Component Governance as a Key Factor for IT Business Alignment of Telecommunications Companies

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Abstract: Modern telecommunications companies currently undergo remarkable structural changes to be successful in the Next-Generation markets for communications and content products. The implementation of capable IT structures will be a key success factor to be profitable. This paper describes the market challenges of telecommunications companies and illustrates a comparison of different governance methods. It also introduces a new governance method and finally outlines which structures are appropriate to meet the shifted market requirements.

1 Challenges for Modern Telecommunications Companies

Currently, modern telecommunications companies (TelCos) undergo enormous structural changes towards IP-based telecommunications companies (IPTs). The product portfolio of IPTs contains bundles of products e.g. IP-based broadband Internet access (www), IP telephony (Voice over IP VoIP), IP television (IPTV) and premium content (e.g. movies, games, music). Many TelCos aim at scenarios, where it is possible to produce, buy and consume all connection products (IP access), all service products (www, VoIP, IPTV) and all the content anywhere and anytime online.

In this target scenario time-to-market (T2M) for new products and the production time for product instances should be as short as possible. These are strategic business objectives for IPTs to meet the market requirements of the future and to ensure long-term success(cf. [SMA08]).

These strategic requirements can only be fulfilled if telecommunications companies can meet certain operational goals. Due to the high number of customers in mass markets, product instances need to be produced and provided fully automatically (zero touch). Otherwise it is infeasible to reach the required quality and to provide fast online-provision of products. Manuel steps in the production process would make it impossible for IPTs to be profitable in mass markets.

To ensure the fast introduction of new product types it is necessary to find a simple way to "plug" new products into the existing product infrastructure without interfering with existing product instances or production processes. This paper introduces component go-

vernance as an approach to tackle these challenges.

The remainder of this paper is organized as follows. The next section briefly describes the impact of IT on the business objectives of a company. Section 3 outlines that governance is a key factor of business alignment and describes on which levels governance could be established. In section 4 we compare different governance methods and introduce component governance as a new governance method. The last section concludes the paper and outlines future work.

2 The Impact of IT on Reaching the Operative Business Objectives

To be successful in telecommunication markets it is mandatory to meet the market requirements of the future. TelCos have to provide their products in mass markets to be profitable. Therefore TelCos need to produce the required products in a fast and flexible way. With regards to these circumstances an analogy to different types of manufacturing can be found.

In general there are three categories of manufacturing:

- *Job-shop production:* In Job-shop production or batch processes a product is assembled by several activities step by step. It is not necessary that every product runs through all process steps. For example in a bakery the products are produced in batches and in a high variety but the activities are fulfilled one after another. The job-shop production model is an approach which is very flexible but the number of produced products is rather moderate.
- *Mass production:* Mass production or assembly lines are very common in automobile industries. The activities and sequences to assemble a product are fixed. Therefore the outcome is very high but the variety and flexibility is rather low. For the company it is very cost and time-intensive to change the production line.
- *Continuous production:* In the continuous production model the product is produced in a non-stop flow. Famous examples for continuous production flows are oil refineries or the salt production. With a high process speed it is possible to produce a high quantity of products. In a continuous production scenario the outcome is measured in weight or volume. A changeover is very time-consuming, causes a lot of efforts and is in most cases nearly impossible to reach.

The main differences between the three types of manufacturing described above are the output volume and variety and the process flexibility. In continuous production processes the output of products can be very high but as a result the flexibility is very low. In a mass production scenario the volume can be high but the variety and the flexibility is still low. Job-shop production processes are very flexible and also the variety can be very high but the outcome is rather moderate or low compared to the continuous production model and to assembly lines (cf. [Sch98a]). For TelCos it is critical to be very flexible and move fast in mass markets. Within modern TelCos exist very different and complex considerations to

reach the ideal production process. On the one hand in a TelCo the production structures are very similar to the Job-shop production but on the other hand the products are produced for mass markets. With regards to both requirements we introduce a new approach that allows to treat a job-shop model as a conjunction of a number of assembly lines. The component governance model is the most adequate strategy to be adopted by telecommunication companies to be profitable in mass markets and to reach a TelCo‘s business goals.

