

# Measuring and Controlling IT Services

## The Case of Telecom Enterprises

Péter Fehér, Péter Kristóf

**Abstract** — Telecom enterprises are organizations with complex processes and structure the operation of which is highly dependent on information technology (IT) and the services provided by it. The landscape of the IT architecture reflects the complexity of the business processes. As this entanglement makes IT-based solutions and applications mission critical, securing the availability and operation of the services belongs to the top cost drivers at telecom enterprises, causing serious risks as well. Handling these costs and risks and aligning business strategy with IT-based solutions the use of Enterprise Architecture and IT controlling is suggested. The joint deployment of the two disciplines secure the measurement and controlling of IT services: the elaboration of the current state, the fact-based planning of the desired future state and the transition between them. Aligning business strategy and IT strategy helps optimizing infrastructure costs and mitigating risks. The paper gives a brief overview of the newest methodologies and emphasizes a holistic approach while bringing examples from the telecom industry.

**Index Terms** — Enterprise Architecture, IT controlling, business-IT alignment, TOGAF, cost accounting.

### I. INTRODUCTION

Telecommunication enterprises offer complex business services to their customers that are more and more dependent on information technology solutions. Both the enterprise architecture of the companies, as a whole, and the IT architecture, as part of it, mirror the complexity of the offered services. IT services are critical for providing business services, therefore business performance, and even business costs are heavily dependent on IT solutions. Not a surprise, telecommunication enterprises are among the top spenders to information technology: IT costs of a telecom company (comparing to its revenue) are double or even triple of an average manufacturing, utilities or food industry company [9].

The economic crisis of the last years, and the changes in the compliance environment (extra taxes, roaming limitations in EU) challenged the profitability of this sector. In the EU, Hungary and Greece introduced the highest speciality tax rates of respectively 40% and 36%. While the business environment became less predictable, sharing the business risk with customers by increasing customer prices is limited, because of the price sensitive nature of the market [8].

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As telecom companies cannot increase their revenues significantly, they have to concentrate on their cost structure: postpone development and investments, and generally decrease operational costs, including IT investments and IT operational costs. Because of this business requirement, there is an increased pressure on IT departments in the telecom sector to reduce IT costs while keeping the value creation ability of IT services.

The paper analyses this challenge from an enterprise architecture point of view, while describing both business and IT solutions of the telecommunication industry. Enterprise architecture management is ‘[...] the practice that tries to describe and control an organisation’s structure, processes, applications, systems, and technology in an integrated way’ [14].

### II. HANDLING COMPLEX TELECOM ENTERPRISE ARCHITECTURES

The complexity of the telecom enterprise architecture poses both an opportunity and a limitation of a more conscious and more controlled behaviour of the industry. The main reasons and challenges behind the complexity of enterprise architectures, especially IT architectures are the following:

- Complex telecom services require complex business processes and IT solutions.
- Mergers and acquisitions are common in the telecom industry, but these transactions generally result in an increased complexity of architectures.
- The change of the environment requires fast responses from telecom companies that leave less time for architecture optimisation.

#### A. Examples for complexity

To illustrate the impact of these reasons a few examples are presented.

#### Example 1

*A telecommunication company that has roots in the cable TV industry, and now offers broadband internet and other telecommunication services, rapidly expanded in the last decade. It acquired companies from all of its service areas: cable TV providers, landline telecommunication companies, and internet providers. The expansion was strategically and financially justified, and the number of the company’s customers increased quickly, and now it provides service to several million households, at several hundred thousand sites.*

*Although the customers benefited from the technological development and increased service quality, they suffered from the too bureaucratic processes, and poor customer care. The company received several customer complaints, and even consumer protection websites cited alarming events about its practice.*

*The company realised, that over the expansion, its enterprise architecture (both business processes and IT services) could not follow its changes: because of the rapid growth business processes were rarely integrated, nor consolidated, and the company has kept the very heterogeneous IT architecture of the acquired companies. In an extreme case, the company acquired a local cable TV and internet providing company that has just 10 months ago acquired a smaller cable TV company, and was in the middle of its architecture consolidation process. By the end of the process, the telecommunication company in our example had got three additional customer relationship management software, including the customer database.*

*As the result, the telecommunication company had to deal with at least duplicated, but mostly multiplied databases, functional systems, and complex integration solutions. Employees in the customer office often applied excel tables to integrate the data from different sources. The company had to realize that its business and IT architecture raises a barrier to effective business management.*

