Enterprise Architecture Management and its Role in IT Governance and IT Investment Planning

1 Abstract

A comprehensive enterprise architecture management has strategic and operative aspects. Strategic tasks cover the identification of appropriate fields of activity for information technology (IT) investments in accordance with business strategy and portfolio management. Enterprise architecture management is cross-linked with other IT management processes and delivers the necessary information for a sustainable governance. The continuous analysis of the IT landscape, the deduction of measures for optimization and its controlling also belong to the tasks of architecture management. Standards for development and infrastructures are made, e.g. reference architectures and a "book of standards", whose implementation is overseen by solution architects throughout the operative architecture management.

2 Keywords

IT investment planning, IT governance, application portfolio optimization, strategic and operational architecture management.

3 Introduction

In many companies the role of architecture management amounts to nothing more than drawing up plans of the actual IT landscape and putting them at the disposal of target groups like IT management, project leaders, or IT steering committees. Sometimes there is also the role of a project- or solution architect, who designs appropriate architecture concepts for single projects. Thus, architecture management concentrates on the modelling of the actual status and, through project support, on the accompanying of change processes evolving from the business.

Yet, are there no other big opportunities for a more comprehensive version of architecture management?

- Could the actual model not serve as the basis for a target-oriented evaluation with which weaknesses in the grown IT landscape can be identified? (s. section 5.2, Figure 8)
- Could this as-is model not also serve a better controlling of a company´s IT investments? (s. section 5.2, Figure 9)
- Could there be standards and guidelines for transformation processes evolving from the business which guarantee an efficient development, maintanance, and safe operations? (s. section 5.3.1)
- Finally: is it not possible to cross-link the work of solution architects with planning tasks more tightly? (s. section 5.4)

By dealing with these questions this article tries to show approaches for the development of a more comprehensive enterprise architecture management

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4 Background

4.1 Enterprise Architecture Management

Enterprise architecture (see Figure 1) is a structured and coordinated collection of plans for the design of the IT-landscape of a company,

- which represent in various details and views,
- focused on special groups of interest (e.g. managers, planners, clients, designers)
- different aspects of IT-systems (e.g. data, functions, interfaces, platforms, networks)
- and their embedding within the system (e.g. goals, strategies, business processes)
- in past, present, and future specifications (NIE2006).

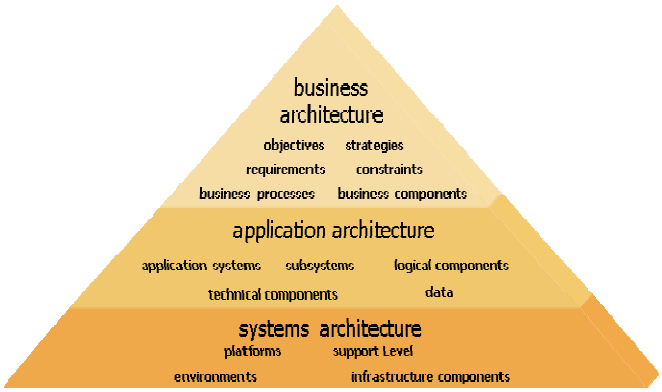

Figure 1: Enterprise architecture

Enterprise architecture management combines all those processes, methods, tools, and responsibilities which are necessary to make things work, to ensure that IT-systems do just what they must do – cost-efficient, smoothly, and elegantly. Simply said: architecture management is a process resulting in enterprise architecture.

Enterprise architecture management is the instrument with which to run the household: to cultivate application- and infrastructure landscapes, maintain and improve the value of existing assets, seamlessly integrate new components, adjust everything and make it work. "Housekeeping" is in high demand when budgets for new prospects decrease!

This continuous analysis of application- and infrastructure portfolios belongs to the tasks of an enterprise architect. For this the ongoing maintenance of the enterprise architecture model is indispensable. On this basis weaknesses can be identified and potentials for optimization detected, then measures can be taken and incorporated into change processes. For an enterprise architect this means to focus his work on these requirements and consider enterprise architecture as a means of IT-governance. In this context enterprise architecture

- must generate transparency and be understood by the management; be the RADAR of the Chief Information Officer (CIO) and a management information system,
- must be analytically useable and derive new information from known facts, must react on new demands, be flexible and, better still, actively prepare for changes,
- must open perspectives on the future; may not only be a static representation of the actual state, but must be the basis for scenarios and plans for the to-be,
- must be realizable and operatively effective, and with methods, organisation forms and architecture management tools strongly support the tranformation of strategy into operative reality,
- must be measurable and binding and an effective basis for the controlling and monitoring of strategic IT-measures (NIE2005).

An analogy will help us understand what the key steps are for construction and use of enterprise architecture. As for a journey we firstly need maps and documentation of the

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area we want to travel in. This would be the enterprise architecture which consists of elements of existing models: business process models, organization models, IT-product lists, IT infrastructure catalogues, and the like.

As soon as we have the maps for our travel area we want information on places of interest, hotels, road conditions. Likewise, an enterprise architecture displays its true value if not only seen as a static picture but if actively used for analyses and as the management information system of the CIO.

The analysis of our maps is followed by the planning of the route. The analysis of enterprise architecture, too, must be followed by the development of planning scenarios which address detected weaknesses and show problem solutions. The "to-be image" and transformation planning are then incorporated into the project portfolio and program management to realize the strategic plan. Within the implementation of the transformation plan enterprise architecture functions as a governance instrument.

An initial version of the enterprise architecture emerges from a project with a duration of 3-6 months and must then be imported into an on-going architecture management process.

An enterprise architecture designed for immediate use in the context of an IT-governance program thus originates from a cycle of documentation, analysis, planning, implementation, and control (see Figure 2).

An enterprise architect focuses on the continuous development and optimization of the application- and infrastructure landscape oriented at the business strategy. On the one hand architecture management as an enabling process supports the demand processes of order- and portfolio management. On the other hand, as a governance instrument it has standardizing and controlling effects on the supply processes of project-, program-, and service management.

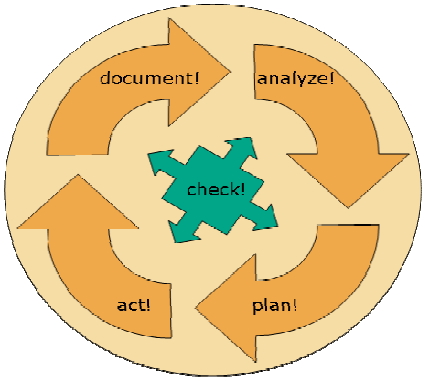

Figure 2: The enterprise architecture cycle

Architecture management is responsible for the planning, development, use, and maintenance of enterprise architecture. It organizes associated processes, controls and monitors the development. Therewith architecture management describes procedures for the close interlocking of business, IT-applications, and IT-infrastructure.

Architecture management is concerned with

- the strategic processes for documentation, analysis, and planning of enterprise architecture
- the operative processes for the consistent implementation of enterprise architecture, the conformity check against reference architectures, and defined infrastructure "shopping carts",
- the definition of documentation procedures,
- analysis- and planning methods,
- evaluation procedures,
- tools and their integration into the toolbox,
- procedural methods and responsibilities,
- key figures and controlling.

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Architecture management has both an operative and a strategic dimension. Documentation, analysis, and planning of enterprise architecture on a strategic level must result in measures which are to be operatively implemented into projects or line functions.

