Marc Lankhorst et al.

Enterprise Architecture at Work

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Modelling, Communication, and Analysis

With 167 Figures and 12 Tables

Springer

Marc Lankhorst
Telematica Instituut
P.O. Box 589
7500 AN Enschede
The Netherlands
e-mail: marc.lankhorst@telin.nl

Colour figures sponsored by ABN AMRO

Library of Congress Control Number: 2005924300

ACM Computing Classification (1998): H.1, D.2.11, J.1

ISBN-10 3-540-24371-2 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-24371-7 Springer Berlin Heidelberg New York

Springer is a part of Springer Science+Business Media

springeronline.com

Printed in Germany

Cover design: KünkelLopka, Heidelberg
Typesetting: by the Authors
Production: LE-TeX Jelonek, Schmidt & Vöckler GbR, Leipzig
Printed on acid-free paper 33/3142/YL - 5 4 3 2 1 0

Foreword

'Architecture', in a broad sense, is the synergy of art and science in designing complex structures, such that functionality and complexity are controlled. The notion of architecture is used in a wide range of domains, from town planning to building and construction, and from computer hardware to information systems, each being characterised by the types of 'structures' or 'systems' being designed. However, we can recognise some common concerns in all these approaches.

To begin with, architecture, and hence the architect, is concerned with understanding and defining the relationship between the users of the system and the system being designed itself. Based on a thorough understanding of this relationship, the architect defines and refines the essence of the system, i.e., its structure, behaviour, and other properties.

This representation of the system's essence, also called the 'architecture' of the system, forms the basis for analysis, optimisation, and validation and is the starting point for the further design, implementation, and construction of that system. The resulting artifacts, be they buildings or information systems, naturally have to conform to the original design criteria. The definition of the architecture is the input for verifying this.

During this process, the architect needs to communicate with all stakeholders of the system, ranging from clients and users to those who build and maintain the resulting system. The architect needs to balance all their needs and constraints to arrive at a feasible and acceptable design.

Fulfilling these needs confronts the methodology for defining and using architectures with demanding requirements. These can only be met if the architects have an appropriate way of specifying architectures and a set of design and structuring techniques at their disposal, supported by the right tools. In building and construction, such techniques and tools have a history over millennia. In information systems and enterprise architecture, though, they are just arising.

Important for an architecture description language is that the properties of the system can be represented in their bare essence without forcing the architect to include irrelevant detail. This means that the description language must be defined at the appropriate abstraction level.

If the architecture is concerned with the relationship between an enterprise and its IT support, the architect should be capable of expressing the structure, behaviour, and coherence of both the business processes and the IT support, such that one can use these specifications to get a thorough understanding of the architecture, to optimise it according to specific business goals, and to develop a strategy for introducing improvements in the current situation. This implies that the architecture description language should embrace easily understandable human notions of business processes and their IT support, far away from low-level implementation issues. It requires a level of comprehensibility of the description language by a broader audience than just the few specialists that are capable of understanding the obscurities of formal, mathematically oriented languages.

The very same applies to the methods that allow the architect to structure and manipulate architectural specifications such that their complexity can be controlled. Not in the least, the language and methods are the basis for unambiguous mutual understanding and successful collaboration between the stakeholders of the architecture. All stakeholders need to be aware about the implications of the choices in the architecture, and be capable of possibly influencing such choices.

This book presents the results of a research project that produced just that: a comprehensible, high-level design language for enterprise architecture, accompanied by a set of techniques and guidelines for visualisation and analysis of architectures. These results were validated in practice in real-life case studies in cooperation with several large, information-intensive organisations. Currently, various companies, ranging from vendors of architecture tools to consultants and other users of enterprise architecture, are implementing the results of the project.

This project is a prime example of the knowledge transfer for which the Telematica Instituut was founded. Both government and industry fund this Dutch national research institute. Its mission is to boost the innovative and competitive power of society by bridging the gap between academic research and its industrial application. The ArchiMate project, from which this book results, is a prime example of fruitful cooperation between these worlds. This proves the success of this knowledge transfer.

I hope and trust that the ArchiMate project not only proves to be an example of high-quality research in the important field of enterprise architecture, but also will have a considerable impact in practice.

Prof.dr.ir. C.A. Vissers
Scientific Director
Telematica Instituut
Enschede, December 2004

Preface

Many stakeholders within and outside the company can be identified, ranging from top-level management to software engineers. Each stakeholder requires specific information presented in an accessible way, to deal with the impact of such wide-ranging developments. To predict the effects of such developments and modifications of an organisation's business and IT, it is necessary but very difficult to obtain an overview of these changes and their impact on each other, and to provide both decision makers and engineers implementing the changes with the information they need.