### Example 2

*An integrated multinational telecommunication company decided to integrate its previously semi-independent subsidiaries of mobile and landline telecommunication, internet, satellite- and cable TV services. These services supported the business and IT architecture of the subsidiaries, but because of the redundancies, the company had to face similar difficulties like in Example 1. Because of the different historic background of the subsidiaries, it was hard to judge which processes and systems are better, and how the systems should be consolidated.*

Having complex architecture is not necessarily wrong, but needlessly complex architectures mean both development and operational risks for telecom companies, and requires extra resources to maintain the necessary level of services. Moreover, there is an increasing gap between business strategy, business requirements and the existing enterprise architecture, especially in the field of information technology [19]. As Example 1 and 2 illustrated, mergers and acquisitions result in redundant IT systems and databases. But even shutting down unnecessary applications could retain the existing complexity: previously dedicated background applications and services became later the background of other applications, and to avoid further risks, companies keep this complexity. As result applications and databases are connected to other applications and databases in a spaghetti-like architecture [16].

In order to support the cost cutting challenges of the companies, we have to understand and manage this complex

architecture, and to provide a structured, transparent and simple approach to control and even to simplify complexity.

### B. The need for enterprise architecture and IT controlling

Growing enterprises usually forget to perform a variety of critical and complex tasks which used to be in the focus of their daily activities after they started up: thinking about why the company was established, what the main activities are and how the client needs are fulfilled. They also forget about planning the future, building their strategy and defining the desired state of the business. Additionally they have no clear view about how their today's technology can perform and how it should be developed in order to fulfil future needs. As they are getting larger, the complexity of their business activities and the architecture will be also growing. These challenges – deeply impacting the design of the enterprises – are the result of changes in the environment (e.g. globalisation, service orientation), the competition and mergers or acquisitions.

This is especially true for telecom companies the operation of which is highly dependent on services provided and supported by information technology. Handling billions of transactions and providing services for millions of clients result in a complex IT architecture. For dealing with this complexity and designing and controlling IT architecture of large telecom companies the paper suggests using the approach and toolset of enterprise architecture and IT controlling.

## III. LITERATURE OVERVIEW

Business performance highly depends on a balanced and integrated design of the enterprise. This includes staff (with all competencies), organizational structure, business processes, production and services, finance and business environment. Facing the challenges the management needs to make conscious decisions about the design of the enterprise [10].

At this point enterprise architecture (EA) is used as an instrument to steer an enterprise's future, and serves as a coordinating mechanism toward the actual transformation. In articulating an enterprise's future direction, the multi-perspective approach, which is typical of enterprise architecture, enables the achievement of organizational cohesion and integration. Furthermore enterprise architecture provides the clear overview required for translating strategy into execution, enabling the top-level management to take the ownership of decisions about the design of the future enterprise [10].

From this point of view the goal of enterprise architecture is to act as a guide (or pathfinder) and take the enterprise on a transformational journey – from an incoherent and complex world to a more rationally designed organization with multi-service, revenue-generating platforms and efficient operational structure. The aim should be clear: enterprise architecture is required to deliver tangible business benefits [5] and has to play a significant role in aligning business needs and technology solutions while offering

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- an insight into the current utilization of IT in business operations,
- a vision for the future utilization of IT in business operations, and
- a roadmap for the evolution of the IT from the current state to the desired future state. [5]

Helping the fulfilment of this aim, different kinds of frameworks have been elaborated. Architecture frameworks help the companies to consciously go through the process of architecture development, and also offer an initial structure of activities. In the following sections an overview of the necessary background for applying the EA approach in the telecom industry is presented.

A. Frameworks

Enterprises can be of any size and can have different level of complexity – their architecture will tend to be similar. Over time different kinds of models, tools and frameworks have been developed to address this complexity and to support enterprise architecture [1]. Frameworks support structuring architecture description techniques by identifying and relating different architectural viewpoints and the modelling techniques associated with them. Some of them are quite specific about what kind of elements a structure should have [14]. Besides, the frameworks intend to help professionals dealing with architectural issues by providing also an ontology using different levels of abstraction for mapping all kind of required information and helping the communication between the professionals involved [15].