The information technology (IT) of a company is exclusively used to achieve the overall business objectives (cf. [RR06]). In an ideal business scenario the IT of an enterprise follows the company's business model without limiting it. Strategic changes to the business model of an IPT should only provoke operative changes of its IT without affecting the strategic IT landscape of the entire company. To reach the previously described situation it is necessary to align the IT landscape and the business model of the company (Business Alignment) in a proper fashion.

The strategic business models of TelCos include distinct scopes:

- *Trading:* TelCos offer their own products and services as well as third party products.
- *Production:* To produce and finish their own products. TelCos have a complex production infrastructure.
- *Usage:* TelCos provide their products 24/7 to their customers. To meet the resulting requirements, a TelCo needs high quality processes in Operations, Performance Management and Assurance.
- *Innovation:* To maintain the competitive advantages it is necessary that IPTs assure a extraordinary innovation cycle to launch new products and related technologies.

All these various scopes affect all different business processes of a company. Companies have to provide a consistent interface for customers, have to ensure the interoperability of different related products, have to meet the requirement of distributed production and have to solve the problems of shared and highly dependent communication infrastructures (Platform).

The processes of a modern TelCo are not longer manageable with any reasonable efforts. In fact it is virtually impossible to solve the dependencies of processes of TelCos. Therefore the IT of a TelCo has a strategic key role to act profitable in the markets. Modern TelCos are strongly affected by fully automated IT processes. More and more all the manual activities and services will be replaced by central automated IT processes. That means IT will be a key factor for success moreover IT will gain a central function to control the company. Governance will be the key method to align the IT with the operative business objectives of the company.

3 Governance as a Key Factor for Business Alignment of IT

Governance assures the Business Alignment of IT through the implementation of appropriate management and controlling strategies. Based on the reasons described above governance will be a strategic key factor for the success of IPTs in the future. Governance could be established on various levels:

- *Execution Governance:* Many of today's famous governance methods try to achieve an execution governance by using the concepts of service oriented architectures (SOA [BCK98] [HWSD07] [RFPK07]). To reach these goals companies often use catalogues to manage services (service-repository) or define overall data structures (business-object-models). It is very common to use abstract modeling notations e.g. Unified Modeling Language (UML [FEL97]) to harmonize the concepts and documentations. From a generic perspective these mechanisms solely ensure the accessibility of programs (services), the clear programming (data models, etc.) and the executable deployment of programs. The important conclusion is, that these models do not ensure that the implementation supports the business model and business objectives of the company (cf. [AS08]).
- *Process Governance:* The basic idea of the governance is the formalization and the harmonization of the whole process landscapes (cf. [Sch98b]). In huge complex process landscapes (e.g. TelCos) it is almost impossible to realise this approach. Because of the rapid pace change of businesses and the decentralized processes, the process models cannot be maintained in a sufficient time frame. A requirement of company-wide process models are company-wide data models. Data models have the same problems as process models: It is almost impossible to maintain consistent models in a fast changing IT landscape. Governance of company-wide processes and data models requires constant monitoring and is affecting thousands of individual factors. This endeavour requirements generate huge efforts and costs. In addition, the adoption of standard IT systems evokes that process elements and data models are driven by external IT products but not by a strategic specified company process model.
- *Business Transaction Governance:* Each relevant process will be initiated by the corresponding business transaction (e.g. product request or beginning of product usage) Every business transaction holds a binding in- and output functionality. The governance is responsible that all business transactions are executed by the IT. A TelCo for instance has around 30 different business transactions. business transaction governance can possibly replace process governance. To a certain degree that is possible because IT could support some business transactions without knowledge of every process detail.
- *Structure Governance:* Structure governance determines which business transactions are allowed to trigger other business transactions. The rules for structural governance will be aligned with important company structures e.g. product structures. The attempt of the structure governance is to provide a consistent mapping of the business model of a company.