This book is about *enterprise architecture*, the practice that tries to describe and control an organisation's structure, processes, applications, systems, and technology in such an integrated way. More specifically, we focus on methods and techniques for making and using integrated descriptions by means of architecture models, visualisation of these models for various stakeholders, and analysis of the impact of changes.

The unambiguous specification and description of components and especially their relationships in an architecture requires a coherent architecture modelling language. Such a language must enable integrated modelling of architectural domains and should be appreciated both by people from IT and by people with a business background. In this book, we present such an enterprise modelling language that captures the complexity of architectural domains and their relations and allows the construction of integrated enterprise architecture models. We provide architects with concrete instruments that may improve their architectural practice.

Furthermore, we provide techniques and heuristics for communicating with all relevant stakeholders about these architectures. Central to the communication of architectures is the notion of *viewpoint*. Viewpoints define abstractions on the set of models representing the enterprise architecture, each aimed at a particular type of stakeholder and addressing a particular set of concerns.

An architecture model is not just useful to provide insight into the current or future situation; it can also be used to evaluate the transition from 'as is' to 'to be'. We therefore provide analysis methods for assessing both the qualitative impact of changes to an architecture and quantitative aspects of architectures, such as performance and cost issues.

In order to make the approach we envisage practically feasible, architects require a tool environment, which supports the definition, generation, editing, visualisation, analysis, and management of architecture models and views. Moreover, such an environment should work in concert with existing domain-specific modelling tools, since we cannot expect architects to start using other tools, let alone other languages, than the ones they are used to. Although some tool developers are active in the enterprise architecture market, none currently provide a complete solution; some are focused on IT portfolio management, others on business process modelling, or on software architecture. We therefore present the design of a viewpoint-driven enterprise modelling environment that can provide just this support, and a vision on the future of model-driven enterprise architecture tooling. Currently, we are working with a number of commercial tool vendors to realise these ideas.

The modelling language and the other techniques in the book have been proven in practice in numerous real-life case studies. To put these instruments into context, the book also addresses the use of enterprise architecture models and techniques in governance, with a focus on alleviating the infamous business–IT alignment problem.

Audience

The intended audience of this book is twofold. On the one hand, we target enterprise, business, and IT architecture practitioners, especially those who are looking for better ways of describing, communicating, and analysing (enterprise) architectures. On the other hand, we aim for students of IT and (IT) management studying the field of enterprise architecture.

Overview of the Book

In the first chapter, we give an introduction to architecture in general and enterprise architecture in particular, outline its drivers, and describe the architecture process. Chapter 2 explains the methods and techniques currently used in this field. Following this, we outline the foundations of our approach to enterprise architecture modelling (Chap. 3). We then describe our view of architecture as being primarily a means of communication with all the stakeholders involved (Chap. 4). Architectures are fruitfully used both in requirements analysis and design for new applications, busi-

ness processes, etc., and to gain insight into existing systems (in the broad sense).

In our approach, the use of architecture *models* has a central role; the modelling language used throughout the rest of the book is introduced in Chap. 5. Having a language is not enough: the architect also needs to be guided in its use, which is the topic of Chap. 6.

Many stakeholders with different goals or concerns in mind can view architectures. Each of these requires its own depictions of (part of) an architecture model, and the creation, use of such views and viewpoints is the topic of Chap. 7. Given that we have accurate models of an architecture, we can subject these models to various types of analysis, to establish for example what the impact of a change might be, or whether the performance of the technical infrastructure is sufficient given the applications and business processes that use it. These analyses are discussed in Chap. 8.

The practical applications of these modelling, visualisation, and analysis techniques are the topic of the next three chapters. In Chap. 9, experiences and best practices from case studies regarding the alignment of business, applications, and infrastructures are presented. These provide the context in which architectures are designed. Chapter 10 describes software tools that are currently available and our vision on and prototypes of future software support for enterprise architecture. Chapter 11 presents our practical experience with applying the techniques and prototypes in a number of real-life case studies. Finally, Chap. 12 provides a vision of the future: what is next; what comes 'after' architecture?

Acknowledgements

This book has resulted from the ArchiMate project, a Dutch research initiative that provides concepts and techniques to support enterprise architects in the visualisation, communication, and analysis of integrated architectures. The ArchiMate consortium consists of Telematica Instituut, ABN AMRO, Stichting Pensioenfonds ABP, the Dutch Tax and Customs Administration, Ordina, Centrum voor Wiskunde en Informatica, Radboud Universiteit Nijmegen, and the Leiden Institute of Advanced Computer Science. See http://archimate.telin.nl for more information about ArchiMate.

