies within it, as well as systematically and expediently collecting the information. The accumulated knowledge from EA work emphasizes the meaning of decision making bodies, e.g., an architecture board. The enterprise architect is a role plausible in designing and implementing enterprise applications and integration architectures, but the EA management in a large corporation is too great a task to be carried out by an individual. Even though 'champions' or 'evangelists' can do a good job in promoting the idea, EA work in a deploying organization is best carried out by an architecture group where the stakeholder groups are represented and where there is enough decision making power to make the EA related decisions binding.

An enterprise architecture framework can be seen as a template for a shared agenda. The *business architecture* is the common grounds, very often shaped by enabling technologies. Taking the role of the technology in the organization of the business, even the business architecture might be constructed not by the business experts alone, but with contributions of the ICT specialists. Evaluation of architectures helps to decide, e.g., what is included in the business portfolio. Information is clearly an asset for business enterprises, and the core of many public services. Leveraging of the business *information and data* became possible with advanced information systems. Business domain knowledge together with expertise in database technologies, distributed data processing, data mining and services computing hold the promise to result in innovations in the area of information architecture.

In EA, *applications and systems* are treated not only as solutions to single problem areas, but as parts of the enterprise architecture consisting of a network of systems depicted typically with a systems map. Besides satisfying the information needs of, e.g., a business function, or a process, a system may provide interfaces to others, by sharing an information base or a platform with other systems. The value of the systems comes not only from the system itself but its being networked with other systems and the information resource it is to the enterprise.

Though it is certainly the home base of the ICT specialists, the *technology viewpoint* also needs business awareness for architecture and technology evaluations and matching the resources to the ICT investments and their prioritization. If there was an understanding on this, the pattern of the IT organization overrunning the budgets set for development projects by the general managers would have less chance to emerge.

Having the viewpoints or different architectural dimensions for the respective communities to contribute to the collaborative development of the enterprise sets the outline of the agenda, depicted in the EA process. The

process ensures that the strategies find their correct interpretation at the level of operations, in the implemented systems and infrastructure elements. The level of domain, which may mean a business unit or function, a business process or a set of processes, a service or a group of services, is the test bed and the practical implementation of the enterprise architecture principles outlined at the enterprise level. At the level of the domains in the enterprise, knowledge and skills are required from both business operations and the ICT practice. At this stage, the plausibility of the enterprise level decisions is tested in a practical business setting.

In many methodological approaches, frameworks and models for the EA work, the domain level remains a blank area. Negotiating with senior management and supporting their decisions with technology information on enterprise level plans and developments goes half of the way. For a consultant, the work cycle that may be more difficult takes place at the unit level, where the more concrete and detailed plans are designed for the desired change. Work with both unit managers and process owners at the operational level, and other roles with responsibility for current systems, provides challenges to the planning, to make the desired changes happen. The constraints are detailed and real business data can be used for evaluations. This is also likely to be the most promising work area since the confronting with business reality with expertise of the technology community bears an opportunity for innovation. The challenge of working across expert community boundaries can be rewarded with excellent project outcome.

For the end-user organizations, the urgency of the issues combined under the EA concept is obvious. This area of research is, however, still rather thinly occupied in the field of information systems. In the following, some possible reasons are listed with considerations on the consequences.

1. The enterprise architecture as a management tool belongs more to the area of business enterprise management, and the main locus for the discussion is within the organizational and management science. The information systems discipline has not been as active in carrying on this discussion, but major findings are to be found in trade literature that have implications in the practical work of the enterprise managers and consulting.

2. The IS field seems to raise at some intervals again and again the topic of the self-understanding and phenomenological and ontological roots of this discipline. When this topic comes again under consideration, discussion on the task areas of IS as a field of study could be looked at in order to consider the possible contributions to the comprehensive ICT management and to have an agenda for enterprise architecture research. With its supporting scientific fields, the IS paradigm can be equipped to accommodate this super-universe of discourse on enterprise ICT management. When approaching the EA questions, the researcher still finds masses of trade literature sources, but there are fewer scientific explications and critical discussion that would provide an established EA paradigm (or maybe competing paradigms) as reference.

3. The field of software engineering and architecture management within it, including enterprise application architectures and architectures of distributed

systems, occupies the EA field, but does not cover all the relevant issues. There is to be found common grounds for discussions across the disciplines. The IS area can be seen to have the strength of interpreting business and organizational issues to the systems development language. The EA area can build on this strength and cultivate it to further achievements within this discipline.

