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Mastering Business Intelligence Complexity - A Service-Based Approach as a Prerequisite for BI Governance

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ABSTRACT

Integrated approaches to management support – Business Intelligence (BI) – have become widespread. The respective solutions have evolved to highly integrated, complex solutions that cannot be treated as sequences of isolated projects anymore and require central coordination and regulation. As a consequence, companies have begun to implement BI governance structures. However, these initiatives face the challenge that there is still a lack of insight into how to capture and track the underlying service landscape. Based on a framework for service delineation, two case studies are analyzed and discussed. As a result, a service oriented concept for supporting BI governance is derived. It complements the framework with aspects of solution composition and decomposition as well as for lifecycle management and thereby enables a holistic perspective in BI governance approaches.

Keywords

Business Intelligence, Governance, Service Management, Data Warehousing Infrastructures

RELEVANCE

When the term *Business Intelligence* (BI) was coined, it was primarily used as a marketing oriented term by consultants and analysts. Gartner, Inc. – one of the protagonists – summarized in the mid nineties that "*… data analysis, reporting, and query tools can help business users wade through a sea of data to synthesize valuable information from it – today these tools collectively fall into a category called ´Business Intelligence´*" (Anandarajan et al., 2003). After years of controversial discussions, the term BI has been established in research and practice. Today BI is commonly understood to be an integrated, organization-specific and IT based total approach to decision support (Baars and Kemper, 2008).

Meanwhile, the actual management support solutions have undergone fundamental changes, too. In more and more companies, BI is based on intricate, multi-layer architectures that are interwoven with all sorts of transactional systems (McKnight, 2007, Sherman, 2007). Additionally they have evolved to enterprise spanning infrastructures that support all hierarchy levels and business functions (Moss and Atre, 2003). In consideration of the infrastructural, integrated, and cost-intensive character of BI, it becomes evident that the management of BI has to go beyond the control of a simple sequence of isolated BI development projects. This conclusion is also supported by empirical results which show that most BI users have left the initiation and concept phases of their integrated solutions and are now in high-quality growth and consolidation stages (Unger and Kemper, 2008).

Those developments entail the need to craft individual conceptual frameworks, to implement BI support centers, and to design regulations that govern the provision and the operation of BI-applications (Cunningham and Elliott, 2005, Eckerson, 2006, Geiger et al., 2007, Miller et al., 2006, Strange and Hostmann, 2003). This notion is also increasingly shared among practitioners. Therefore companies have begun with the implementation of dedicated organizational units for the professionalization of BI. However these units still vary widely in scale, scope, and provenience – some are primarily understood to be offsprings of the IT department while others are closely related to business units (Unger and Kemper, 2008).

Due to the relative infancy of these initiatives, there is recognizable a lack of approaches that help those units tackling the complexity in steering and aligning BI. It needs to be acknowledged that BI is shaped by difficult business-IT-interrelations and the need to bring together a variety of heterogeneous functional units – much more than in the realm of traditional transactional systems. The issues have become more complex, as the production and consumption of BI services are increasingly spread across multiple units and in some cases even started to go beyond organizational borders.

For the purpose of designing sustainable approaches, the BI domain can draw from findings in the general field of IT governance, which recently has drawn increased attention by practitioners and researchers (Ali, 2006, Brown and Grant, 2005, De Haes and Van Grembergen, 2006, Hildreth, 2005, Lainhart IV, 2000, Seabrook, 2003, Weill, 2004).

IT governance addresses issues of rules, recommendations, roles and responsibilities as well as project prioritization with the aim of consistently aligning the IT with the overall strategy of the organization (Broadbent, 2005, Gutierrez, 2008, IT Governance Institute, 2003). The peculiarities of BI, however, need to be reflected in a dedicated *BI governance approach*. Notable steps in that direction are the development of BI maturity models and the adaption of IT service management frameworks to Business Intelligence (Eckerson, 2008, Henschen, 2007). Notwithstanding those efforts, there is still a lack of insight into how BI services actually can be distinguished *from a governance perspective* and how they should to be described, measured, and managed. It needs to be acknowledged that the operation of BI solutions has commonly become a continuous task that binds considerable financial, personnel and managerial resources – it goes far beyond handling isolated development tasks: The variability and sensitivity of BI supported managerial tasks as well as the complexity of the BI systems makes it indispensable to provide adequate support and conduct regular adaptions - that need to be prioritized and aligned with the overall strategic goals of the enterprise (Gonzales and Wells, 2007, Miller, 2007).