Chapter 9 of this book results from the GRAAL project, a daughter project of ArchiMate. The GRAAL project is co-financed by the Telematica Instituut and the Centre for Telematics and Information Technology (CTIT) of the University of Twente, Enschede, The Netherlands. See http://is.cs.utwente.nl/GRAAL for more information about GRAAL.

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[1] Telematica Instituut, Enschede, The Netherlands.
[2] Centre for Mathematics and Computer Science (CWI), Amsterdam, The Netherlands.
[3] Radboud University, Nijmegen, The Netherlands.
[4] Leiden Institute of Advanced Computer Science (LIACS), Leiden, The Netherlands.
[5] Ordina BV, Nieuwegein, The Netherlands.

[6] University of Twente, Enschede, The Netherlands.
[7] Stichting Pensioenfonds ABP, Heerlen, The Netherlands.
[8] ABN AMRO, Amsterdam, The Netherlands.
[9] Dutch Tax and Customs Administration, Apeldoorn, The Netherlands.
[10] Delft University of Technology, Delft, The Netherlands.

1 Introduction to Enterprise Architecture

In current business practice, an integrated approach to business and IT is indispensable. As a real-life example, take the Dutch government, who are currently undertaking a massive redesign of the entire chain of organisations involved in the social security system. Within this context, the collection of employees' social security premiums is transferred from the central social security organisation to the tax administration. This sounds logical, since collecting taxes is superficially very similar to collecting social security premiums. However, this seemingly simple change entails a major redesign of organisational structures, business processes, IT applications, and technical infrastructure. Enormous flows of data need to be redirected within and among the different organisations: more than 600,000 payroll tax returns are filed each month, a large proportion of which arrive within a peak period of a couple of days.

Controlling such changes cannot be done by just 'winging it'. But how can we get to grips with this complex, multi-faceted world?

1.1 Architecture

It is often said that to manage the complexity of any large organisation or system, you need architecture. But what exactly does 'architecture' mean? Of course, we have long known this notion from building and construction. Suppose you contract an architect to design your house. You discuss how rooms, staircases, windows, bathrooms, balconies, doors, a roof, etc., will be put together. You agree on a master plan, on the basis of which the architect will produce detailed specifications, to be used by the engineers and builders.

How is it that you can communicate so efficiently about that master plan? We think it is because you share a common frame of reference: you both know what a 'room' is, a 'balcony', a 'staircase', etc. You know their function and their relation. A 'room', for example, serves as a shelter and is connected to another 'room' via a 'door'. You both use, mentally, an architectural model of a house. This model defines its major functions and how they are structured. It provides an abstract design, ignoring many de-

tails. These details, like the number of rooms, dimensions, materials to be used, and colours, will be filled in later.

A similar frame of reference is needed in designing an enterprise. To create an overview of the structure of an organisation, its business processes, their application support, and the technical infrastructure, you need to express the different aspects and domains, and their relations.

But what is 'architecture' exactly? Even in building and construction, the term is not without ambiguity. It can signify the art and science of designing the built environment, or the product of such a design. Thus, the term architecture encompasses both the blueprint for a building and the general underlying principles such as its style, as in 'gothic architecture'.

In this book, we will use the IEEE Standard 1471-2000 (IEEE Computer Society 2000; see also Sect. 2.2.2) definition of architecture:

> **Architecture** is the fundamental organisation of a system embodied in its components, their relationships to each other, and to the environment, and the principle guiding its design and evolution.

This definition accommodates both the blueprint and the general principles. More succinctly, we could define architecture as 'structure with a vision'. An architecture provides an integrated view of the system being designed or studied.

As well as the definition of architecture, we will use two other important notions from the IEEE standard. First, a 'stakeholder' is defined as follows:

> **Stakeholder**: an individual, team, or organisation (or classes thereof) with interests in, or concerns relative to, a system.

Most stakeholders of a system are probably not interested in its architecture, but only in the impact of this on their concerns. However, an architect needs to be aware of these concerns and discuss them with the stakeholders, and thus should be able to explain the architecture to all stakeholders involved, who will often have completely different backgrounds.

1.2 Enterprise Architecture

More and more, the notion of architecture is applied with a broader scope than just in the technical and IT domains. Architecture at the level of an entire organisation is commonly referred to as 'enterprise architecture'. An 'enterprise' in this context can be defined as follows (The Open Group 2002):

> **Enterprise**: any collection of organisations that has a common set of goals and/or a single bottom line.

This leads us to the definition of enterprise architecture:

> **Enterprise architecture**: a coherent whole of principles, methods, and models that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems, and infrastructure.

Enterprise architecture captures the essentials of the business, IT and its evolution. The idea is that the essentials are much more stable than the specific solutions that are found for the problems currently at hand. Architecture is therefore helpful in guarding the essentials of the business, while still allowing for maximal flexibility and adaptivity. Without good architecture, it is difficult to achieve business success.