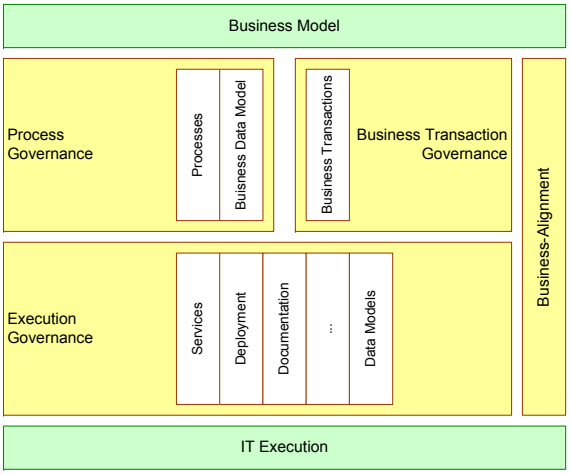

Figure 1: Levels of governance. All levels are necessary to ensure the realization of the business requirements by IT.

Figure 1 illustrates that all levels of governance must be taken into account. Otherwise it will be impossible to ensure that the IT is able to support the business model and business requirements of the company. If only one layer is missing it also may be unfeasible to meet the needs of the market. There are various governance methods to improve the Business Alignment of IT in business. Irrespectively which governance method is adopted in a company it has to be ensured that all the different levels of governance are supported.

4 A Comparison of different Governance Methods

The following section will describe how governance could strongly improve the Business Alignment of the entire IT landscape of a TelCo. Therefore we compare 3 different governance methods. Firstly we describe the functional governance. In the second subsection we depict the characteristics of product governance. As a third governance method we take a new so-called component governance into account. In order to have a consistent basis for the comparison we consider various governance methods using the cost function *C*.

$$C = C_{swimpl} + C_{plug} + C_{unplug} + C_{t2m} + C_{data} + C_{process}$$

Therefore C_{swimpl} is equivalent with costs of software implementation. C_{plug} is the costs to plug the software for a new product and C_{unplug} the costs to unplug the software and costs for migration. C_{t2m} stands for costs for time to market. C_{data} and $C_{process}$ describe the costs to maintain data and process models. To establish a consistent basis for the

comparison of different governance methods the cost variables may accept integer values in the range of -2 and 2.

Since IT governance is mainly needed to support IT changes our model basically analyzes the costs which arise when products are plugged or unplugged.

4.1 Functional Governance

In a functional governance scenario the business transactions of various products will be aggregated into blocks with similar functionality. A TelCo has many functional blocks, e.g. sales and distribution (Customer Relationship Management), production (Fulfillment), operations (Operations), management of resources (Readyness), error handling (Assurance), product usage accounting (Mediation, Billing) etc. Each product uses several functionalities of different functional blocks (see figure 2). Each block is designed to maximize the reuse of existing IT functionality.

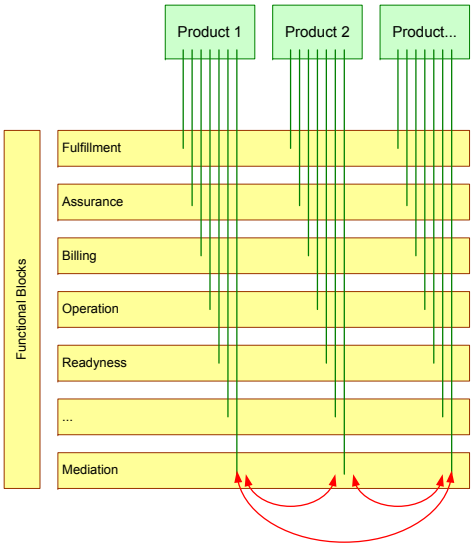

Figure 2: Functional governance. Each product uses functionality of various functional blocks. Each functional block centralizes similar functionality in respect of a high reuse (green lines). The functional governance generates a lot of dependencies between different products (red lines).

Because of the shared usage of functional blocks and a high level of reuse all products are strongly dependent on each other. That means a change of functionality within one block could theoretically affect all the products which use this particular functional block. Hence the functional dependency α of the products is in a worst case scenario $\alpha = n$. Therefore n is defined as the dependency with all products.