4. The IS has a strong tradition and different schools keeping up a seminal discussion on the end-user and on the aligning of technological solutions with the needs of the end-user. The end-user here is an individual user of a computerized information system. Questions on collaboration and elaboration of the common goals of business and ICT management besides end-user participation will be needed for EA studies. The organizational aspect as organizational change management is promising here. Further, in the field of computer support for coordinated, collaborative work, CSCW, there is sound academic literature to draw on that deals with individuals and groups, activities, work flows and issues on software systems supporting these. This will be needed especially when the tool related questions in EA management and planning are taken under examination.

5. The notion of architecture is bound with the area of software architecture, and those working in research under the label of *architecture* necessarily draw on sources and ideas of software architecture. Software and systems architecture tools are not easily extended to meet all the requirements of the enterprise architecture as a management tool. The different practices in modelling their view of the enterprise by the different stakeholder groups and decision making levels do not alone suffice with software modelling tools. The EA methodology process provides also a unifying frame for the collection of techniques needed in the analysis, planning and design activities as well as in the evaluation.

6. When studying end-user organizations of the scale of a large corporation or a massive public sector organization, the information management questions of the comprehensive ICT support in the organizational context catch the attention, also from the IS point of view. The IT governance as a relatively new concept occupies aspects of the area of organizing the ICT related services. However, it does not provide all that is needed for the management ICT and its alignment with the business goals. The governance issues deal with ICT management as a functional management that, with given business strategies and a set budgetary frame, solve the issues of managing systems and related services. There remains a gap at the strategic management level discourse that would involve technology expertise for the shaping of the business, the allocation of resources and visioning the future. The strengthening position of the CIO, but certainly also learning taking place in the business management, will change this section in the discourse to a natural part of the management practices.

The change in the business of the case company of this research effort is common today among ICT providers: software development and consulting as well as other services distinguish themselves along with the market changes.

Outsourcing, offshoring, software factory –type of development and agile SE methods as well as availability of open source applications software or provisioning software as a service are changing the software market. A clearly understood profile of the consulting services helps both the clientele and the provider in common efforts.

The engineering approach as in software, requirements, information and even organizational engineering, accompanied with method engineering, is rooted in the systems development paradigm. The ownership of the development process and the agenda setting (denoting the power in the discourse) remains with the engineers or ICT specialists. However, for a successful change, as the AR principles suggest, the ownership needs to be with those who will work with the system, the technology or the method. This difference is understood with the consultant taking the role of a facilitator, giving the client organization members the process ownership and the opportunity to shape the change themselves.

The EA consulting method shows the necessary flows of information but is not imposing a workflow. It is proposed as a meta-model to be adapted for organization specific context. The consultant is not making decisions but is presenting choices. This gives space to the end-user organization to take the responsibility and, as needed make the EA decisions – which also requires reflection and actions from their part, not least due to the tight coupling of EA decisions to business decisions. Further, change resistance can thus be kept to a minimum. However, the EA method adoption, and taking up active EA management requires also learning, both individual and organizational, in the deploying organization.

The technology penetration to all areas of organizational activity requires more attention not only in end-user organizations but also in service providers. There is more demand for ICT services like integration and consulting. New technological paradigms and developments, such as service orientation, XML-based systems and business process management systems mean challenges to the provider. With the service orientation and related architectural and ICT business approaches (SOA for example, and the so called cloud computing concept), the ICT deploying organizations need even more an awareness of their EA. Decisions on services to be provided or leased can be evaluated and justified with a defined EA. The EA methodology is technology independent, and should enable an evaluative, analytical approach to any new technologies and designs. In the EA methodology, firstly, the evaluation of new possibilities is part of the routine, and secondly, the analytical examination of the business opportunities and technology enablers is not biased towards any technology or a specific system. A consultancy and an end-user organization adopting an EA approach are better equipped for any new technological developments.

There is ongoing research on EA that will provide answers to some of the numerous open questions in the area. Each architectural dimension would deserve an evaluation of the existing methods and techniques for planning, evaluation and development efforts. The variegated EA descriptions and the tools for creating and managing these descriptions are another area where

further work is already done and will provide immediate benefits to EA efforts. Different industry domain EA frameworks and models are likely to emerge, and research could be accelerating the efforts towards unified codifications in this area as well. Differences in realizations of EA processes between industries and organization types might be an interesting area of investigation. A broad area only touched in this dissertation is opened for further exploration in the information exchange and business processes crossing corporate boundaries. While technologies are available and being further developed, innumerable organizational and management questions emerge on ICT support in the business networking settings.