The most important characteristic of an enterprise architecture is that it provides a holistic view of the enterprise. Within individual domains local optimisation will take place and from a reductionistic point of view, the architectures within this domain may be optimal. However, this need not lead to a desired situation for the company as a whole. For example, a highly optimised technical infrastructure that offers great performance at low cost might turn out to be too rigid and inflexible if it needs to support highly agile and rapidly changing business processes. A good enterprise architecture provides the insight needed to balance these requirements and facilitates the translation from corporate strategy to daily operations.

To achieve this quality in enterprise architecture, bringing together information from formerly unrelated domains necessitates an approach that is understood by all those involved from these different domains. In contrast to building architecture, which has a history over millennia in which a common language and culture has been established, such a shared frame of reference is still lacking in business and IT. In current practice, architecture descriptions are heterogeneous in nature: each domain has its own description techniques, either textual or graphical, either informal or with a precise meaning. Different fields speak their own languages, draw their own models, and use their own techniques and tools. Communication and decision making across these domains is seriously impaired.

What is part of the enterprise architecture, and what is only an implementation within that architecture, is a matter of what the business defines to be the architecture, and what not. The architecture marks the separation between what should not be tampered with and what can be filled in more freely. This places a high demand for quality on the architecture. Quality

means that the architecture actually helps in achieving essential business objectives. In constructing and maintaining an architecture, choices should therefore be related to the business objectives, i.e., they should be rational.

Even though an architecture captures the relatively stable parts of business and technology, any architecture will need to accommodate change, and architecture products will therefore only have a temporary status. Architectures change because the environment changes and new technological opportunities arise, and because of new insights as to what is essential to the business. To ensure that these essentials are discussed, a good architecture clearly shows the relation of the architectural decisions to the business objectives of the enterprise.

The instruments needed for creating and using enterprise architectures are still in their infancy. To create an integrated perspective of an enterprise, we need techniques for describing architectures in a coherent way and communicating these with all relevant stakeholders. Different types of stakeholders will have their own viewpoints on the architecture. Furthermore, architectures are subject to change, and methods to analyse the effects of these changes are necessary in planning future developments. Often, an enterprise architect has to rely on existing methods and techniques from disparate domains, without being able to create the 'big picture' that puts these domains together. This requires an integrated set of methods and techniques for the specification, analysis, and communication of enterprise architectures that fulfils the needs of the different types of stakeholders involved. In this book, we will introduce such an approach. Architecture models, views, presentations, and analyses all help to bridge the 'communication gap' between architects and stakeholders (Fig. 1.1).

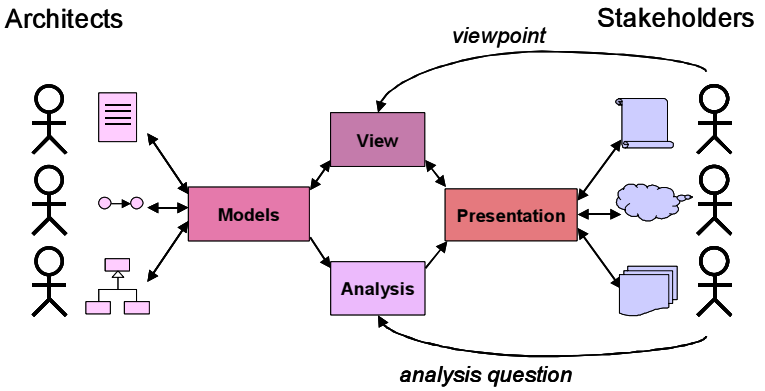

Fig. 1.1. Communicating about architecture.

1.3 The Architecture Process

Architecture is a process as well as a product. The product serves to guide managers in designing business processes and system developers in building applications in a way that is in line with business objectives and policies. The effects of the process reach further than the mere creation of the architecture product – the awareness of stakeholders with respect to business objectives and information flow will be raised. Also, once the architecture is created, it needs to be maintained. Businesses and IT are continually changing. This constant evolution is, ideally, a rational process. Change should only be initiated when people in power see an opportunity to strengthen business objectives.

The architecture process consists of the usual steps that take an initial idea through design and implementation phases to an operational system, and finally changing or replacing this system, closing the loop. In all of the phases of the architecture process, clear communication with and between stakeholders is indispensable. The architecture descriptions undergo a life cycle that corresponds to this design process (Fig. 1.2). The different architecture products in this life cycle are discussed with stakeholders, approved, revised, etc., and play a central role in establishing a common frame of reference for all those involved.