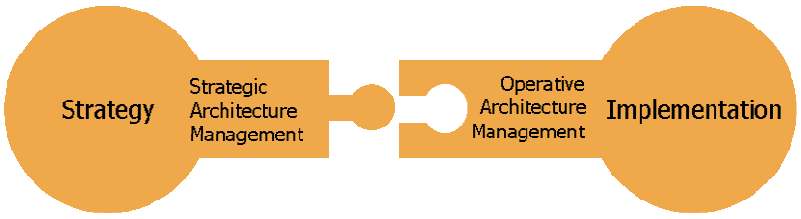

Figure 3: Operative and strategic architecture management

Here, too, architecture management must give support, e.g. develop reference architectures in the fields of application- and system architecture, monitor their use and implementation, actively help, get things started.

4.2 IT Governance

Searching for definitions of the term Corporate Governance, we find (e.g. in Germany's Corporate Governance Code) (DGI2003) that corporate governance contains essential legal directives to the direction and supervision of listed companies and defines international and national standards of good and responsible business management. The board of directors is responsible for the appropriate risk management of the enterprise Further- and develops the strategic alignment of the business and provides for its implementation.

Good and responsible management, strategic focus of the company and its implementation, appropriate risk management and –controlling: the top managers of our companies are committed to these principles. Facing this list which IT-manager would not react enthusiastically if asked for his contribution to the realization of these principles? And surely he would indicate that information is the key to success of the corporate governance program, that all kinds of management need transparency, that each implementation of strategies needs a clearly defined course of action developed on the basis of all pieces of information, that risk management and –controlling can not be realized in the dark but only in the light of a transparent basis of information. And he would finish his remarks by adding that it is no other than IT which, with the help of its information systems, produces the light without which no controlling, navigation, monitoring or correction of course would be possible.

To follow governance principles also means to make informed decisions. Governance presupposes planning, organization, controlling, and monitoring – in short: management – on the basis of comprehensive information.

But what exactly does the IT department do to support the other specialist departments in their planning-, controlling-, and monitoring tasks and to contribute to the implementation of corporate governance principles? It delivers precisely this comprehensive information: with data warehouse systems, business intelligence suites, management or executive information systems. The management of the departments use just these systems to improve the business, save costs, open new markets, develop or place new products. With the information provided by these systems they support good and responsible corporate management, the strategic orientation of the company and its realization, an appropriate risk management and –controlling.

Let´s have a look at following example: On the basis of their key figures the board of management finds that one product area does not operate profitably. The departmental management is required to reduce costs and increase sales. What are they going to do to meet these requirements? The first action will probably be an analysis of the current

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status to generate a detailed list, e.g., of the distribution of costs across the departments, or of the series of operations, or to thoroughly understand the distribution of costs across the distribution channels. The figures for this analysis are obtained from the information systems of the company. IT-systems will likely play an important role in the controlling of the measures derived from the analysis.

Thus IT plays a significant role in corporate governance issues. This is often demonstrated by legal specifications such as the Sarbanes Oxley Act, Section 404 (SAR2002) which make high demands on internal company controlling and therefore on the IT. But what about governance of the IT department itself?

Let´s have a look at another example: The management board decrees cost savings which for the IT department mean a budget decrease of 15%. Now our CIO is in a similar situation as his colleague in aforesaid example. Which IT system can the CIO use to generate an initial analysis as a preparation for this strategy? Where do we find information on IT applications, IT infrastructure components, their dependencies on the business (organization units and business processes), and which in addition to this identifies and makes analyzable the costs, risks, ongoing projects and available IT staff? Does the IT department deliver the key information for the implementation of corporate governance for all other company areas but has no own tools to develop and control IT governance processes?

Where do we find the management information system of the CIO? Where is the model which documents IT assets with all their dependencies, effects, and cross-references in a way that they are transparent, analyzable, and can be planned? We find the answer to these questions in enterprise architecture. This is the model which documents and networks all IT assets in the necessary form; enterprise architecture provides support for analysis and planning indispensable for an effective IT governance.

The installation of an IT governance program asks for measures on three areas of activity: processes, organization, and information (MAN2007). Typical topics of these areas are:

Process

- Networking of IT management processes
- Business–IT Alignment
- Workflow
- Result types and templates
- Quality Gates
- Ways of decision making (monarchic, dual, feudal, or federal structures)
- Stakeholders
- Use Cases

Organziation

- Bodies
- Roles (task, competence, responsibility)
- Escalation- and steering committees
- Communication (acceptency, commitment, perforation)

Information

- Goals and strategies

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- Focus (scope)
- Assessment and benchmarks
- Transparency (dependencies and effects)
- Information model and tool environment
- Weakness analysis (e.g. heterogeneity, complexity, cost drivers, value creation)
- Standards and reference architectures
- Principles, compliance rules & policies
- Decisions
- Metrics and KPIs

All three areas of activity of IT governance are addressed and supported by the implementation of an enterprise architecture model and the development of an „enterprise architecture practice" within the company.

The IT Governance Institute (2000) defines IT government as follows: "IT governance is under the responsibility of the board of directors and the management and is an integral part of company management. IT government consists of leadership, organization structures and processes which ensure that IT supports the company strategy and goals. IT governance ensures that

- the expectations on IT are fulfilled,
- IT-resources are continuously planned, controlled, and optimized,
- the performance of IT is measured
- and risks are minimized."

So this is about effectivity, efficiency, and security. To do the right things correctly and safely. Enterprise architecture provides the necessary overview, the understanding for the relation of company goals, business processes, technical requirements, projects, IT applications, IT platforms, and IT infrastructure. It interconnects these elements, demonstrates effects and dependencies, documents costs, risks, availabilities, stability, and a lot more attributes.

But enterprise architecture can do significantly more: it can not only document a given situation, but also delivers procedures for the analysis of weaknesses. Where are the cost drivers in the application landscape? Where are redundant development technologies? Where the support of business processes is inadequate or redundant? This as-is analysis is the basis of an effective IT governance process and, as part of corporate governance, indipensable.

What is the next step after the analysis? It is the planning and implementation of measures. Enterprise architecture helps us plan, it is the basis for the development of planning scenarios in which alternative ways of IT application portfolios are evaluated. Enterprise architecture therefore is a central instrument of any kind of governance program. How could we lead, direct, and control without knowing where we stand, how the route looks like and where it leads to?

4.3 IT Investment Planning

The point of IT investment planning is to direct IT budgets onto the right areas, i.e. to ensure the effectivity of investments. Finance management supports IT investment planning by defining, administering, and monitoring IT cost centres. From our experience IT

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investment planning is often equated with project portfolio management, which - usually annually - balances business requirements with the budgets available for the projects. To this end projects are e.g. evaluated regarding their monetary and strategic importance for the business. The monetary importance is derived from the business case of the project, the strategic significance is derived from the support this project provides for the actual business strategy, e.g. an impact on the improvement of the market position in relation to the competition.

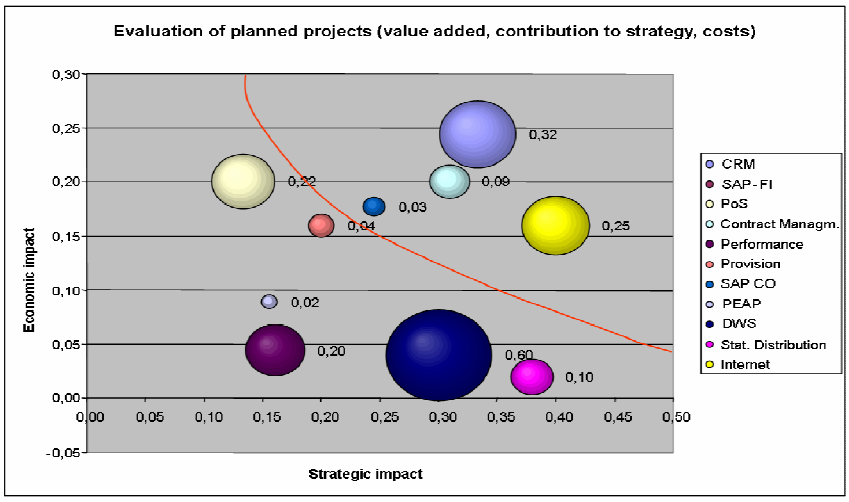

Figure 4: Project portfolio (example)

On this basis projects are positioned within a portfolio, for example (see figure 4), where the expected project costs are indicated by the size of the symbol, too. The allocation of available budgets on projects which are economically and strategically important results in a "red line" and the assignment of those projects which are above/right of this line in the portfolio.