Through the discursive approach selected for this study, another dimension for further studies is the establishment of a common platform for developments with different points of view: the organizational and business developments and the ICT developments. The gap in-between, or a missing alignment, is not bridged by enhanced models, software applications or tools, but rather by adopting a dialogue practice among expert groups.

YHTEENVETO (FINNISH SUMMARY)

Tieto- ja viestintäteknologian (ICT) kehitysharppaukset ovat integroineet teknologiat tiiviisti sekä kaupallisten että julkishallinnon organisaatioiden toimintaan. Tietojärjestelmät, sekä tieto- ja viestintätekninen infrastruktuuri ovat yhä keskeisempiä kehitettäessä liiketoimintaa, sen malleja ja prosesseja. Organisaatioiden ICT:n hallinta, suunnittelu ja kehittäminen ei siten enää voi olla yksinomaan teknologia-asiantuntijoiden varassa, vaan nämä asiat ovat yhtä lailla organisaation toiminnan johdon asialistalla. Jotta sijoitukset laitteistoihin, järjestelmiin sekä myös niiden vaatimiin osaamisresursseihin olisivat linjassa organisaation päämäärien ja toiminnan tavoitteiden kanssa, niiden hallinnan, suunnittelun ja kehittämisen täytyy tapahtua liikkeenjohdon eri tasojen sekä tietohallinnon yhteistoiminnassa.

Asiantuntijaryhmien vuorovaikutus on perinteisesti koettu haasteelliseksi ICT:n suunnittelussa ja kehittämisessä. Kokonais- eli yritysarkkitehtuurilähestymistapa yhdistää liiketoiminnan kehittämisen ja teknologiamahdollisuuksien tutkimisen, siirtäen tiedon olemassa olevien järjestelmien sekä infrastruktuurin hallintaan ja jatkokehittämiseen. Tässä tutkimuksessa konstruoidaan tietojärjestelmien kehittämismenetelmien sekä kokonaisarkkitehtuurikirjallisuuden pohjalta ja käytännöstä, yritys- arkkitehtuurin kehittämisprojekteista, kootun aineiston avulla yritysarkkitehtuuriprosessin metamalli, joka ohjaa toiminnan ja teknologioiden vuorovaikutteista kehittämistä laajoissa organisaatioissa. Malli mukailee organisaation johtamista, tukien ICT:n nivomista toimintaan strategiatasolta operatiiviseen liiketoimintaan ja järjestelmien toteuttamiseen asti.

Menetelmätietämyksen pohjalta on totuttu viemään organisaatiojohdon päätökset toiminnasta ja sen resurssien suuntaamisesta lähtökohdaksi teknologiatuen suunnitteluun. Uusi malli paitsi huomioi tiedon mahdollistavista teknologioista jo liiketoiminnan kehittämisvaiheessa, myös varmistaa että valmiiksi organisaation käytössä olevat järjestelmät ja teknologiat, sekä niiden kenties vielä hyödyntämättömät resurssit tuodaan toiminnan ja sen ICT-tuen suunnitteluun. Toiminnan ja resurssien, sekä käytössä jo olevien ja toisaalta uusien teknologioiden mahdollisuuksien ja myös rajoitteiden kohtaaminen keskustelevassa prosessissa riittävän varhaisessa vaiheessa varmistaa sen, että vältytään päällekkäisiltä, liian kalliilta ja epätarkoituksenmukaisilta ratkaisuilta.

Prosessissa tieto ei virtaa ainoastaan ylhäältä alas suunnittelupäätöksinä, vaan myös soveltavista yksiköistä ja käyttäjätasolta ylöspäin kokemus- ja palautetietona, joka siten saadaan hyödyntämään koko organisaation jatkokehittämistä. Organisaation laajuiset, toimintaa, rakenteita ja prosesseja koskevat mallit ja ratkaisut, sekä teknologioita ja järjestelmien toteuttamista koskevat linjaukset, viedään edelleen järjestelmäsuunnittelukuvauksina, malleina ja ohjeistuksina järjestelmäkehittäjille. Koska toteuttamiskonteksti ja koko organisaation käytössä oleva infrastruktuuri on valmiiksi kuvattu, säästyy aikaa, työtä ja samalla taloudellisia resursseja yksittäisissä ICT-hankkeisssa.