B. Why TOGAF?

On the field of enterprise architecture, The Open Group Architecture Framework (TOGAF) is a well-known framework that links four different types of architecture contents: business, data, application and technology [2]. Originally it was a generic framework and methodology for development of technical architectures, but evolved into an enterprise architecture framework and method. It has four main components [14]:

- Architecture Development Method (ADM): provides a ‘way of working’ for architects. The ADM is considered to be the most significant component of TOGAF, and consists of a stepwise cyclic approach for the development of the overall enterprise architecture and defines a full life-cycle process for planning, designing, realizing and governing enterprise architecture. Doing so it brings discipline to the architecture development process [5].
- Architecture Content Framework: considers an overall enterprise architecture as composed of four (above mentioned) closely interrelated architectures: business architecture, data architecture, application architecture, and technology (IT) architecture. It describes what the architecture should look like by the end of the transition process.
- Architecture Capability Framework: addresses the organisation, processes, skills, roles, and responsi-

lities required to establish and operate an architecture function within an enterprise. It also provides a set of concepts for a successful implementation of enterprise architecture governance.

- Enterprise Continuum: comprises various reference models. It illustrates how architectures are developed across a continuum ranging from foundational architectures, through common systems architectures and industry-specific architectures, to an enterprise’s own individual architecture.

Architecture is the art and science of designing complex structures. In this context, enterprise architecture 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. [14]

C. IT controlling

To a great extent (and also at telecom companies) the complexity of IT is also the result of an uncontrolled proliferation of redundant systems and solutions. In a fragmented organizational structure each business unit has its own IT budget – therefore it will follow its own way in procuring, building and operating its technology. Furthermore IT departments are organized on a project basis and are free in making decisions. As the decision making happens locally, it prevents leveraging enterprise-wide synergies and leads to a nearly unmanageable jungle of redundant applications and data [5] and a widening communication gap between business and information technology. Architecture is an essential tool in controlling the complexity of the enterprise. Better alignment between business and IT leads to lower cost, higher quality, better time-to-market, and greater customer satisfaction. [14] For ensuring enterprise IT being stable, agile, adaptable and efficient, the methodology and toolbox of IT controlling is available. IT controlling provides support for managers when making decisions about IT-related resources. [17]

Furthermore IT controlling is about the control of IT-related operations in the organization. Its goal is to ensure efficiency and effectiveness of IT operations while providing quality, functionality and compliance to deadlines in information processing. IT controlling has a monitoring function as well as a coordination function for the management of information.

IT controlling focuses on a certain controlling application and covers common aspects such as data aggregation and processing, budget planning, and coordination of individual information and data sets. The formal aim of IT controlling is to ensure the effective and efficient usage of IT resources. Alongside formal aims, aims with regard to content are pursued, whereby business value, costs, quality, functionality, and in-time delivery are the goals with highest priority. IT controlling can be divided into three core processes [12]:

1. Planning: setting performance targets in alignment with the business and IT strategy.
2. Monitoring: to measure the status-quo and expected deviation from it or the deviation from performance targets.

3. Steering: continuous target-performance comparison. In the event that a deflection is identified, appropriate steering actions should be initiated.

IT controlling consists of making decisions about acquisition, change, and disposal of IT, as well as monitoring IT performance data in order to be able to control IT more effectively and efficiently.

#### D. Bridging the business-IT gap

At companies operating in sectors which are highly dependent on technology, the stakeholders from business and the stakeholders from IT often misunderstand each other and forget that they are approaching the same question from very different directions. One group is focusing on business demands while the other has to satisfy IT demands in a timely manner while managing the complexity and performance of the entire application landscape. Over time both of these groups have developed own theories, practices and rules which lead to an ever widening gap between them [3].

While IT controlling is proceeding from a business perspective and defines metrics and indicators to measure the status and contribution of information technology, enterprise architecture management is a procedure to create transparency, to clarify the role of IT and to spur the alignment of business and IT. As IT controlling and enterprise architecture are addressing the topic of business-IT alignment, they are also providing means for communication.