The term IT investment planning used here has further meaning, though. The IT budget as a whole covers significantly more than just the part which is available for new projects and controlled purposefully and according to business strategy by the project portfolio management.

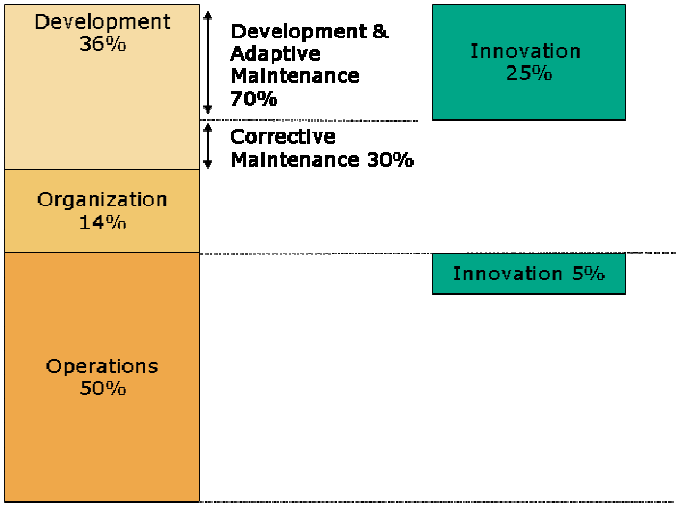

Figure 5: Distribution of IT costs

An examination of the distribution of costs of big IT areas helps to find out how big the share of the whole IT budget needed by portfolio management is to ensure a target-oriented investment to the benefit of the business.

Figure 5 shows an exemplary distribution. As in recent years for many economic fields a significant reduction of new developments as opposed to maintenance has been obvious, this example on development assumes 30% corrective maintenance and 70% for new developments and adaptive maintenance.

If we assume that the business invests a share of 10% on innovations of technology projects, for example, we find that only about 30% of the whole IT budget is spent on real innovations. Only this share is used to increase the value of the IT for the business.

Portfolio management concentrates on the evaluation of IT investments in new projects and sometimes also directs part of investments into adaptive maintenance. This then

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depends on the scale of maintenance activities. Often enough, though, the controlling of adaptive maintenance, i.e. the adaptation to changes of business requirements or legal conditions, is done by dedicated maintenance activities.

Usually, investments in corrective maintenance and the operation of the existing landscape are not included into investment controlling through portfolio management or similar concepts, but are seen as must-investments. But is it not especially this grown landscape which is full of technical challenges and therefore a true cost-driver?

5 Enterprise Architecture, IT Investment Planning, and Governance

5.1 Primary Objectives

How can we ensure that while planning our IT initiatives we address the right fields of activity, that means pushing those activites which optimize the contribution IT to the business value? How can we ensure that our IT systems, our development and operation processes run optimally, i.e. cost-efficient, well-performing and without friction? How can we ensure that the expectations on IT are continually and safely met, namely that processes are continually supervised, measured, and monitored?

The subject of enterprise architecture managment is to identify the right fields of activity, to support them appropriately, and to continually accompany the process and monitor it. The overall objective of enterprise architecture management: to do the right things efficiently and reliably (see figure 6).

Enterprise architecture creates transparency and controllability of IT transformation processes. It identifies the proper IT services by expert knowledge and technically driven application portfolio management and directs IT investments for maintenance and optimization into the correct fields of activity ("housekeeping"). To do this efficiently heterogeneous structures within the application- and technology portfolio must be consolidated and successful solutions must be standardized and re-usable. Governance requires reliability and accountability, transparency of IT assets and –processes. This serves risk management and compliance, increases the safety of the development and supply of applications. The use of enterprise architecture management therefore can be evaluated by its impact on the dimensions effectivity, efficiency, and reliability of IT.

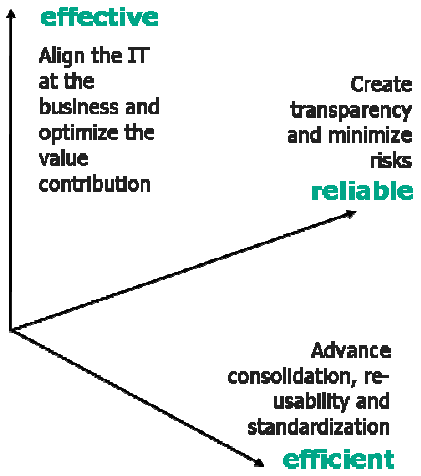

Figure 6: Use of enterprise architecture management

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5.2 Finding the right fields of activity

An important task of architecture management is to design and cultivate the as-is model of enterprise architecture regarding purposes of analysis and planning in a sufficiently current status. The analysis of the actual landscape indicates potentials for optimization and is thus the basis of the application portfolio. There are a number of figure types for the representation an actual model of enterprise architecture. Figure 7, e.g., shows a so-called cluster map in which application systems and their interfaces are graphically presented. Such displays can highlight many enterprise architecture attributes relevant for analysis, for example in terms of colour. Often this is called "cartography" of enterprise architecture (MAT2004). Costs, availabilities, business criticality, and compliance can be examples for such attributes.

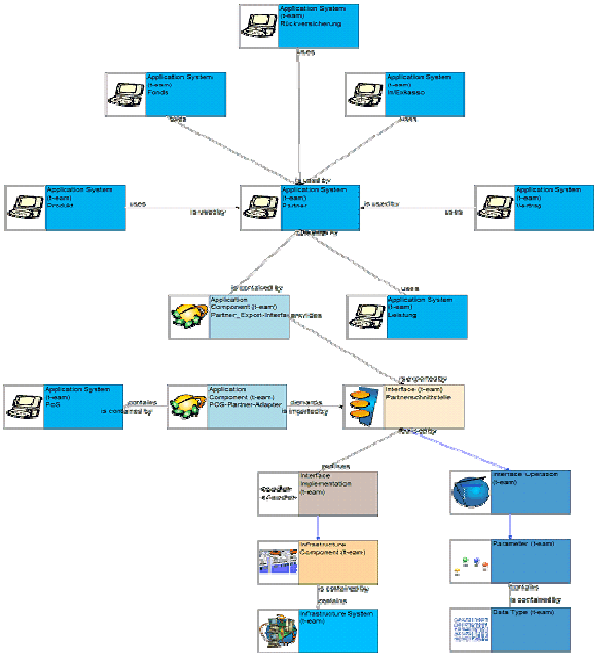

Figure 7: Cluster map

Besides cluster maps there are other forms of representation which allow to establish direct relations to the supported business. A well-known sample for such a form of representation is the "business support matrix" (see figure 8), which e.g. juxtaposes the main processes of the organization with the main services provided by the organization within a matrix (MAT2004, NIE2006). The supporting applications are then entered into the matrix and may be coloured regarding cost of production or maintenance, availability, compliance or indicating white spots, for example. Often instead of the main services organization units or locations are juxtaposed with the processes.