Eri sidosryhmiä ja eri tasojen päätöksentekijöitä ajatellen prosessissa käytetään organisaatiosta, sen toiminnasta sekä ICT-infrastruktuurista ja järjestelmistä kuvauksia, jotka on laadittu eri menetelmin, tarkoituksenmukaisella abstraktiotasolla ja riittävällä mutta ei liian yksityiskohtaisella tarkkuustasolla. Yhteinen viitekehys jäsentää arkkitehtuurin eri dimensioiden kuvaukset näille tasoille sekä osoittaa kuvausten suhteet. Kokonaisarkkitehtuurityön ydintä on eri asiantuntijaryhmien välinen neuvottelu ja vuorovaikutus sekä organisaation ja sen liiketoiminnan, että ICT:n kehittämisestä.

Tutkimuksessa johdettiin looginen etenemisjärjestys sekä huomioitavat edeltäjyydet ja riippuvuudet yritysarkkitehtuurin suunnittelu- ja kehittämistehtävissä. Prosessimalli jäsentää myös erilaisten arviointimenetelmien ja kehittämistekniikoiden käytön oikea-aikaiseksi ja oikein kohdistetuksi. Tietoturvan huomioiminen aina liiketoiminnan suunnittelusta alkaen nivoutuu myös yritys- tai kokonaisarkkitehtuurityöhön ja saa siitä tukea kattavuudelle ja tietoturvan hallittavuudelle. Tutkimuksessa konstruoidun menetelmäkehikon käyttökelpoisuus tietoturva-arkkitehtuurin suunnitteluun testattiin yhdessä osatutkimuksessa. Muut osatutkimukset täydentävät kokonaisarkkitehtuurimetodologian: yritysarkkitehtuuriprosessin organisaatiokontekstin kartoitus, asiakasorganisaation muutoksenhallinnan prosessin tarkastelu yritysarkkitehtuurihankkeen taustatekijänä sekä käyttäjäorganisaation ja konsultoivan organisaation työ- ja vastuujaon tarkastelu yhteistoiminnallisessa arkkitehtuurisuunnittelussa.

Tutkimus hyödynsi tietoja jotka kerättiin lähes 20 erilaisen ja eri aloja edustavien asiakasorganisaatioiden kokonaisarkkitehtuurihankkeista. Lisäksi koostettiin arkkitehtuurikonsultoinnin parissa toimivien asiantuntijoiden kokemusperäistä tietoa arkkitehtuurihankkeista. Tulokset syntyivät konsultointia tarjoavan yrityksen toimintatutkimuksena, johon tutkija osallistui. Ennen julkaisua osatulokset arvioitiin yrityksessä ja kokeiltiin konsultointityön käytännössä. Syntyessään menetelmä oli siten jo sovitettu konsulttiorganisaation käyttöön ja sen muihin menetelmiin, eikä erillistä käyttöönottovaihetta siten tarvittu. Merkittävimmät osatulokset sekä yleinen prosessimalli julkaistiin tieteellisinä artikkeleina.

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APPENDIX 1

Data documentation for the studies at TietoEnator
Mirja Pulkkinen

Appendix 1 The intermediate documentation during the AR effort at TE

DOCUMENT AUTHOR(S) Related AR Activity	INFOR- MANTS at TE	ISSUES	INFORMATION SOURCE
Muistiinpanot TietoEnator Yrityskäynti [Notes from company visit] 08.01.2002 Author: Mirja Pulkkinen AR Activity: Inquiry 1	P10 P3 P4	First record of main EA concepts with meanings First rough outline of the process in customer organization in an EA project	Consulting work experience
25.01.2002 Author: Mirja Pulkkinen AR Activity: Inquiry 1	P10 P2 P3 P4	Architecture / EA concepts, setting a baseline for the creation of a shared set of concepts Plans for data collection	Consulting work experience
Material from TietoEnator 13.02.2002 Author: Mirja Pulkkinen AR Activity: Inquiry 1	P10 P3 P4	Architecture concepts and work methods	TietoEnator internal architecture training material Consulting work experience
TietoEnator Esiselvitys [Preliminary Study] 15.02.2002 Author: Mirja Pulkkinen AR Activity: Inquiry1, Formulate question		Plan outline for 1st AR cycle: Process elements at a coarse grained level Roles Methodology in use Development plan for EA method	Collected information and material Literature