The architecture of an enterprise is commonly regarded as the cornerstone for its long-term evolution. In order to support this holistic approach it should be included in IT controlling. As a complementary to IT controlling, enterprise architecture management is a continuous and iterative methodology with a major goal of controlling and improving the existing and future IT support of an organization. Putting this methodology into practice the enterprise architecture process not only considers the information technology of an enterprise, but also takes business processes, business goals and strategies into consideration in order to build a holistic and integrated view of the whole enterprise. ‘The goal of enterprise architecture management is a common vision regarding the status quo of business and IT as well as of opportunities and problems arising from these fields, used as a basis for a continually aligned steering of IT and business.’ [3]

#### E. Business Process Framework (eTOM)

The Business Process Framework (formerly known as eTOM – enhanced Telecom Operations Map) is a TM Forum (a non-profit industry association for service providers and their suppliers in the telecommunications industry) initiative. Its purpose is to deliver a process framework for service providers within telecommunications industry. The framework maps and describes all the enterprise processes required by a telecom service provider and analyses them to different levels of detail according to their business significance and priority. Beside serving as the blueprint for process direction and providing a reference point for internal process reengineering needs, the framework outlines potential boundaries of soft-

ware components to align with the customers’ needs and allows an overview on the required functions, inputs and outputs that must be supported by products. [4]

The Business Process Framework can be used as a tool for analysing an organization’s existing business processes and for developing new ones. In applying the methodology, different processes delivering the same business functionality can be identified, and so duplications eliminated, gaps revealed, new process design speeded up and risks reduced. It also helps measuring and assessing the value, cost and performance of these processes [4] and so supports controlling them.

Telekom Malaysia can serve as a good example. The country’s largest integrated solutions provider started a project in 2009 for optimizing end-to-end business processes, enhancing operational efficiency and improving customer experience. The project was carried out on Business Process Framework basis and resulted in a consolidated and single platform for consumer, business and wholesale services in just 10 months. A significant result was also achieved by China Mobile. The world’s largest operator launched a cloud mobility initiative for its 90 million subscribers, using Business Process Framework. With this project they achieved savings of \$120 million and increased revenue of \$40 million annually [18].

The Framework is defined as generically as possible, so that it is independent of organization, technology and service. It is basically intuitive, business driven and customer focused. To reflect the way businesses look at their processes, the Framework supports a horizontal (functionality-related processes) and a vertical (end-to-end processes) perspective on the grouping of the process elements. The overlay of the horizontal functional processes and the vertical end-to-end process groupings form a matrix structure, which is the core of innovations and fundamental benefits of the Framework. It offers a standard language and structure for the process elements that can be understood and used in specifying and operating end-to-end processes and creating the capability that enable these processes. [4]

Using the eTOM framework is a good start to structure the business architecture part of any telecom industry organization, through providing a standard processes group and business architecture relationships.

After having established the foundations of enterprise architecture (EA) and IT controlling we will continue with practical questions.

## IV. PRACTICAL QUESTIONS OF THE EA APPROACH

The first question of applying the enterprise architecture approach is how to create a relationship between business strategy and organizational activities. Without analysing the strategy development process, the enterprise architecture approach should apply the results and implications of the business strategy [16]. Of course the strategy development process can build on the existing and future opportunities of ICT solutions [13], but analysing this topic related to the EA approach is beyond the objectives of this paper.

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Creating the relationship between business strategy and enterprise architecture is part of the company-wide governance, especially IT governance structures and processes [7]: The business strategy should be decomposed into business objectives, and tools to achieve them. To translate the abstraction of a business strategy the offered products and services should be identified.

Therefore, following the Enterprise Architecture based approach, telecom companies should understand and model their service portfolio. Defining the service portfolio enables to examine the possible existing strategic gap between business and IT services. In our research we explored and analysed the enterprise architecture structure of several organizations, mostly in the financial and telecommunication sector.

The findings in this section are generalized, but illustrated by telecom examples. As basis for developing the presented architecture model, the content metamodel of TOGAF [11] was selected with the following expansions: process modelling, governance, services and infrastructure consolidation. During research these elements were tailor made for the efforts of representing our service based enterprise architecture model.

A. Business architecture

In order to map the business architecture of telecom companies, strategic questions of target customer segment markets and offered services should be answered. In the last 15 years, telecommunication companies widely diversified their service portfolio, and beside the traditional telecommunication services (landline and mobile telecommunication), data communication (landline and mobile), IT services (e.g. cloud services), and content services (cable TV, mobile TV, internet-based contents) are also provided.

Each of these strategic services consists of several options. A very simple service breakdown is the following: a mobile strategic service is divided into pre-paid and subscription-based alternatives, and in each of them there is a wide variety of costumer packages that identifies the different fees. But each package contains additional services beside the basic call service: internet, sms/mms, voice mail, missed call service. These services are labelled as *customer-facing business services*, and customers are expected to pay for these services.

The business architecture, business services and the enabling processes are standardised in the (eTOM) Business Process Framework that defines the main business activity areas, that concentrates mostly on operational activities.