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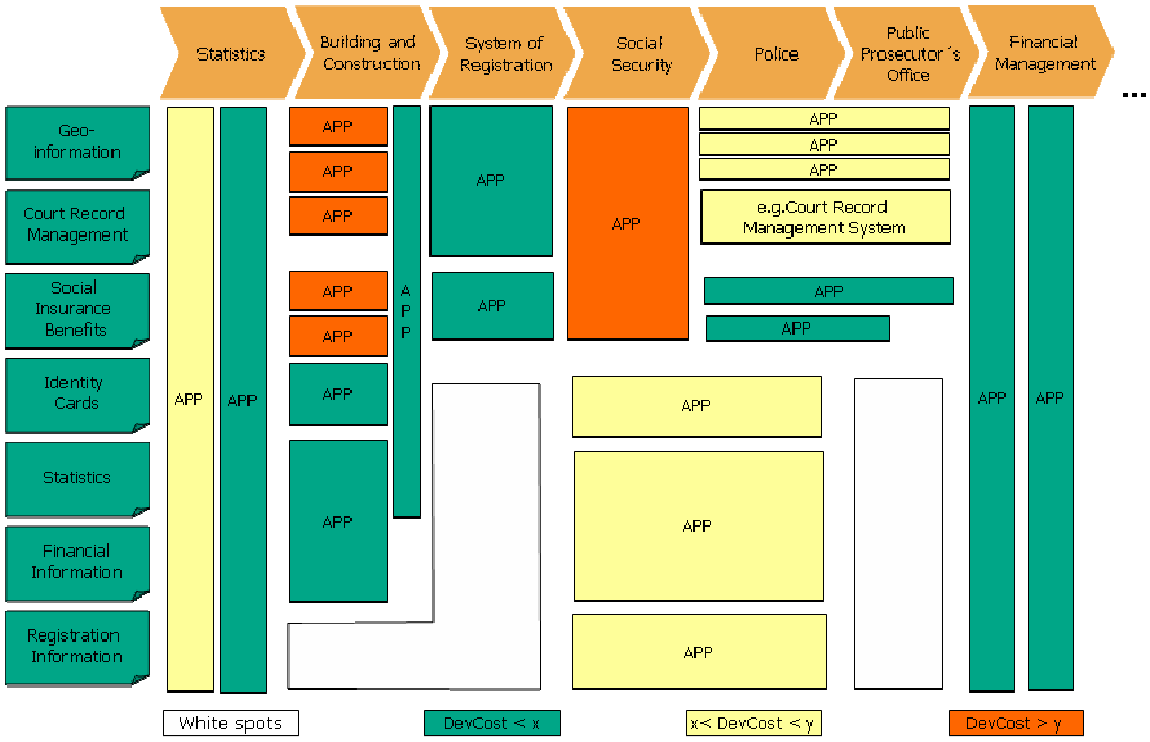

Figure 8: Business support matrix (example: public administration)

The business support matrix offers the possibility to set application systems in direct relation to supported business processes and their importance for the business, or to services and their volume share. With this it becomes possible to operationalize the IT support for the business. For the analysis of enterprise architecture this form of representation has been well tried. The placement of application systems within such a matrix allows the analysis of costs, of the technical coverage regarding gaps or redundancies, and to examine interfaces regarding complexity or heterogeneity.

The placement of application systems in a structured application landscape is based on references between the architectural levels business and application. Application systems support business processes and the handling of products. The visualization of a product/process matrix already enables some evaluation, but even more can be achieved by a documentation of the application landscape in a data bank and/or a special tool for the modelling of enterprise architectures.

Such a documentation of the application landscape is an efficient basis for analyses and sets the stage for the optimization of existing enterprise architecture. The visualization of the application landscape is also prerequisite for navigation and communication. In projects, steering committees, coordination meetings: everywhere a visualization is necessary. Our daily practical experience with projects shows that such visualizations are often drawn up according to situation, but rarely comprehensively across different areas of interest, and not combined with necessary maintenance and adaptation processes.

As soon as the objects in our application landscape are mapped one can begin with the evaluation regarding costs, redundancies, gaps, and breaks. Did we analyze the number of interfaces, run scenarios? Do we really use the data of the application landscape or do we merely look at it instead of into it?

The representation of the application landscape needs attributes. If the objects within the enterprise architecture have no attributes the analysis of the application landscape will not result in a proper statement. Costs, strategic impact, dependencies, performance indicators, efforts, age, capacities – all these are sets of information required for a com-

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plete enterprise architecture, and to be able to analyze them throughout the references in the application landscape.

An application- and infrastructure landscape is not only a sketch or map. It is alive, has attributes, is subject to change, and can provide a lot of useful information.

This requires a planned development. Which references do we need? Which evaluations do we want to make and with which actuality? How often? Which key figures shall be derived thereof and how shall they be condensed? How will the application- and infrastructure landape be maintained and kept up to date? Who is responsible, partaking, coordinating?

These questions are worth answering, because the outcome is the key to the real use of enterprise architecture. Most companies have models galore but can not use them because they are neither aligned nor consolidated; they are semantically and syntactically incompatible and can not be compared.

To design an application landscape by answering above questions requires a syntactic and semantic alignment, a synchronization of the models, and referencing. Sources for the design are existing application portfolios and sketches of the application landscape.

When the as-is model is developed in this way the coherence becomes visible and a thorough analysis of weaknesses can be made. Such an enterprise architecture can, e.g., also present the context of an IT financial management and therewith show how the costs for IT support are aggregated through several levels (see figure 9). Thus the basis for a complex IT investment planning is made.

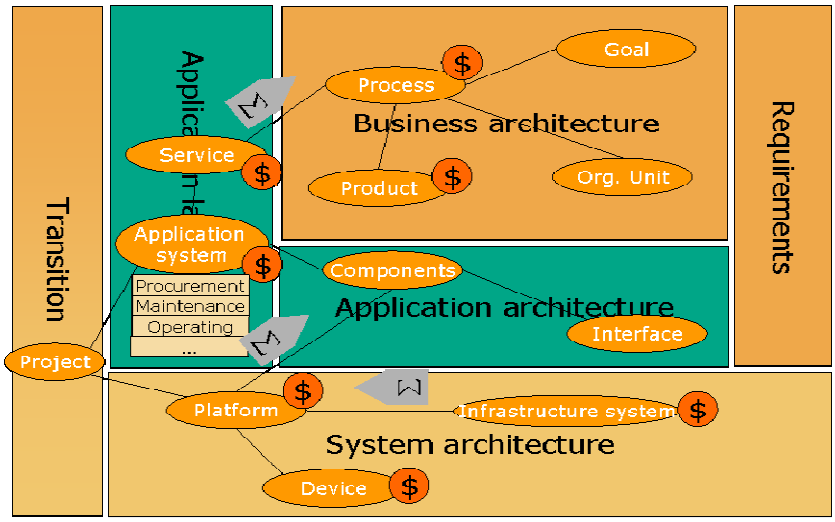

Figure 9: Finance management in enterprise architecture

To use the information on costs for the cartography of application landscapes allows, e.g., the identification of hotspots in which high maintanance costs occur regularly. This perspective (see figure 10) allows the alignment of IT investment procedures with the strategic areas important for the business: are maintenance investments made exactly for those fields of activity which are presently important?