Functional governance reflects a conventional mindset in the IT development industry.

In the business field of TelCos, frameworks like the enhanced Telecom Operations Map (eTOM [Fora]) support and implement ideas from functional governance. Due to the strong dependencies between a TelCo's products it is necessary to maintain a comprehensive data model. In the business field of TelCos different approaches exist to harmonize such huge data models. One example is the Shared Data Model (SID [Forb]).

In the following it will be analysed which costs occur if the company chooses a suboptimal way of implementation. All the considerations on C are based on a worst case analysis. Theoretically it is possible to reach the ideal implementation of one of the shown structures. Without governance it would be a (lucky) coincidence to pick the ideal implementation. In real business it is more likely that a company chooses a suboptimal implementation. Based on the worst case analysis it will be investigated in how far governance can ensure low costs even in the case of suboptimal decisions.

Compared to other governance methods and because of a strong rate of reuse C_{swimpl} is rather low (= -1) in functional governance approaches. C_{plug}, C_{unplug} and C_{t2m} are rather high (= 2) because α increases the chances of a minor change of the product portfolio generating a lot of effort and costs. C_{data} is also high (= 1) because it is necessary to have a consistent data model. Due to the strong dependencies between products' α, there are strong dependencies between processes which generates a high (= 1) $C_{process}$ as well.

$$C_{functional} =$$
$$C_{swimpl}(-1) + C_{plug}(2) + C_{unplug}(2) + C_{t2m}(2) + C_{data}(1) + C_{process}(1) = 7$$

The above cost function shows that $C_{functional}$ could be very high. Thus, in certain cases it could be critical and very cost-intensive for TelCos to only implement only a functional governance.

At a first glance the result seems rather surprising since the common objectives of software design, such as a high reuse of components, lose their value and other factors, e.g. reducing the complexity of data and process models or the ability to integrate third party software (for new products) gains much more value. This interesting change of software design factors and the need to create new unconventional design principles is a particular challenge in developing new IT systems for IPTs.

4.2 Product Governance

For product governance it is significant that each product has its own business transactions without any dependencies to the business transactions of other products. This particular characteristics disallow the reuse of any software components in various products [CW06].

There are no dependencies between products which leads to α = 1. Product governance represents the common approach in mechanical manufacturing. For each product exists at least one production line. Product governance does not require a comprehensive data model but it needs similar functionalities as the functional governance e.g. Fulfillment,

Mediation, etc.. However, the functionalities are required within each product's production line. It is not allowed to have dependencies with other products. For instance a TelCo with 3 products has 3 separate production lines and needs separate Fulfillment functionalities (see figure 3) for each product line instead, as in a functional governance scenario, just one functional block which provides the Fulfillment functionality to all 3 products.

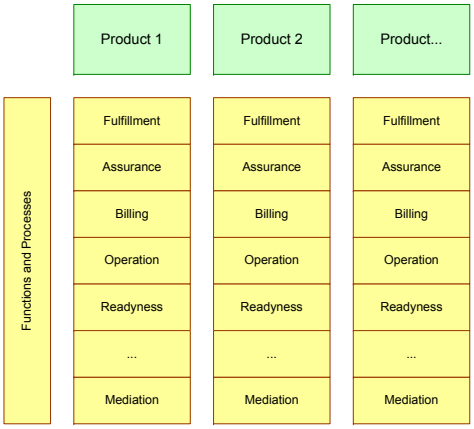

Figure 3: Product Governance. Each product uses completely separate business transactions. A reuse of functionality between the products does not exist.

In contrast with other methods, C_{swimpl} is very high (= 2) as each product has its own software. C_{plug}, C_{unplug} and C_{t2m} are very low (=- 2) because there are no dependencies to other products. A comprehensive data model is not necessary, therefore C_{data} is very low (=-2). $C_{process}$ is very low (=-2) as well, because the processes exist just within the products.

$$C_{product} =$$
$$C_{swimpl}(2)+C_{plug}(-2)+C_{unplug}(-2)+C_{t2m}(-2)+C_{data}(-2)+C_{process}(-2) = -8$$

The cost function for product governance shows a nearly ideal cost structure. In addition to that, the product governance allows a company to outsource a whole production line, because of consistent separation of the products.