Beside customer-facing business services customer demand additional support services, like services desk, customer-care, sales points or device support. Generally these services are not considered as value added services by the customers, but a poor service desk can heavily impact the perception of the overall service quality. These services are labelled as *customer-facing support services*.

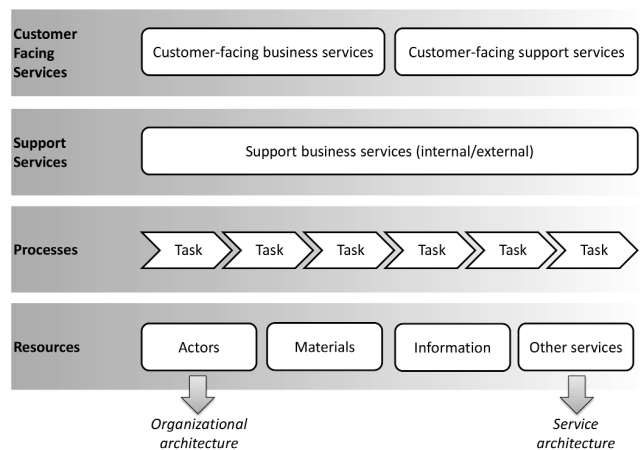
All of the customer-facing services are provided through the realisation of either internal or external business and IT processes that are not directly visible for the customers: market research, accounting, marketing, business operations,

controlling, etc. These services are labelled as *support business services*, and enablers of customer-facing services.

Example 3

A customer wants to buy a new mobile phone with a new subscription. The customer-facing service is sales, and it creates income for the company, and value for the customer. But in order to realise this service the sales clerk has to check the identity of the customer, record the transaction, invoice the fee, and provide the mobile phone itself. Providing mobile phones to customers requires procurement, external and internal logistics, that are not visible, and in fact customers do not care how the company solves this issue. Even most of the steps in case of a personal purchase are not perceived as value adding activities by the customer. Customers does not appreciate activities like identification, recording customer data, although these steps are necessary for the whole processes, and even serve customer's interest.

FIGURE I  
MAIN ELEMENTS OF THE BUSINESS SERVICE ARCHITECTURE  
(SOURCE: P. FEHÉR)



All business services are realised through business processes. This part would be considered as the domain of business process management, but because the business service hierarchy depends on the processes, it should be considered as part of the enterprise architecture [11]. Business processes are sequences of tasks that are often labelled as activities or process steps. Processes can run through different organizational units, but on the task level responsibilities belong to a well-defined organizational unit, even to a well-defined role. In the enterprise architecture approach, this is the domain of organizational architecture that defines the organizational structure, and determines the required roles and actors for each task. During performing a task, an actor uses resources, like materials, information from documents or electronic databases. Performing a task can also require the consumption of additional business or IT services.

B. IT service architecture

Business services and business processes require the availability of information technology services. As in the case of business services, there is only a limited number of IT service that is visible for the business departments, and consider them as value added services. These services are labelled as *business facing* (or direct) *IT services*.

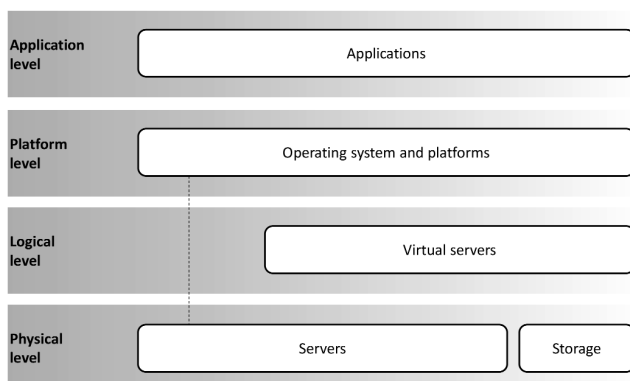
These services present themselves as frontend application functions, that is visible and usable for the business side. But in the background, to provide any service, other application functions are required, that are not visible for the business side. These services are labelled as *support* (or indirect) *IT services*. Practically using a business facing IT service means initiating an IT process, a workflow that is connected to the related applications, and uses their functionality.

C. IT architecture

Application functions are considered as IT-providing services, in case of complex organizations, such as telecom enterprises, applications use the functionality of other applications, and use data from various databases.