Problem Areas and Development Needs for TietoEnator 19.04.2002 Authors: Veikko Halttunen Mirja Pulkkinen AR Activity: Formulate question		Refined Plan with the areas: Project process Process context (management processes) EA process The need for simultaneous business and technology planning The methodologies available, in use, and consulting needs	Collected information and material Literature
Kysymys-luettelo [Set of Questions] June 2002 Authors: Veikko Halttunen Mirja Pulkkinen AR Activity: Formulate question		Process in the projects, tasks, outcomes, and tools; problems	Questions drawing on the plan documents and on EA literature
Yrityskäynnin muistio [Memo of company visit], TietoEnator 28.05.2002 Author: Mirja Pulkkinen AR Activity: Inquiry 1	P10	Plan for conducting data collection	Managerial expertise on methodology needs and methodology development context
Puhelinhaastat-telujen koonti [Summary of Telephone Interviews] 14.06.2002 Author: Mirja Pulkkinen AR Activity: Inquiry 2	P1 P2 P3 P4	Process starting points Process execution Process support Process problem	Expert knowledge on EA type project process based on interviewee work history
Architecture Terminology. TietoEnator 13.02.2002 2nd release 01.07.2002 Last release 03.09.2002 Author: Mirja Pulkkinen AR Activity: Inquiry 2		Concepts and definitions on EA and system architecture. Initial AR Activity: 5 defined concepts Last release: 28 defined concepts	Communication with the company members (meetings, interviews, workshops, materials) and EA literature

Workshop 1 18.06.2002 Memo, Release date 27.06.2002 Author: Mirja Pulkkinen AR Activity: Develop for changing action	P2 P3 P10	Outline of the diversity of possible EA processes with a client organization Elaboration of central concepts	Client organization EA cases explicated Project documantation of the cases Presentation of the cases
Slide sets from company members Release dates 18.06. and 14.08.2002 Authors: TE members AR Activity: Change action	P3 P9 P10	Individual consultant or project level process and task outlines and tool explication	Consultant tools for EA cases
Workshop 2 14.8.2002 Memo, Release date 21.08.2002 Author: Mirja Pulkkinen AR Activity: Develop for changing action / Change action	P1 P2 P4 P8 P10	Strategy processes and the EA process Processes framework	Consulting work experience with EA cases EA Literature
Worksheet template Authors: Veikko Halttunen Mirja Pulkkinen AR Activity: Develop for changing action		Input, output, roles, resources and controls	Literature, Workshop 1 and 2 results,
Worksheets (2 sets) filled out AR Activity: Develop for changing action / Change action	P1&P2 P4	Tasks, Outcomes, Elements of the EA process: Current state, Target State Logical Architecture, Application architecture, ISA, Technology Architecture, Roles	Consulting work experience
Workshop 3 17.09.02 Memo, Release Date 18.09.2002 Author: Mirja Pulkkinen AR Activity: Develop for changing action / Change action	P1 P2 P9 P10	Methodology elements	Previous data Consulting work experience

Evaluation Copy of TE EA Management Model 02.10.2002 Author: Mirja Pulkkinen AR Activity: Develop for changing action		First methodology outline	Results of the data collection (meetings, interviews, workshops) Case materials on EA cases EA literature
Workshop 4 23.10.02 Memo, Release Date 25.10.2002 Author: Mirja Pulkkinen AR Activity: Develop for changing action / Change action	P1 P2 P3 P9 P10	Methodology elements	Previous data Consulting work experience
- *Work results used in practice* -			
Evaluation (comments added to the document) 2 slide sets for more information Authors: TE members AR Activity: Evaluation	P1 P2 P9	Confirmation of structures Additions and Modifications to details	Consulting work competence
Larkki-Projektin toisen vuoden suunnitelman tarkennus TietoEnatorin osalta Released 07.11.2002 Author: Mirja Pulkkinen AR Activity: Reflection to 2nd cycle inquiry		Areas of enterprise architecture management Development of the architecture management process Shared concepts Work	The overall research project plan All evidence collected in the TietoEnator work prior to this effort
Internal EA methodology development white papers (2) 08/2002 Authors: TE members			Findings of TE EA work studies and software engineering