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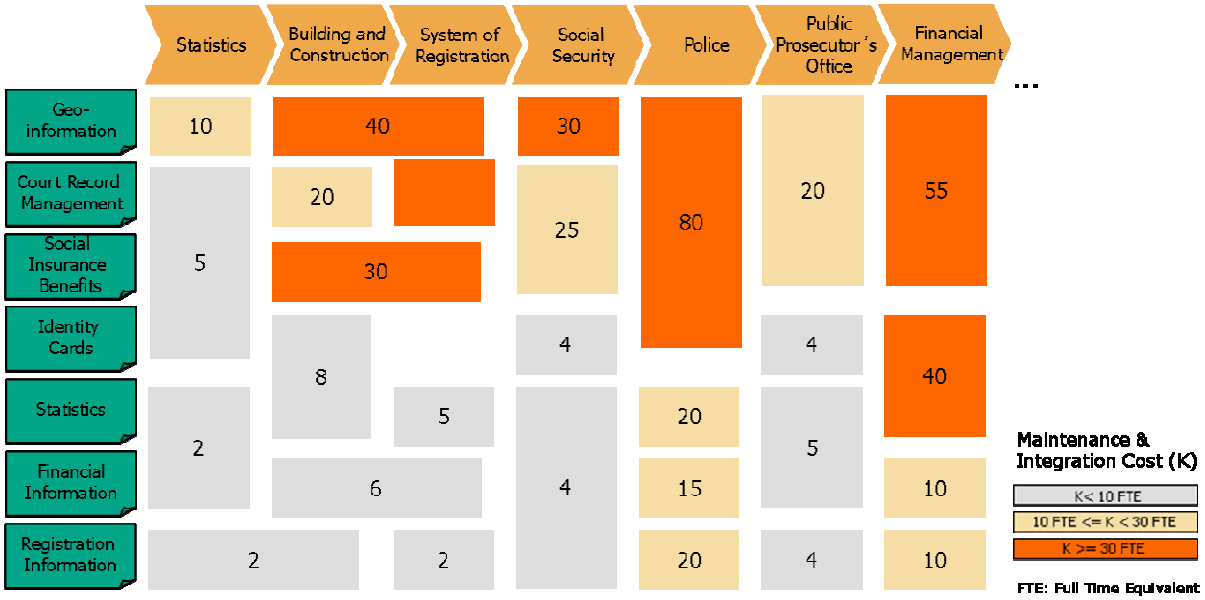

Figure 10: Maintenance & integration costs

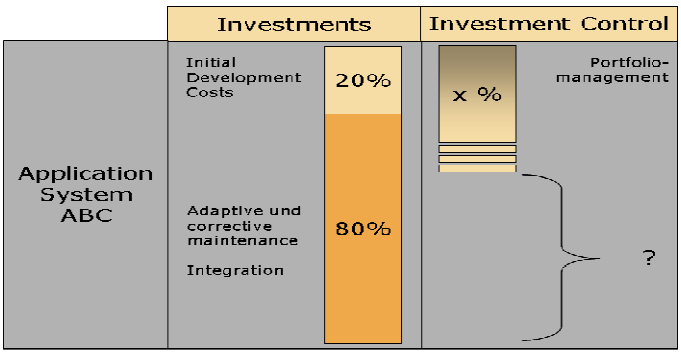

Figure 11: Lifecycle costs of an application system

Considering that only about 20% of total application costs throughout the complete life cycle are spent on the initial development, but 80% on current maintenance and especially integration, this question becomes more important (see figure 11)

Can we ensure with the help of known and existing mechanisms such as IT portfolio management that IT investments are made in coherence with the business strategy?

Portfolio management as the interface between business and IT is responsible for the decision from which projects the company derives the most benefit – and which therefore must be implemented. Can portfolio management ensure that IT investments are made for those fields of activity which support the strategic direction of the whole company?

The following situation shall serve as an example: the annual evaluation of the project portfolio defined n new projects. Each of these projects has calculated its own individual business case, is conform to the strategy, and was allocated with a budget. In a grown application landscape we can presume that each of the n projects must deal with integration issues with other existing systems. Let´s say that the application system ABC shown in figure 11 will have to be integrated into m projects (with m <= n), and that each project must invest a share of its budget into the integration with ABC. The investment for the integration of ABC is thus the result of $I_{ABC} = \sum P_i$ (0 < i <= m). The total investment of all m projects is ensured by portfolio management. But all these projects invest parts of their budgets into application ABC and thereby contribute to the 80% maintenance and integration costs shown in figure 11.

Portfolio management did not assess investment I_{ABC} against system ABC but against the actual importance of the m projects for the business. Therefore investment I_{ABC} is only justified through the business cases of the new projects. But are we really willing to con-

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tinuously invest in application ABC? Does the application fit into the landscape? Maybe these investments are necessary because ABC uses a non-standard technology, resulting in higher integration efforts?

Portfolio management does not question the quality of the grown landscape and the consequences for new projects and adaptive maintenance resulting from this. Could we not strongly decrease the costs for operation, new projects, and mainanance by a continuous optimization of the application and infrastructure landscape, and therewith significantly increase the budget for innovation?

We have already looked upon the role of architecture management in the context of housekeeping. Why is housekeeping so important? In many economic sectors IT has become a primary means of production: banks, insurance companies, energy brokers, and telecommunication companies produce their services and products almost exclusively with IT; logistics, transportation and trading firms highly depent on IT.

Thus the grown application- and infrastructure landscape has an immense value for a company and must be taken care of and maintained just like real assets and means of production. This facility management for the IT department requires planning and controlling: do we still invest in the proper IT production facilities, or do we maintain applications, interfaces and development technologies for products which are no longer the focus of our business strategy? Do we have badly adapted or developed IT systems which disturb smooth business operations or prevent the establishment of new systems and thus have a negative impact on the time to market?

5.3 The Right Support of the Right Fields of Activity

5.3.1 Development of standards

As hotspots with high maintenance costs indicate to the enterprise architect to examine the compatibility of the technology used in these hotspots with other parts of the application- and infrastructure landcape, hotspots with high development costs indicate development tools which are inefficient, e.g. due to a lack of maturity or bad support.

Whenever these hotspots belong to domains (e.g. cross-points of business processes and products) which are business crucial and distinctive an enterprise architect is under high pressure to act: standards must be established which ensure efficient and effective activities for development, maintenance, and operations.

Often standards are generated bottom-up: a book of standards is developed which lists products and technologies for development, maintenance, and operations. Sometimes we find additional information on products, e.g. life cycle attributes, which tell us how long a specific product is usually supported. It is even more effective to classify products regarding the level of support they are given by the company. To determine technological cornerstones such levels of support or standard levels are defined for available or planned components of the book of standards (see figure 12):

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- Level A is supported as production- and development environment.
- Level B is supported as production environment. Standard software systems which require components of B can be operated. Integration of standard software into the existing landscape is possible.

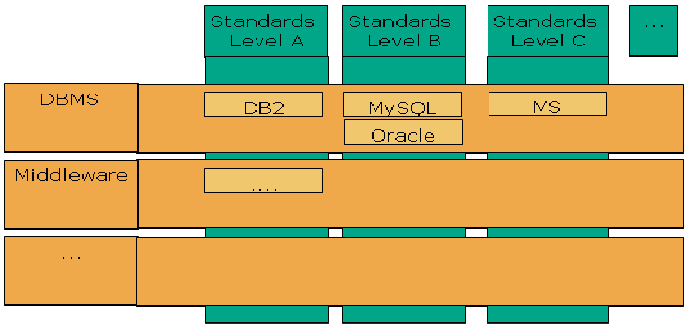

Figure 12: Standard Level

- Level C is only supported as production environment. Standard software only conform with level C components can be operated (perhaps with support of external partners), but must be run on its own and can not be integrated into the existing landscape.