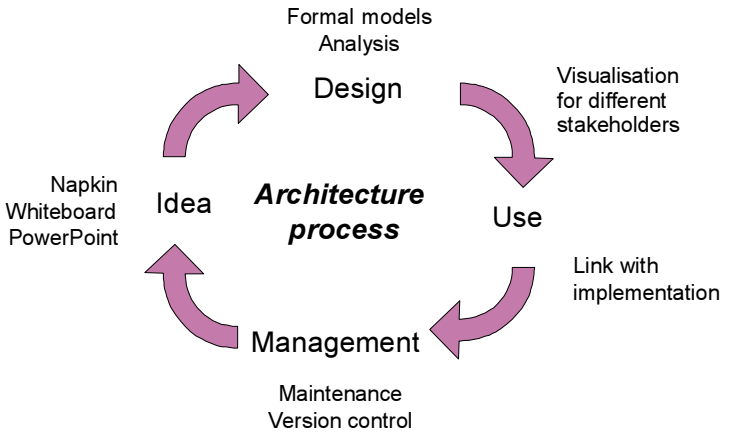

Fig. 1.2. The architecture description life cycle.

1.4 Drivers for Enterprise Architecture

It need not be stressed that any organisation benefits from having a clear understanding of its structure, products, operations, technology, and the web of relations tying these together and connecting the organisation to its surroundings. Furthermore, there are external pressures to take into account, both from customers, suppliers, and other business partners, and from regulatory bodies. Especially if a company becomes larger and more complicated, good architectural practice becomes indispensable. Here, we briefly outline the most important and commonly recognised internal and external drivers for establishing an enterprise architecture.

1.4.1 Internal Drivers

Business–IT alignment is commonly recognised as an important instrument to realise organisational effectiveness. Such effectiveness is not obtained by local optimisations, but is realised by well-orchestrated interaction of organisational components (Nadler et al. 1992). Effectiveness is driven by the relationships between components rather than by the detailed specification of each individual component. A vast amount of literature has been written on the topic of alignment, underlining the significance of both 'soft' and 'hard' components of an organisation.

Parker and Benson (1989) were forerunners in using the term 'alignment' in this context and emphasising the role of architecture in strategic planning. The well-known strategic alignment model of Henderson and Venkatraman (1993) distinguishes between the aspects of business strategy and organisational infrastructure on the one hand, and IT strategy and IT infrastructure on the other hand (Fig. 1.3). The model provides four dominant perspectives that are used to tackle the alignment between these aspects. One can take the business strategy of an enterprise as the starting point, and derive its IT infrastructure either via an IT strategy or through the organisational infrastructure; conversely, one can focus on IT as an enabler and start from the IT strategy, deriving the organisational infrastructure via a business strategy or based on the IT infrastructure. In any of these perspectives, an enterprise architecture can be a valuable help in executing the business or IT strategy.

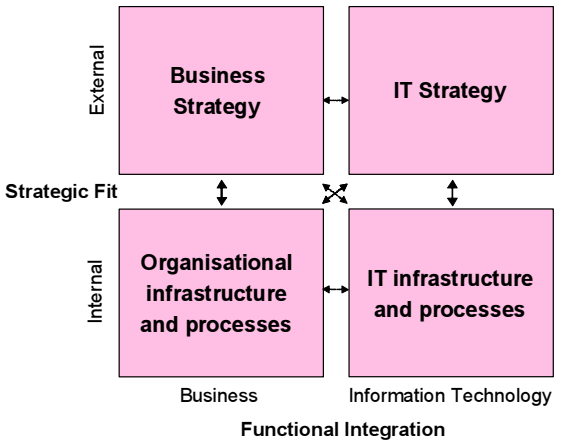

Fig. 1.3. Strategic alignment model (Henderson and Venkatraman 1993).

Nadler et al. (1992) identify four relevant alignment components: work, people, the formal organisation and the informal organisation. Labovitz and Rosansky (1997) emphasise the horizontal and vertical alignment dimensions of an organisation. Vertical alignment describes the relation between the top strategy and the people at the bottom, whereas horizontal alignment describes the relation between internal processes and external customers. Obviously, the world of business–IT alignment is as diverse as it is complex. In coping with this complexity, enterprise architecture is of valuable assistance.

In Fig. 1.4, enterprise architecture is positioned within the context of managing the enterprise. At the top of this pyramid, we see the mission of the enterprise: why does it exist? The vision states its 'image of the future' and the values the enterprise holds. Next there is its strategy, which states the route the enterprise will take in achieving this mission and vision. This is translated into concrete goals that give direction and provide the milestones in executing the strategy. Translating those goals into concrete changes to the daily operations of the company is where enterprise architecture comes into play. It offers a holistic perspective of the current and future operations, and on the actions that should be taken to achieve the company's goals.