In order to provide the required environment for applications, a physical infrastructure (even external or internal) is required: servers and storage facilities provide the required processing and data storage resources for applications. In case of complex telecom architectures server virtualisation became popular, and provides more flexibility, and a more consolidated infrastructure in the physical level. On the virtual level, however, even several hundred virtual servers provide services. Virtual servers with the operating system and other platform software (e.g. a framework, a running environment, etc.) provide the basis to run the applications. Elements of this environment are labelled as *platform services*: ‘A technical capability required to provide enabling infrastructure that supports the delivery of applications’ [11].

FIGURE II  
MAIN ELEMENTS OF THE IT ARCHITECTURE  
(SOURCE: P. FEHÉR)



Additional architecture elements, such as network appliances or message brokers are also part of the IT architecture, that provide IT services (data transfer, messaging, communications).

V. COST ALLOCATION OF IT SERVICES

From business point of view it is important to see how information technology services support and enable business operations, and to understand the costs of these services. IT controlling, more specifically cost controlling and cost allocation helps to understand the main cost factors. In case of enterprise architecture approach the relationship between different levels of the architecture is defined, therefore cost allocation into higher level is possible.

The overview of an enterprise architecture presented the main elements of a complex telecom architecture. This understanding is required in order to calculate the costs of business, especially customer facing business services. During the budget planning process, and during the cost accounting main cost factors are planned and summarised. So even not knowing every detail of the cost factors of information technology services, the total sum is usually available for telecom companies.

In a wider view, even total cost of each department (such as IT) can be calculated, but without knowing the costs and contribution to business services neither architecture consolidation, nor cost reduction can be performed.

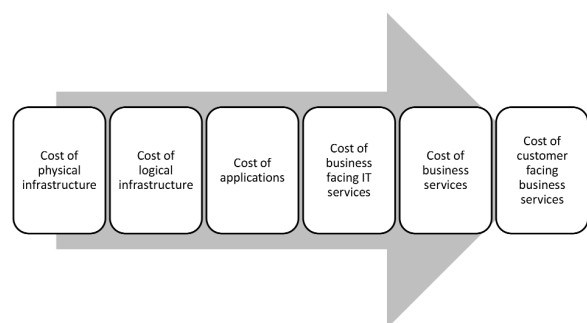
The biggest challenge in allocating IT costs is how to deal with this complexity, and how to provide a clear understanding of IT and business costs.

The main cost drivers are the following:

- Depreciation of infrastructure elements (based on previous years' CAPEX spending)
- Human costs
- Other contracted costs (OPEX)

These costs are allocated through the levels of the enterprise architecture.

FIGURE III  
PROCESS OF COST ALLOCATION IN CASE OF TELECOM ENTERPRISES  
(SOURCE: P. FEHÉR)



At this point we have to differentiate between the financial (cash-flow) and accountancy understanding. In case of budgetary planning and budget control the financial approach is applied, therefore incomes and expenditures are registered. But expenditures on investments like buying a new server, or implementing a new CRM application does not change the value of company assets, only cash is transformed into another kind of asset.

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From an accountancy point of view the decrease of the value of these assets (depreciation) is considered as costs. In case of IT assets, the value of new investments is depreciated through 3-5 years. Companies should therefore consider, that

changes in their IT budgets will have immediate impact on their cash flow, but a longer impact in their cost structure (Table 1), but over the long run, considering the life-cycle of equipment these expenditures and costs.

TABLE I  
COMPARING THE CASH FLOW AND ACCOUNTANCY APPROACH

(Infrastructure development)	Year 0	Year 1	Year 2	Year 3	Total
<b>Cash Flow</b>	-€600 000	-€60 000	-€60 000	-€60 000	-€780 000
Investment	-€600 000				-€600 000
Support		-€60 000	-€60 000	-€60 000	-€180 000
<b>Costs</b>	€0	-€260 000	-€260 000	-€260 000	-€780 000
Depreciation		-€200 000	-€200 000	-€200 000	-€600 000
Support		-€60 000	-€60 000	-€60 000	-€180 000

Organizations should also consider that consolidation of IT architecture could mean an enhancement both in their cash-flow (e.g. price of sold servers, savings on support and

maintenance) and in their cost structure (no more depreciation and support costs).