There are quite a few more standards, though (see figure 13):

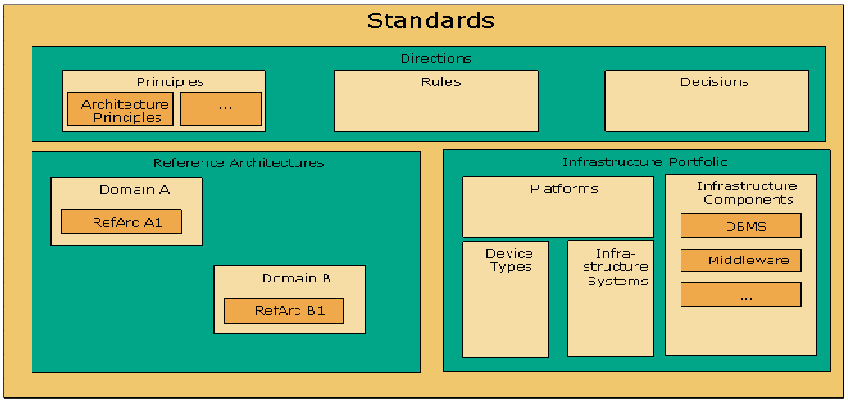

Figure 13: Standards

- Superior standards: principles, rules, and IT decisions
- Standardization of applications by an infrastructure portfolio ("shopping cart") in the book of standards
- Standardization of development and supply of applications through reference architectures

The following example of reference architectures shall help to clarify the use of standards in architecture management.

5.3.2 Setting standards through the development of reference architectures

Hardly any company can keep open all options, can support all conceivable principles, master all possibilities of software architecture design: that would be too complex and expensive. It makes sense to have guard rails, make commitments, exclude options. It makes more sense to define reference architectures. A reference architecture is a construction pattern for software systems which defines principles for

- the creation of components and levels and their responsibilities,
- the vertical and horizontal structure of a system,
- the design of interfaces and their intercommunication,
- the integration of surfaces,
- the integration of components and services, e.g. error management, reporting, workflow.

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A specification of a reference architecture contains the resources necessary for its implementation such as the infrastructure for development, testing, and operation, as well as skills and procedures (e.g. data saving, deployment). Heuristics to fulfill functional and non-functional requirements and for development costs, dates, and risks also belong to a reference architecture.

Usually there are several reference architectures for a company. The popular vision of just the one target or reference architecture for a big company could in practice not be realized. The requirements on back office systems, mobile distribution support, web applications, production controlling or dispositive systems are too diverse. Also, the business scenarios which serve as the basis for system development differ too much. Usually several reference architectures are needed because just one can not serve all business areas, products, and distribution channels of a complex company. So do not keep open all kinds of options for development but use an instrument of defined reference architectures which is target oriented at the business!

A reference architecture delivers contruction plans for new systems. To define such construction plans one can fall back on patterns for software development; reference architecture itself is a pattern for the design of whole systems. To this belongs the determination of development technologies to be used and of tokens from the shopping cart of system architecture.

Reference architecture is an extract of the complex diversity of all thinkable principles for the design of software systems. Thus a reference architecture narrows down the necessary expert knowledge, limits the heterogeneity of development-, testing- and production environments. Once there is a commitment to its introduction, reference architecture provides an important contribution to ensure an efficient development and supply of applications.

Reference architectures are not developed out of the blue but are typically derived from existing developing lines within the company – usually while an enterprise architecture is built up. "Development line" refers to construction principles, development tools, and infrasctructure used in a project or application system or groups thereof. The existing development lines are examined regarding common technology and construction principles, and differing criteria.

To derive reference architectures from development lines is necessary because reference architectures need experience values. There is no reference architecture without heuristics! We need this experience to check architectural drafts and choose the reference architecture appropriate for a concrete task, and to be warned in time if threshold values, e.g. of transaction rates or availiabilities, are exceeded. We also need these heuristics to assert governance into the operative environment. Also, conformity checks are based on experience values.

Each reference architecture is tied to an operational scenario, for example mobile sales support, development of internet portals, back office services. A reference architecture describes a technical solution pattern for such an operational scenario and defines the principles on which a company builds and supplies application systems which support this operational scenario. From a technical perspective the term "architecture domain" is often used to describe the fields in which the construction principles necessary for a specific operational scenario are specified in a reference architecture.

How are operational scenarios identified? Many companies do this with a sense of proportion and good knowledge of the technical incidents which result in requirements on IT. Often an organisation chart of the departments is helpful. One procedure for the methodical derivation of operational scenarios is based on the juxtaposition of major processes and products of the company. In this matrix fields for operational scenarios can be easily defined and analysed.

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Reference architectures and operational scenarios are the most effective instruments in terms of convergence. The step-by-step convergence of business and IT and the reduction of heterogeneity and complexity require governance extending to the operational level. The things defined in an application portfolio are operatively implemented by the use of reference architectures. Operational scenarios and their reference architectures generate the basis for compliance checks.

Usually, with the outlined procedures, reference architectures providing the necessary heuristics are derived from existing development lines. But reference architectures can not always be de deduced from existing development lines, sometimes new ways have to be found. The standardization of reference architectures must not slow down innovations. When a reference architecture does not become obvious, an architecture planning must be carried out within the framework of the project or a pilot study. In the context of this architecture planning and based on sytem requirements and conditions several architecture scenarios must be developed and evaluated. In these cases new development lines are drawn, assumptions are made and supported by prototypes, and pilot projects will be made.

If a new development line proves successful it will enable the fulfillment of expectations, because a new reference architecture will emerge from this. Only after a successful implementation of at least one system a reference architecture for this operational scenario can be derived, and the experience with it is then taken into account for the application portfolio. This is why one should always refer to experience when developing reference architectures. One needs information on volumes, performance, availability, reliability, scalability, number of users, and security. To a certain extent the experience gained out of one´s own company can be used, too. Information exchange with other users, architecture management days, congress reports, and benchmarking can be the sources. Yet, for a reference architecture heuristics are imperative!

There are other sources for the development of new reference architectures, new technical impulses, and innovation:

- While examining project specific architecture drafts an architecture board finds gaps in the builiding of reference architectures and orders or initiates the testing of a new development line, which is then, after a possible modification, included into the number of eference architectures.
- The planning of strategic application portfolios leads to the realization that there are fields to which no reference architecture can be applied. In this case, too, the trying out of a new development line and its inclusion into the number of reference architectures must be initiated.

Both cases presuppose that there is a department in charge of the project. Any architectural development solely motivated by technology remains unfocused.

The examples show that reference architectures play a role in various contexts of architecture management processes:

- Architects of operative software make use of reference architectures as patterns for project work.
- Within the framework of evaluating architecture drafts – be it in a project, review, or by an architecture board – reference architectures serve as a measure. Without them there would be no reference figures for the usefulness of architecture drafts. Only a reference architecture which has already proven its value for a defined and documented number of requirements, e.g. quantity structures, allows us to evaluate another architecture draft.
- Reference architectures are used in the context of application portfolio planning to determine the kind of "building" for a lot which is empty or in need of refurbish-

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ment. Thus the prevalence of reference architectures can already be specified during the planning of application portfolios. Then requirements e.g. regarding needed qualifications can be derived, and human resources development and staff planning are provided with another planning basis.

- The specification of reference architectures is accompanied by the determination of components of the "shopping cart". The total of all infrastructure components needed for the implementation of reference architectures is the actual shopping cart for development and production. Development lines no longer enforced eventually need further infrastructure components, but these find production support only until the development line is ended. Other infrastructure components may be supported with the productional help of external partners.

Reference architectures belong to most powerful instruments of enterprise architects: they deliver standard patterns for the controlling of new developments and maintenance. They are based of efficient development technologies based of a set of tools reinforced in the infrastructure portfolio. They deliver the initial acceleration for development projects and provide guidance for the solution architects. Also, they define a standard which can be checked on the conformity to the architecture.

5.3.3 Controlling of the standardization process

The controlling of the standardization process prevents the enterprise architect from slipping into the role of a policeman enquiring into the conformity with regulations which are inadequately specified, communicated, and supported. How can we focus the process of development and maintenance of standards and ensure that the necessary standards for development, maintenance, and operation are available for precisely those areas in which IT investments result in a high contribution to the business success? Especially in big IT organisations with many and diverse requirements the enterprise architect in charge is faced with the question which areas he should focus on. Ideally, standards are created for exactly those functional domains which are currently important for the business strategy, and which then can ensure an efficient development and efficient operations.