Next to its architecture, which could be viewed as the 'hard' part of the company, the 'soft' part, its culture, is formed by its people and leadership, and is of equal if not higher importance in achieving these goals. Finally, of course, we see the enterprise's daily operations, which are governed by the pyramid of Fig. 1.4.

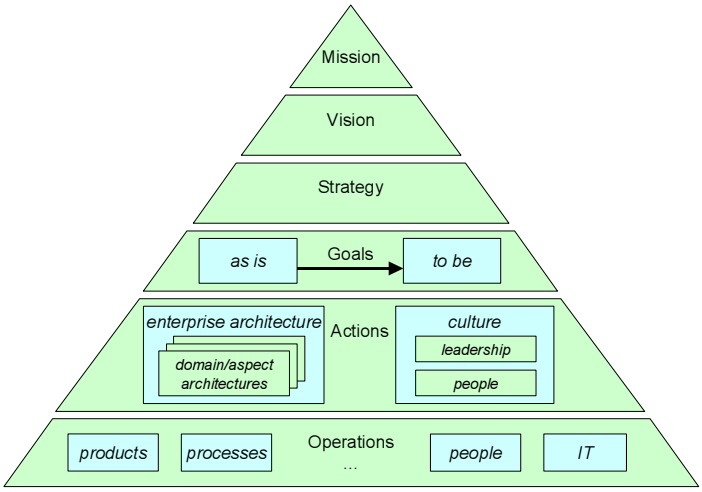

Fig. 1.4. Enterprise architecture as a management instrument.

To some it may seem that architecture is something static, confining everything within its rules and boundaries, and hampering innovation. This is a misconception. A well-defined architecture is an important asset in positioning new developments within the context of the existing processes, IT systems, and other assets of an organisation, and it helps in identifying necessary changes. Thus, good architectural practice helps a company innovate and change by providing both stability and flexibility. The insights provided by an enterprise architecture are needed on the one hand in determining the needs and priorities for change from a business perspective, and on the other hand in assessing how the company may benefit from technological innovations.

Moreover, in an increasingly networked world, no enterprise can focus solely on its own operations. To get to grips with the wealth of interconnections with customers, suppliers, and other partners, an enterprise architecture is a valuable asset. A prominent example of this is outsourcing part of a company's business processes and/or IT operations. For any sourcing project to be successful, it is paramount to have a clear insight into precisely what the activities and responsibilities are of all the partners involved, and what the services and interfaces between these partners are.

1.4.2 External Drivers

Next to the internal drive to execute effectively an organisation's strategy and optimise its operations, there are also external pressures that push organisations towards adopting enterprise architecture practice. The regula-

tory framework increasingly demands that companies and governmental institutions can prove that they have a clear insight into their operations and that they comply with the applicable laws on, say, financial transactions.

In the USA, the Clinger–Cohen Act of 1996, also known as the Information Technology Management Reform Act, demands that every government agency must have an IT architecture, which is defined as: 'an integrated framework for evolving or maintaining existing information technology and acquiring new information technology to achieve the agency's strategic goals and information resources management goals.' Section 5125 (b) of the Act assigns the Agency Chief Information Officer (CIO) the responsibility of 'developing, maintaining, and facilitating the implementation of a sound and integrated information technology architecture.' The US Department of Defense even requires all IT to comply with this Act, including that in weapons and weapons system programmes.

The Clinger–Cohen Act has been an important stimulus for the development of enterprise architecture as a discipline, not just in a government context, but in general. Although most European governments do not impose such strict requirements on their agencies, these architecture practices are making inroads in Europe as well.

The capital adequacy framework known as Basel II, endorsed in 2004 by the central bank governors and the heads of bank supervisory authorities in the Group of Ten (G10) countries, puts requirements on banking organisations with respect to their financial risk management, to promote stability in the financial world. The Basel II framework imposes strict regulations on banks in terms of risk measurement and management, with wide-ranging implications for both their organisations and their IT systems. The framework provides explicit incentives in the form of lower capital requirements for banks to adopt more comprehensive and accurate measures of risk as well as more effective processes for controlling their exposures to risk. This encompasses both credit risk and operational risk, the latter being defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. Given this wide scope and the detailed requirements on risk management, compliance with Basel II can hardly be envisaged without a sound architectural approach.