Larkki-Projektin toisen vuoden suunnitelman tarkennus TietoEnatorin osalta [Refinement of the 2nd year plan for TE work] Released 21.11.2002 Author: Mirja Pulkkinen AR Activity: Reflection to inquiry / Inquiry 1, 2nd cycle starting		Changed plan Merging two lines of EA methodology development, new target Methodology Framework Evaluation of the framework Shared concepts on EA	
29.11.2002 TEAM Version 1 Author: Mirja Pulkkinen AR Activity: Reflection		The 1st year result	All information collected prior to this effort
EA Development Model 2 for TE Larkki project report 07.01.2003 Author: Mirja Pulkkinen AR Activity: Develop for changing action		EA Grid first version	Synthesis of previous work: The EA development model (EADM) for TietoEnator by MP, and TietoEnator internal work on EA methodology. EA literature
Managing of requirements and preliminaries; slide set Author: Mirja Pulkkinen 17.01.2003 AR Activity: Develop for changing action		EA Grid considered for process definition Abstraction levels and dimensions	Research summary
Levels of Examination, Articulating the EA Consulting Work Author: Mirja Pulkkinen 21.01.2003		The levels of abstraction / decision making explicated	
Example table Excel sheet 29.01.2003 AR Activity: Develop for changing action	P10		EA Grid usage
Commented Methodology document 07.02.2003 AR Activity: Develop for changing action	P1 P2 P9	Comments	Consulting competence

Managing of requirements and preliminaries v2 slide set 14.02.2003 Author: Mirja Pulkkinen AR Activity: Develop for changing action		Flows of information in EA decsision making	Constructing the basis for the process
Architectures Slide set 27.02.2003 AR Activity: Change action	P4	Architecture views and viewpoints	Consulting work practice
TietoEnator Enterprise Architecture Method Figures, Slide set Authors: Mirja Pulkkinen, TE members AR Activity: Change action		Core concepts of methodology collected	EA Literature Consultant tools
Enterprise Architecture Development Method 2 for TietoEnator Intermediate Report Author: Mirja Pulkkinen 23.03.2003 AR Activity: Develop for changing action		Requirements for targeted method Coping with levels and dimensions Methodology components Development needs	Construction of the methodology
Techniques for Architecture Modelling Author: Mirja Pulkkinen 24.03.2003 AR Activity: Develop for changing action		Architecture descriptions	Literature
Plan for method deployment in consulting Slide set 01.04.2003 Author: TE member AR Activity: Change action	P1 P2 P3 P4 P10		
Review form for EA methodology observation & evaluation Author: P3 03.04.2003 For evaluation phase	P3		Company standard review form

Comments on methodology 14.04.2003 AR Activity: Develop for changing action	P6	Roles of consulting work mapped to the EA Grid	Comments
Development Method 2 "TEAM" Released: 16.04.2003 *Shared in Company intranet for use* AR Activity: Change action			
- *Work results used in practice* -
Development Method 2 "TEAM" Commented document 20.05.2003 AR Activity: Develop for changing action	P 10 other consultants		Comments
Templates slide set 28.05.2003 AR Activity: Change action	P1 Other not named consultants	EA work deliverables Templates for EA project work mapped to the EA Grid	Consulting methods
TietoEnator Enterprise Architecture Development Method Evaluation Copy Larkki Project deliverable 06.06.2003 Author: Mirja Pulkkinen		The Methodology - Result of construction	All cumulated information
MUISTIO [MEMO TietoEnator methodology pilot evaluation and research publication plan] Author: Mirja Pulkkinen Released: 24.06.2003 AR Activity: Evaluation , Reflection	P10	Evaluation plans Publication plans	

			Evaluation
MUISTIO [MEMO TietoEnator methodology pilot evaluation, publication plan and 3rd year preliminary plans] Author: Mirja Pulkkinen Released: 30.7.2003 AR Activity: Evaluation, reflection and inquiry: formulate question (3rd cycle),			Evaluation
Role descriptions Working document Author: TE member 11.08.2003		Roles and project areas	Company material
Working Document Author: TietoEnator member 27.08.2003		Dimensions worked on, results produced	9 client organization EA consulting cases explicated with result details
Presentation of the methodology Authors: Mirja Pulkkinen, TE member 03.09.2003	TE Group Technology Symposium	Evaluation of the methodology	
Evaluation summary Larkki Feedback GTS03 Author: P1 AR Activity: Evaluation	P1 The Symposium audience	Evaluation Open ended questions: Does the TEAM method meet your reality? What kind of architecture-related tasks do you get most often? What do we need to add to the TEAM method to make it a practical tool?	Evaluation query forms
TEAM vs. TE Object slide set Author: TE members 09.09.2003	P2	Methodology continuum from consulting to software development	Software Development Methodology Consulting Methods Literature