An example shall clarify this: Let us assume that a public IT service provider pursues the strategy to gain market leadership in terms of providing statistics. The objective is to create a statistics department which later on shall act as a service provider for several public organizations. Thus the IT support for the domain of processing statistics becomes very important (see figure 14 and figure 15). This domain needs standards for development, maintanance, and operation: the reference architecture for data collection and processing of statistics must be derived from the experience values of existing systems. The book of standards must be maintained and advanced accordingly, and solution architects, project managers and developers must be made familiar with these standards. The strategy of our IT service provider is to enter a market segment in which the price, i.e. the costs of statistics processing, determines the position of a company.

The service provider wants to modify its business and be more cost efficient in commodity issues than the competition. Figure 16 shows a rating matrix with a positioning of the service provider's strategy in the upper left quadrant.

The industry specific mapping of technologies to matrix cells within this matrix supports the development of standards conform with the business strategy.

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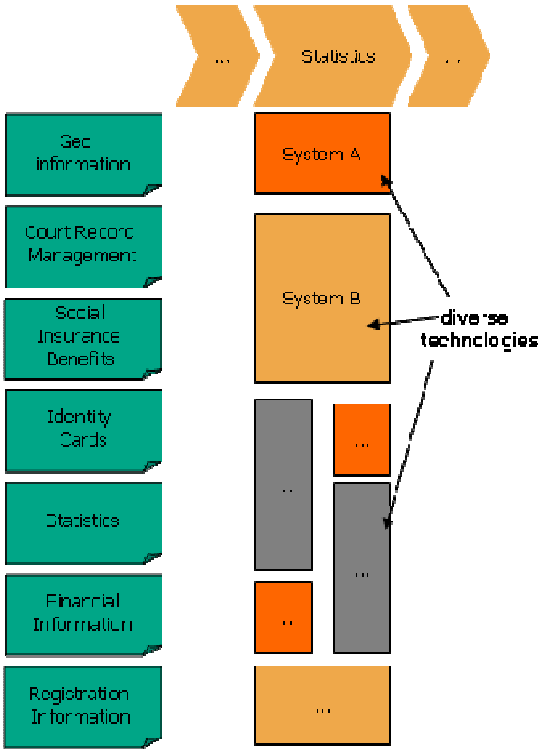

Figure 14: Diverse systems and technologies within functional domain (example)

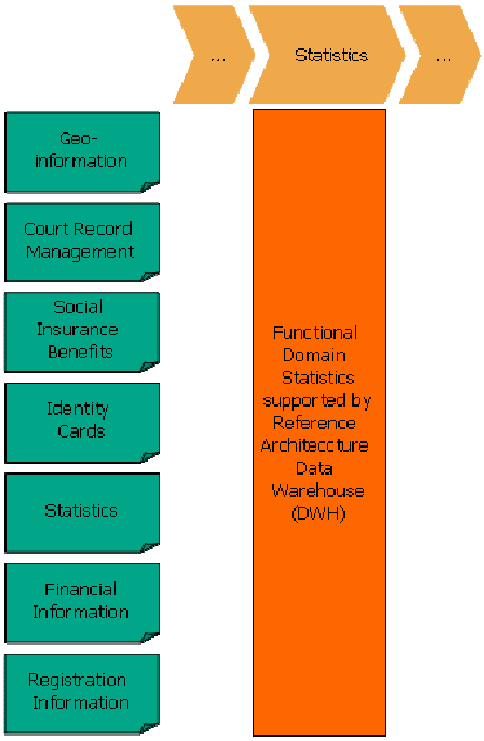

Figure 15: Standardization within functional domain through reference architecture (example)

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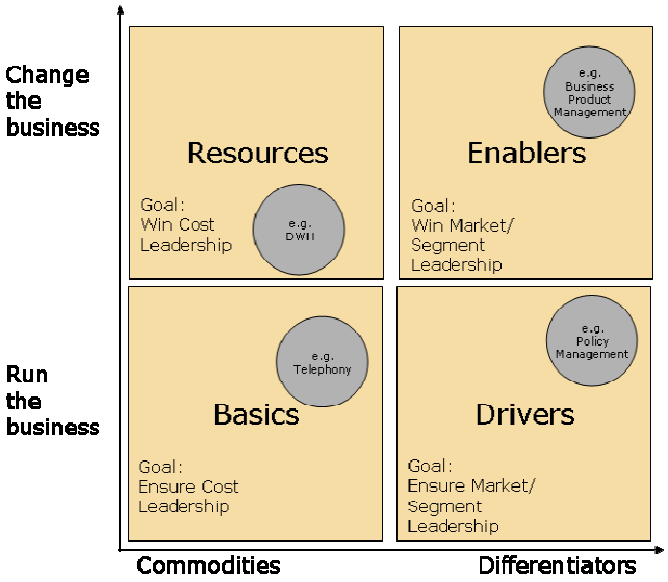

Figure 16: Technology standardization priorities based on business strategy

Thus in addition to the bottom-up catalogization and classification the standardization can be made top-down.

For our example figure 16 represents data warehouse technologies in the upper left quadrant, which should be included with high priority into the standardization process in accordance with the business strategy of the services provider. With the help of this rating matrix depicting technologies which are to be standardized, the enterprise architect ensures that at first those standards are established which support the development and operation of business critical services.

5.4 To Support the Right Fields of Activity Right and Reliably

The measures derived from the running analysis of the application- and infrastructure landscape must be implemented. This presupposes that the enterprise architect is able to launch these housekeeping project out of his office in the IT department. Herefore an independent housekeeping is needed – or a "jump on the bandwagon" of project portfolio management.

What do we need to establish such a housekeeping process as a major part of strategic architecture management, and as primary task of the enterprise architect? We must classify architecture management into the context of IT management processes. Demand-, supply-, and enable-processes must be categorized and cross-linked into the big picture (see figure 17).

In this big picture we will find the connection between architecture management and portfolio management, which allows the enterprise architect to initiate housekeeping projects (see figure 18).

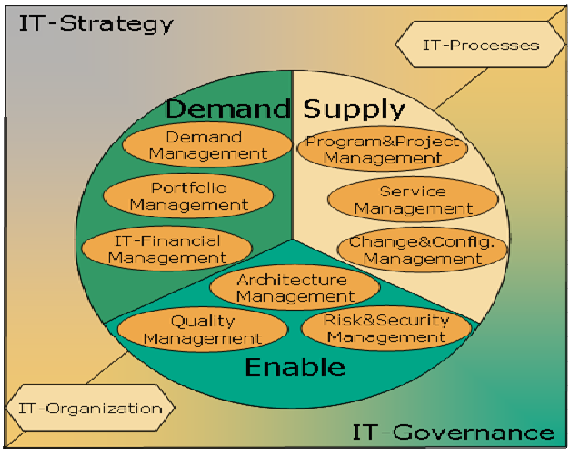

Figure 17: Big Picture of IT-Management Processes

The process (simplified here) is run by following steps:

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(1) Architecture Management has identified an application system with non-standard architecture, which must be reengineered to an application system with standard architecture. Architecture Management reports this to the demand management. This demand report includes a business case and a rough architecture scenario.

(2) Demand management presents a project proposal to portfolio management.

(3) Porfolio management checks the budget with IT financial management.

(4) IT financial management accepts or denies the requestd budget.

(5) Portfolio management accepts or denies the housekeeping project.

(6) Demand management launches the housekeeping project.