Another US act, the Sarbanes–Oxley Act of 2002, also has a major impact. This act, formally known as the Public Company Accounting Reform and Investor Protection Act, was drawn up in the aftermath of the Enron scandal, to force companies to adopt good corporate governance practices and to make company executives personally accountable. These accountability regulations make it very important for a company that it is clear

what the responsibilities of each employee are. IT systems must provide the necessary accounting information to be able to perform the audits required by the Act, and should enforce their users to have appropriate authorisation. Again, enterprise architecture may be of assistance in providing the necessary insight, and many companies are improving their architecture practice to conform to these regulations. And given that this Act applies to all companies that have their stocks quoted on the US stock exchanges, it has a worldwide impact.

1.5 Summary

Architecture is the art and science of designing complex structures. Enterprise architecture, more specifically, is defined as a coherent whole of principles, methods, and models that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems, and infrastructure. Architecture models, views, presentations, and analyses all help to bridge the 'communication gap' between architects and stakeholders.

Architecture is an indispensable instrument in controlling the complexity of the enterprise and its processes and systems. On the one hand, we see internal drivers for using an architectural approach, related to the strategy execution of an organisation. Better alignment between business and IT leads to lower cost, higher quality, better time-to-market, and greater customer satisfaction. On the other hand, external drivers from regulatory authorities and other pressures necessitate companies to have a thorough insight into their structure and operations. All of these drivers make a clear case for the use of enterprise architecture.

2 State of the Art

This chapter gives an overview of currently used methods and techniques in enterprise architecture. Naturally, this description is a snapshot, and we cannot claim to be exhaustive, since the field of enterprise architecture is evolving rapidly. However, it provides this broad overview of current methods and techniques to give the reader an impression of the advances in this field.

First, we position enterprise architecture relative to a number of well-known standards and best practices in general and IT management. Second, we outline the most important frameworks and methods for enterprise architecture currently in use. Next, we discuss service orientation, the most important architectural paradigm that has emerged over the last few years. Finally, we describe a number of relevant languages for modelling organisations, business processes, applications, and technology.

Based upon this state of the art, in the next chapter we will describe what we see as missing in current methods and techniques, and how our own approach tries to fill some of these gaps.

2.1 Enterprise Architecture and Other Governance Instruments

Enterprise architecture is typically used as an instrument in managing a company's daily operations and future development. But how does it fit in with other established management practices and instruments?

Here, we describe how enterprise architecture is positioned within the context of corporate and IT governance by relating it to a number of well-known best practices and standards in general and IT management, as outlined in Fig. 2.1. In the next subsections, we will treat the relation of enterprise architecture with some well-known management practices in each of these areas:

- strategic management: the Balanced Scorecard;
- strategy execution: EFQM;
- quality management: ISO 9001;

- IT governance: COBIT;
- IT delivery and support: ITI;
- IT implementation: CMM and CMMI.

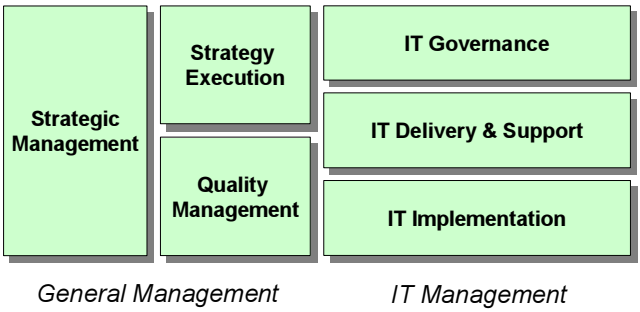

Fig. 2.1. Management areas relevant to enterprise architecture.

2.1.1 Strategic Management: Balanced Scorecard

Kaplan and Norton (1992) introduced the balanced scorecard (BSC) as a management system that helps an enterprise to clarify and implement its vision and strategy. Traditionally, management focus has strongly been on financial aspects. Kaplan and Norton argue that financial measures alone are inadequate to guide the future development of an organisation, and that they should be supplemented with measures concerning customer satisfaction, internal processes, and the ability to innovate.

The BSC therefore suggests to view an enterprise from four perspectives. The *Customer* perspective asks how the enterprise should appear to its customers, with measures like customer satisfaction. The *Financial* perspective is focused on the business value created by the enterprise, entailing measures such as shareholder value. The *Internal Business Processes* perspective looks at the effectiveness and efficiency of a company's internal operations, paying special attention to the primary, mission-oriented processes. Finally, the *Learning and Growth* perspective addresses the corporate and individual ability to change and improve, which is critical to any knowledge-intensive organisation. For each of the four perspectives the BSC proposes a three-layered structure:

1. mission (e.g., to become the customers' preferred supplier);
2. objectives (e.g., to provide the customers with new products);
3. measures (e.g., percentage of turnover generated by new products).

To put the BSC to work, a company should first define its mission, objectives, and measures for each perspective, and then translate these into a number of appropriate targets and initiatives to achieve these goals.