Evaluation Report on TE Enterprise Architechture Management and Development Method TEAM Released: 02.10.2003 Author: Mirja Pulkkinen AR Activity: Evaluation, Reflection, Inquiry: Formulate question			Summary of comments and the review by the TE Group Technology Symposium
Plan Author: TietoEnator members 18.12.2003 AR Activity: Inquiry 1, Formulate question			
Memo: Plan for 2004 07.01.2004 Author: Mirja Pulkkinen		Refined plan for 3rd cycle Research planning	
TE Software methodology material 4 slide sets 3 text documents Received 07.01.2004	TE method teams	The methodology context for EA method	TietoEnator software methodology Consulting methods
EA Processes Working document 16.01.2004 Author: Mirja Pulkkinen AR Activity: Inquiry 2			EA Literature
EA planning and development process: taking the hierarchical spiral model to altitudes Working paper 19.01.2004 Author: Mirja Pulkkinen AR Activity: Inquiry 2			Previous work and literature synthesis and construction
TEAM Process Considerations, slide set Author: Mirja Pulkkinen 22.01.2004 Phase Develop for changing action		Process elements	Previous accumulated knowledge Literature
Group interview notes (Taped interview) Author: Mirja Pulkkinen 26.01.2004 AR Activity: Inquiry 2	P1 P8	Process phases Tool use Problem areas Role questions Project results	2 client organization EA consulting cases EA project documentation

Interview notes (Taped interview) 30.1.2004 AR Activity: Inquiry 2		Process phases Tool use Problem areas Role questions Project results	3 client organization EA consulting cases EA project documentation
Case Example slide set (material to interview) 30.1.2004 AR Activity: Inquiry 2	TE Consultants	Descriptions used Tool use Process Project results	3 client organization EA consulting cases
Interview notes (Taped interview) Author: Mirja Pulkkinen 09.02.2004 AR Activity: Inquiry 2	P3	Process phases Tool use Problem areas Role questions Project results	2 client organization EA consulting cases Project documentation viewing
EA Processes Comparison Table Working document 21.05.2004 Author: Mirja Pulkkinen AR Activity: Inquiry 2			Literature
The summary tables for EA Planning Working Paper Author: Mirja Pulkkinen 09.03.2004 AR Activity: Develop for changing action		The decision making levels EA descriptions and tasks at each level Project beginning and ending tasks EA work results	Previous work Literature Interview data Methodology context
Project process TEAM Slide set Author: Mirja Pulkkinen, TE member 09.03.2004 AR Activity: Change action			
TEAM method in context Author: Mirja Pulkkinen (Last release for review) 17.03.2004 AR Activity: Develop for changing action			All previous work & information
Templates March04 Slide set 18.03.2004	P1	Elements of process	Templates used in EA process phases
Review of the process construction (Group interview at TE) Notes 24.03.2004 Author: Mirja Pulkkinen	P3 P10 P11 P12 P13	The process elements Preliminaries and deliverables in the EA process Methodology context with business development and software development methodologies	

Commission Types Slide set 25.03.2004 Author: Mirja Pulkkinen		Dependencies of project types	
TEAM Method new version 07.04.2004 Author: Mirja Pulkkinen AR Activity: Develop for changing action		Integrated methodology EA Consulting Business Development Software Development	
- *Work results used in practice* -			
Paper draft EA Planning, Development and Management Process for Agile Enterprise Development 15.06.2004 AR Activity: Reflection			Process knowledge accumulated
Evaluation session notes Author: TE member 22.9.2004	P3 P10 P11 P12 P13	Evaluation	Consulting competence
EA Methodology for TietoEnator Author: Mirja Pulkkinen Last additions 23.09.2004		Completed Methodology, integrated with software development and business development methodologies	
The EA process with examples Slide set Author: Mirja Pulkkinen Last release 14.12.2004 AR Activity: Specify learning		Process model	Accumulated process knowledge
EA Process and Evaluation. Project seminar presentation. Author: Mirja Pulkkinen 03.02.2005 AR Activity: Specify learning			Accumulated process and EA evaluation knowledge
- *Work results released* -			