TABLE II  
COMPARING THE CASH FLOW AND ACCOUNTANCY APPROACH IN CASE OF IT INFRASTRUCTURE CONSOLIDATION

(Infrastructure consolidation for Y2)	Year 0	Year 1	Year 2	Year 3	Total
<b>Cash Flow</b>	-€600 000	-€60 000	€400 000	€0	-€260 000
Investment	-€600 000				-€600 000
Support		-€60 000			-€60 000
Sold equipment			€400 000		€400 000
<b>Costs</b>	€0	-€260 000	€0	€0	-€260 000
Depreciation		-€200 000			-€200 000
Support		-€60 000			-€60 000

In order to understand how costs are allocated along the layers of the enterprise architecture, we have to differentiate between direct and indirect costs. Direct costs are directly related to a specific service, while indirect costs are shared among multiple services [6]. Although full accuracy can be achieved only by using direct services, in case of complex telecom architectures it is impossible. Even, because of the complexity, the measurement of each infrastructure element would result in almost impossible work efforts from the organization.

In case of the physical IT infrastructure, elements can be grouped by performance categories (e.g. mid-range of high-end storage facilities, or differentiating based on CPU performance of the servers), and costs of groups should be calculated. Of course, if a company has a very detailed configuration management database that is connected to the accounting system, the costs of each element are visible. In case of telecom enterprises this connection is rare, therefore simplification, wherever possible, is required.

The cost of IT infrastructure elements consists of the depreciation costs of infrastructure element, infrastructure

related external services (e.g. support, maintenance), and the cost of human efforts. In order to measure human efforts, telecom organizations usually use dedicated people for infrastructure or applications environment, or use a time reporting system.

The cost of the virtual environment consists of the direct costs of virtualisation (virtualisation of software licenses, external service and HR costs), but also the indirect allocated costs of the physical infrastructure. The cost of each service can be calculated (beside the direct costs) by the used resources (CPU, memory, storage) of the physical infrastructure.

Cost of applications consists of their direct costs (software license, external services, HR costs), but the biggest cost factor is the allocation of the logical architecture costs, based on the used virtual servers and the used capacities.

**Example 4**

Several telecom companies use robust central servers, such as IBM AS/400 (formally renamed to iSeries) to provide the required capacity to their core operations, such as customer database, enterprise resource planning, or e-mail services.



In case of an AS 400 based service portfolio, the total cost of the AS 400 environment can be easily calculated, through its dedicated depreciation, support, maintenance and HR costs. The applications, running in this environment, use about 70% of its capacities. In this shared environment, costs are allocated by their relative usage, because allocated costs should cover the total cost of the environment. In another case the main application of a telecom company runs in a distributed environment and its components use several virtual servers. The total cost of this application builds up of the allocation of these virtual server costs.

In order to calculate the cost of business facing IT services, another method is required: IT services do not have necessarily direct costs (no depreciation, external services and HR costs and calculated on application levels). Therefore the costs of IT services are the allocations of IT application and databases. In order to calculate the cost of an IT service the identification of the used applications, and its capacity usage is required.

**Example 5**

In case of a webshop of a mobile telecom company when a customer wants to buy a new phone, this process requires the usage of other main background applications: customer database, identification module, payment module, logistic application. In order to calculate the cost of this IT service the allocation of other application costs is required.

As the process and the examples show, the use of the enterprise architecture logic helps to identify the main cost drivers of each IT service, but requires a very complex modelling of the enterprise. In order to avoid complex modelling efforts for simple services, it is suggested to concentrate on the most critical, most expensive IT services.

**VI. CONCLUSION AND SUMMARY**

Applying the enterprise architecture approach requires strong consciousness to explore and understand the existing structure of an organisation (as-is state). Understanding this structure and the interdependencies helps to calculate the costs of each customer facing business service, so the company can decide on shaping its service portfolio.

Based on the enterprise architecture approach, even business-facing IT services became transparent, and each business unit can decide on how to optimise its processes. Maintaining the IT service portfolio is not about only consolidating IT services, but also an opportunity to optimise business unit costs through automating business tasks. But in order to make the decision on these questions, information of IT costs can be a good basis for creating a reliable business case.

The paper showed that transparency and controllability of enterprises require a strategic approach. In order to provide profitable telecom services, the definition and the cost-based pricing of them is necessary. Complex architectures of tele-

com enterprises are difficult to overview, and the clarification of them can only start with modelling the organization and the business processes. Enterprise architecture is an efficient tool and method in this activity.

After having analysed large-size telecom companies we found that a unified model of enterprise architecture and IT controlling can bring significant results in business-IT alignment and cost optimization. In our paper this unification was introduced and confirmed with practical examples.

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