A product governance would be a nearly ideal IT infrastructure for a TelCo. Unfortunately, it is not possible to apply this structure in reality. The reason is that various products of a TelCo need to share some critical technical system resources (platform). For example products need to share the usage of cables in the area of network access or IP connections. In a product governance approach it is extremely difficult to create a single customer interface. For instance for cross product troubleshooting (Assurance) various production lines have to be harmonized.

4.3 Component Governance

As shown in the subsections above, for TelCos it would be very cost-intensive just to apply functional governance. For technical reasons it is also impossible to apply product governance in a TelCo. Therefore we introduce component governance, a new approach which combines the advantages of both other governance methods without limiting a TelCo in its flexibility. For this approach it is significant that the product structure is separated into a tree structure with components. That means market products at the point-of-sale are composed of several components through internal processes. It is imaginable that components are part of different other components or market products as long as the product tree structure for each market product is determined (see figure 4).

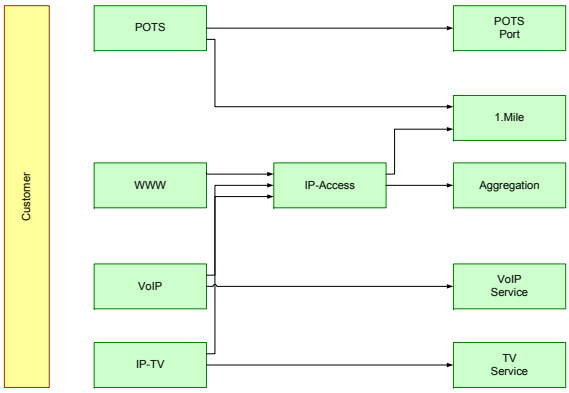

Figure 4: The figure shows an example of a product tree for a combined IPT product. The market product VoIP uses the components IP access and VoIP service.

In component governance each market product or component has its own entire set of business transactions. These business transactions correlate with business transactions of other components only if a the component is used as a pre-product (see figure 5).

As a result of that logic an individual production line exists for each component hereafter referred to as $factory$. In analogy to the product governance a factory for a component has all functionalities. As a result a reuse of functional blocks between factories is prohibited.

It could occur to have dependencies between different market products whenever it is required to share critical system resources. In that case market products or components use the business transaction of the factory together which delivers the product and which holds the critical resources. Because of the reason that just a few critical resources exist, α is approximately constant and therefore is $\alpha \ll n$. Another advantage is that the dependencies occur only locally within the components.

Extensive cross-component data models are not required. However, it is required to have a global product model, so that the factories can use the components provided by other factories.

Compared to other methods C_{swimpl} is very high (= 2) because there is no reuse between

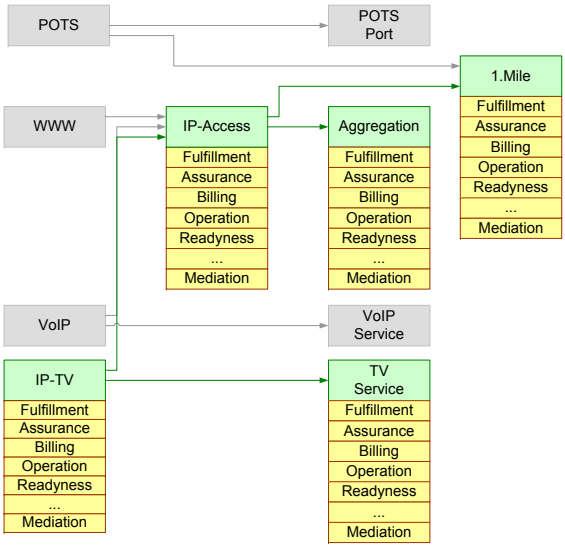

Figure 5: Component Governance. Each component is provided by a factory which has its own business transactions. The components only use business transactions of other factories in when it is necessary to use the component of the other factory.