Paper draft: Systemic Management of Architectural Decisions in Enterprise Architecture Planning. Four Dimensions and Three Abstraction Levels. 15.06.2005 AR Activity: Specify learning		Process model	Evaluation of the work

APPENDIX 2

Example of the data management system with documentation of the Metso Paper case. Aviator DMS runs on the Lotus Notes database management system. The screenshot shows an Aviator "document" (storage unit) with attachments (MS Word, Powerpoint and pdf document files) and metadata.

APPENDIX 3

LARKKI Project   VH, MP
QUESTIONNAIRE [Translated by dissertation author]
ICT ARCHITECTURE (ENTERPRISE ARCHITECTURE) PROJECTS
(CONSULTING)

Starting points for an architecture planning / development effort

1. What is or are the predecessor(s) of the architecture consulting project?
   - Strategic planning process of the client
   - Management consulting project with the client
   - Change in requirements of systems
   - Functional gaps found in the enterprise architecture (as example, expansion of functionality)
   - Other preceding matters (process, process phase, project(s) etc.)

2. How is the background of the enterprise (end-user organization, the client) analyzed?
   - Basics (industry sector specific factors, size, lifetime etc.)
   - The client change management capability (experience, methods)
   - Other issues

3. Is there a process model for the architecture consulting / management / planning / development? Are there other guiding principles to conduct the project? Is there a choice of different process models for different client cases / types of architecture projects? If yes, what are they? Have you participated or are you participating in developing a process model for architecture consulting?

If there are alternative models, further questions on them below (4 ja 5), if not, skip.

4. To which extent do the end-user (client) organization factors determine the choice of a process model for the effort?
   - Industry sector, size, lifetime, economics, etc.
   - Experience (management maturity) in change processes
   - Prior consulting case experience
   - Other

5. What is the role of the client and the consultant in deciding on a process model to use?

6. What are according to your experience the architecture consulting phases and the phase deliverables? (Main phases, sub-phases, tasks, sub-tasks; inputs and outputs of these)

Details on conducting the project / the architecture development effort

7. Please define the tasks, responsibilities and deliverables contributed by the end-user (client) organization members, and the consulting project members, with their roles. (Table extended according to needs)

PHASE/ TASKS	Client		Project staff	
	Phases and Work items	Work-load	Phases and Work items	Work-load
Process (project preparations)				
Information collecting (on client organization ICT, on enabling technologies /solutions)				
Workshops with client				
Analyzing the materials (client ICT information, workshops)				
Producing the results				

8. What kind of work procedures and methods were used and at which phase(s) were they employed?

9. What is the overall outcome (result) of the process (project)? In which form is it delivered?

Support for the process

10. Are there templates for the descriptions or models that are produced on the architecture?

11. Are the results (description templates, models) from previous efforts re-used?

Software development methodology in architecture consulting work questions 12-16 (TietoEantor uses object-oriented, UML –based software development methodology)

12. Does the SW development methodology support architecture consulting work?

13. Does the SW development methodology guide the architecture assignment process even if the methodology is not deployed in the work as such?

14. If the SW development methodology is supporting the architecture work, are there aspects or phases in the architecture work where this support is lacking?

15. Should an architecture consulting methodology deploy the same description and modeling techniques as the SW development methodology?

16. Do similar modeling templates or description techniques bring benefits (e.g. Enterprise Architecture and Software Architecture descriptions)?

Evaluation of the process, the project, the outcome (deliverables)

17. How is the outcome of an architecture planning or development effort evaluated? (Is there e.g. an evaluation form to be filled out by participants (client and/or project staff), is there a standard procedure for assessing the project? Is the evaluation conform to systems development project evaluation?

18. Has it been possible to track down the factors contributing to client satisfaction / dissatisfaction? What are these factors?

19. Success evaluation in individual cases with contributing factors that can be discerned, or consultant experience on success factors in architecture assignments. What contributes to success in:
    - Processes
    - Collaboration
    - Methodology, methods, techniques and tools for architecture work
    - Other factors

20. What are the greatest problems? What is to be found in the area of:
    - Processes
    - Collaboration
    - Methodology, methods, techniques and tools for architecture work
    - Other factors