What is important in the BSC is the notion of double-loop feedback. First of all, one should measure the outputs of internal business processes and not only fix defects in these outputs but also identify and remedy the causes of these defects. Moreover, such a feedback loop should also be instituted for the outcomes of business strategies. Performance measurement and management by fact are central to the BSC approach.

If we look at the role of enterprise architecture as a management instrument, it would be especially useful within the Internal Business Processes perspective of the BSC. Many operational metrics can be tied to a well-defined enterprise architecture and various performance analyses might be carried out. However, enterprise architecture has a broader use. In the Learning and Growth perspective, a company's ability to evolve, to anticipate, and to respond to a changing environment is vital. To determine an organisation's agility, it is important to assess what the impact and feasibility of future changes might be. Impact analysis of an enterprise architecture may assist in such an assessment.

2.1.2 Strategy Execution: EFQM

Another important management approach is the EFQM (European Foundation for Quality Management) Excellence Model (EFQM 2003). This model was first introduced in 1992 as the framework for assessing applications for The European Quality Award, and was inspired by the Malcolm Baldridge Model in the USA and the Deming Prize in Japan.

The EFQM model has a much broader scope than ISO 9001 (see Sect. 2.1.3). It not only focuses on quality management, but provides an overall management framework for performance excellence of the entire organisation. The EFQM model consists of nine criteria for excellence, five of which are 'enablers', covering what an organisation does, and four are 'results', covering what that organisation achieves. These criteria and their mutual relationships are shown in diagrammatic form in Fig. 2.2. Leadership and Policy & Strategy determine the direction and focus of the enterprise; based on this, the People of the enterprise, its Partnerships & Resources, and its Processes make it happen; stakeholders of the results achieved are its Customers, its People, and Society in general; and these stakeholder results contribute to the enterprise's Key Performance Results, which comprise both financial and non-financial aspects. The EFQM model provides principles, measures, and indicators for assessing the per-

formance of an enterprise in all of these aspects, and these measurements are the basis for continuous learning, innovation, and improvement.

All this also points to the main difference between the EFQM model and the BSC: whereas the latter is focused on developing effective strategic management, the former concentrates on measuring and benchmarking the performance of an organisation with respect to a number of best practices. Both are complementary: the BSC helps to make strategic choices, and the EFQM model assists in continuous improvement necessary to execute this strategy.

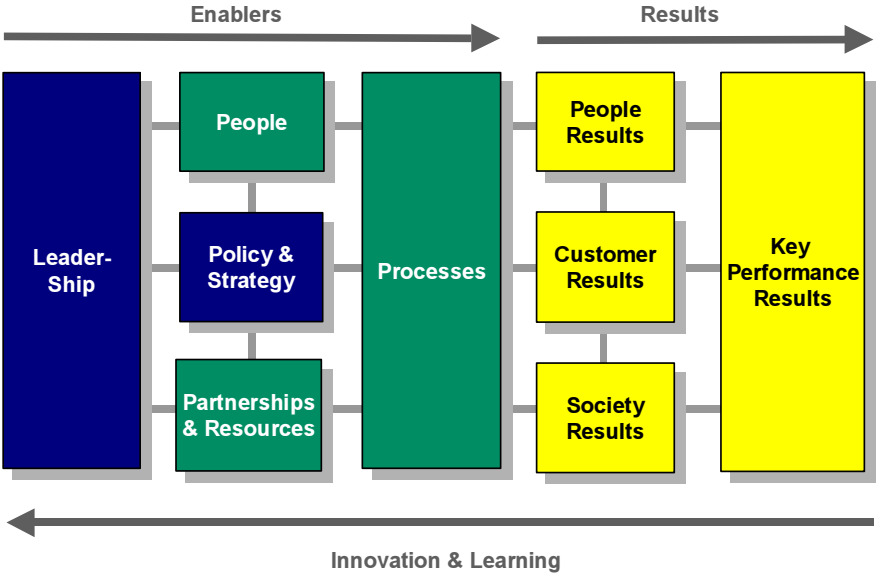

Fig. 2.2. The EFQM Excellence Model (EFQM 2003).

Positioning enterprise architecture with respect to the EFQM model, we view it especially as an important instrument for the Policy & Strategy and the Processes aspects. Based on its mission and vision, an organisation will determine the policies and strategies needed to meet the present and future needs and expectations of its stakeholders. An enterprise architecture is a valuable instrument in operationalising and implementing these policies and strategies. First of all, it offers insight into the structure and operation of the enterprise as a whole by creating a bird's-eye view of its organisational structure, business processes, information systems, and infrastructure. Such an overview is indispensable when formulating a coherent strategy. Furthermore, an enterprise architecture helps in developing, managing, and communicating company-wide standards of operation,