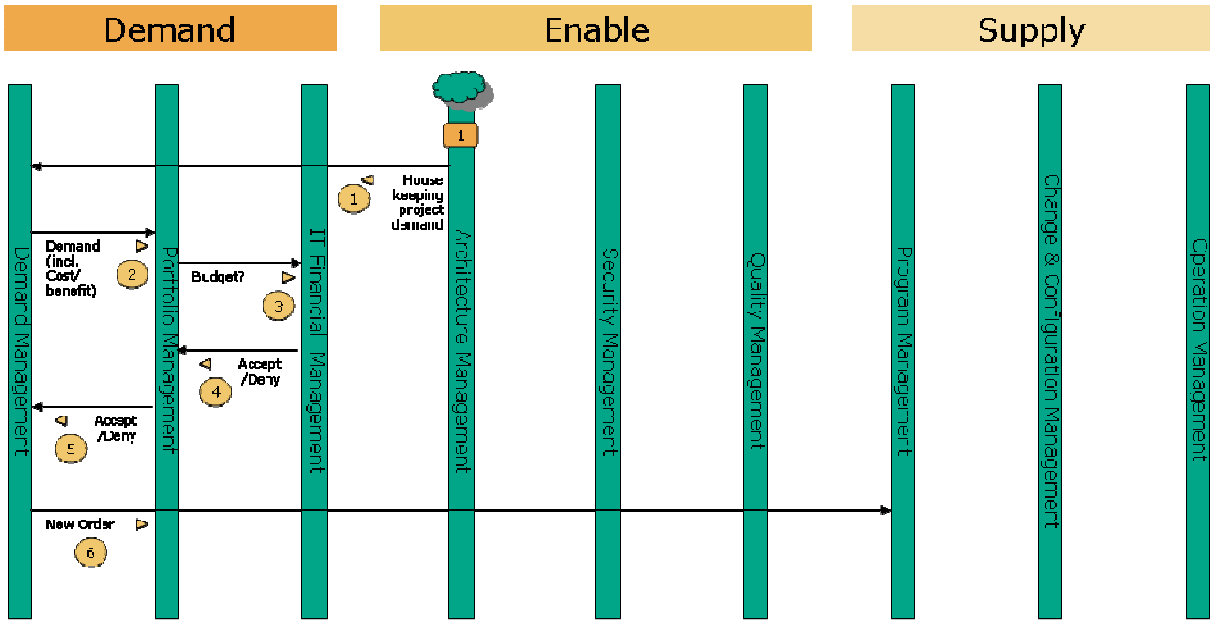

Figure 18: Initialization of Housekeeping Project

There are exceptional situations, e.g. during a merger, when it can make sense to allocate an independent budget to housekeeping which covers the consolidation measures. Then it can be regarded as a strategic action for renovation and optimization rather than being subject to portfolio management. Usually, though, the housekeeping business case initiated by the enterprise architect should prevail against other business projects.

As soon as architecture management is cross-linked with the other IT management processes and the enterprise architect is able to directly launch housekeeping projects the measures in progress must be supported. Standards such as infrastructure portfolio or reference architectures must be included in housekeeping activities. This is the task of solution architects, which pursue the operative architecture management processes.

The office of the enterprise architect is in charge of the identification of the right fields of activity and for the definition of necessary optimization measures. Also, by the portfolio of standards it delivers the required guidance for the implementation, which must then be accompanied by the solution architects. Thus, the enterprise architect is responsible for the strategic architecture management process, which must go hand in hand with the operative architecture management of the solution architects.

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The teamwork of strategic and operational architecture management is key for the reliable implementation of the strategy into stable and functioning IT systems.

6 Conclusion

In the given context, the importance of architecture regarding impact and focus is increasing. The road trends from IT architecture to enterprise architecture: to develop, standardize, plan, and controll architecture (see 19).

Driven by requirements, the development of architecture is based on projects. Primarily efficiency and security benefit from this: in the reusablility, initial acceleration, reduction of set-up times through conventions, patterns, frameworks, and industry standards.

The standardization of architecture is concerned with the conception of shopping carts for infrastructure, and reference architectures for the development. This requires a cross-project perspective. Here, too, the immediate use of architecture lies in efficiency and security. Yet, the standards set the stage for a business-based application portfolio, the objective of which is IT alignment throughout the business.

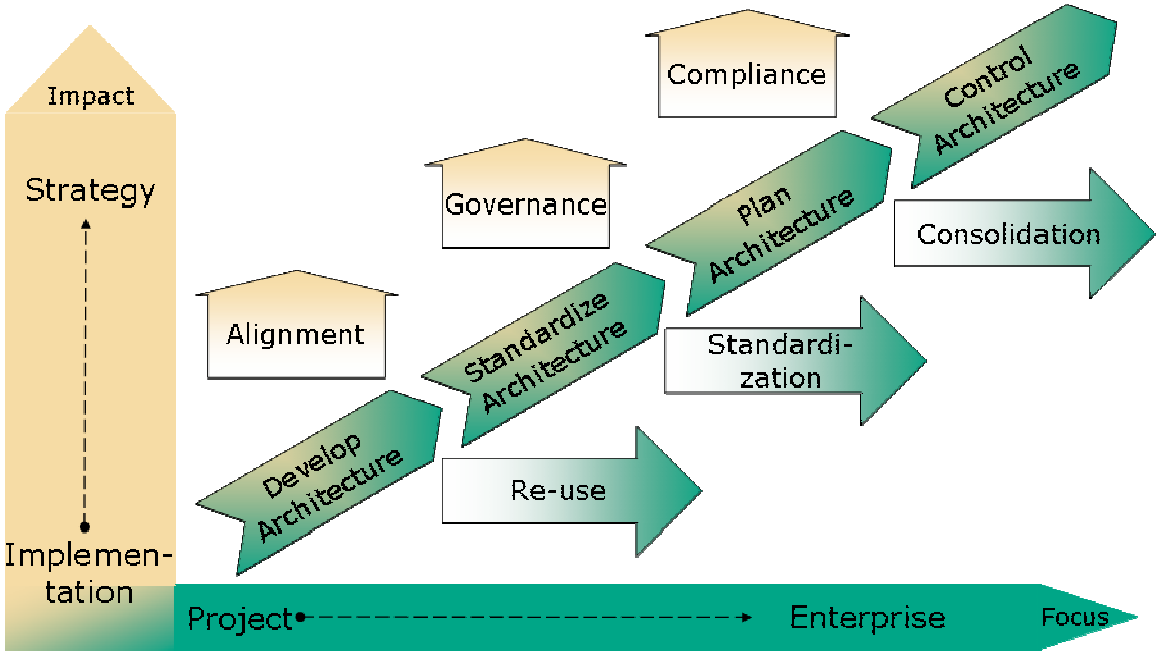

Figure 19: The growing importance of IT architecture

Architecture planning requires an analysis of weeknesses of the IT landscape. First steps are analysis and mapping: among others, heterogeneity, complexity, gaps, value creation, costs must be analyzed to obtain a basis for planning. Application portolio is focused on the wish to optimize the application- and infrastructure landscape regarding the technical quality and orientation at the business.

The business oriented and strategy driven controlling of architecture requires an all-embracing transparency and operationalization. Measurability through key performance indicatiors, compliance checks, embedding into IT management processes, and the value oriented optimization of the IT portfolio are the building blocks of a strategic architecture management which is business focused.

The short programme is the alignment of IT the business sectors, and as the freestyle event a CIO will continuously take over the responsibility for the process optimization thoughout the corporation.

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Such a strategic architecture management has not in view single project architectures but an enterprise architecture which makes transparent the connections between objectives, strategies, business processes, IT services, and platforms. For informed decisions such a navigational help is called for, so that enterprise architecture becomes the information system of a functioning IT governance. In a comprehensive IT planning process ensuring an effective use of means architecture management and portfolio management act complementary – guided by IT governance.

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