components. C_{plug}, C_{unplug} and C_{t2m} are rather low (= 0) because it is only necessary to adjust dependencies between components. C_{data} is low (= 0) as well because there is no need for a comprehensive data model. It is only required to adjust the shared resources.

$$C_{component} =$$
$$C_{swimpl}(2) + C_{plug}(0) + C_{unplug}(0) + C_{t2m}(0) + C_{data}(0) + C_{process}(0) = 2$$

The cost function $C_{component}$ shows that the costs in a component governance approach are much lower than in a functional governance approach. The primary advantages of the product governance e.g. the possibility to outsource factories are still realizable. The fact that factories are individual profit centers eases accounting governance. Component governance is a result of the combination of methods but furthermore it is realizable for a TelCo. Because of the structure of the products it is easier to encapsulate the product structure and factories. This encapsulation matches the grown structures in daily business thus it ensures compatibility with company structures.

Within the factories, the structures and functionalities match current approaches to harmonize the IT of TelCos e.g. eTOM [Fora], SID [Forb] or ITIL [Lim]. Hence it is possible to use standard software products, Commercial off the Shelf $COTS$ products. Furthermore we applied some basic governance rules to achieve a component governance.

Component factory: Each product is provided by exactly one factory. The factory provides all the necessary business transactions for a product.

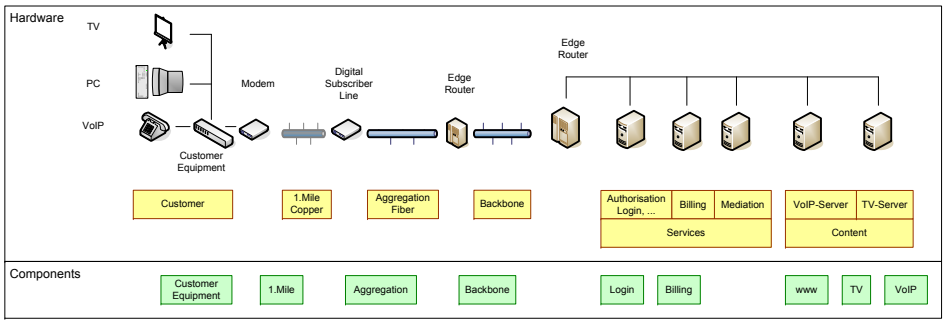

Figure 6: Factory structure. The components are cut along the technical structure of a TelCo.

Consistent factory business model: All factories provide a predefined set of business transactions. Each factory is able to decide whether it will provide a specific business transaction or not, but it is not allowed to provide business transactions that are not part of the predefined set of business transactions. The business model defines business transactions for trading as well as for the production and usage of components or market products. This approach ensures that the factories provide exactly the business transactions which are necessary to meet the requirements of the company's Business Alignment.

Central structures: All factories need to follow the same central structures. This includes mandatory requirements for product structures, models for error handling and production plans to ensure a coordinated component production.

Compared to functional governance, component governance applies only few rules. Based on the standardized business transactions, each factory is a (small) TelCo for its own component. The result is a fractal structure of factories [War96] which enforces Business Alignment in all parts of the IT landscape.

5 Conclusion

In this paper we described and compared three different governance models with regards to the degree the models meet the challenges of a modern IP-centric telecommunications company. In particular we defined a new approach of IT governance which combines the advantages of functional and product governance. We determined the rules for the new approach of component governance especially to support the business alignment of the IT in an appropriate way. The authors assume that the application of component governance is the best way to meet the requirements of a modern IP-centric telecommunications company. Component governance offers exceptional advantages in environments and companies with a high reuse rate of components e. g. telecommunications companies.

In the future, the approach of component governance will be implemented in a major German telecommunications company. Future work on the component governance will

include research work on the adequate encapsulation of factories and on communication structures between several factories.

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