This paper validates and complements a framework for the delineation of BI services. For this purpose, two case studies on large-scale and mature BI initiatives have been conducted. The results are the foundation for the derivation of a concept that addresses the management of BI services and BI solutions. The concept is considered to be pivotal for the design of a BI governance approach which is envisioned to be supported by monitoring and analysis tools.

RELATED WORK

In order to define BI governance and to select a suitable framework for analyzing the chosen cases, it is necessary to identify the key facets of IT governance. According to Weill IT governance is "…*specifying the framework for decision rights and accountabilities to encourage desirable behaviour in the use of IT*"(Weill, 2004). Similar, the IT Governance Institute states that BI governance "…*is an integral part of enterprise governance and consists of the leadership and organisational structures and processes that ensure that the organisation's IT sustains and extends the organisation's strategies and objectives*" (IT Governance Institute, 2003). Besides aspects of designing strategies, structures, and processes for a strategic IT alignment, the development of supporting measures is seen as an important building block (Van Grembergen, 2003).

Here Weill's (2004) notion is shared, that identifying the major types of IT or BI management decisions are pivotal for elaborating a respective governance framework. But furthermore it is seen as a prerequisite for any IT or BI governance approach to capture and structure the *types of objects* and the underlying resources to which these decisions refer (Boynton et al., 1992).

In the context of IT governance, those objects are the IT services, and the bases for their identification are IT service management (ITSM) concepts, which act as the topsoil for IT governance. According to the Office of Government Commerce (2007) a *service* is defined as "*A means of delivering value to Customers by facilitating outcomes customers want to achieve without the ownership of specific costs and risks*".

ITSM is designed to integrate business and IT on process level to support the adaption of governance approaches by providing the necessary means for decomposing complex IT organizations and solutions into encapsulated service definitions. Defining services is seen to be the basis for the derivation of adequate performance metrics and business oriented service level agreements (SLAs) which in turn enable an effective oversight and monitoring of both internal and outsourced IT services (IT Governance Institute, 2003).

IT governance derives its principles from corporate governance (Weill, 2004) and BI governance is likewise understood to be a hierarchical derivation and specific interpretation of the principles and aims of IT governance (cf. Figure 1, Gutierrez, 2008).

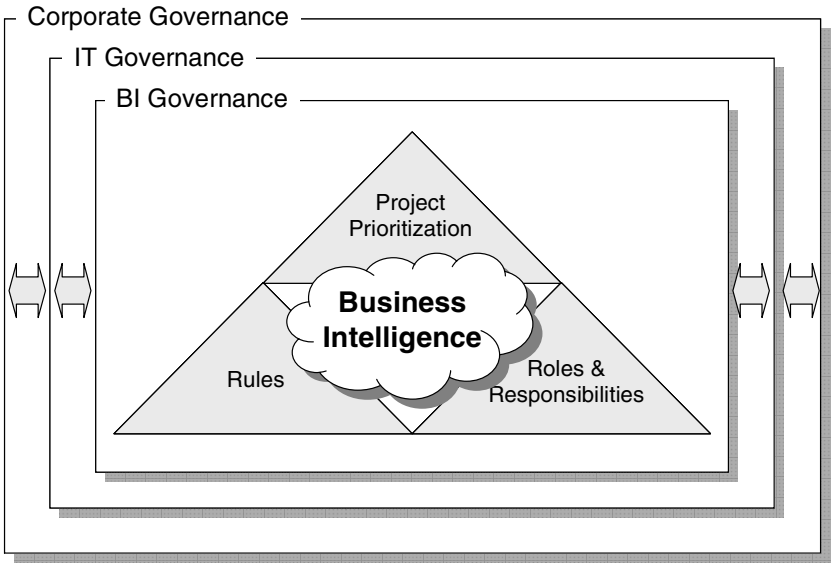

Figure 1. Hierarchical Derivation of BI Governance Principles

BI governance specially refers to the ability to support and guarantee the execution of business processes based on *BI services* that are ultimately aiming at the provision of decision relevant information to managers – either by directly producing the information or by regulating and prioritizing projects for designing adequate IT systems as well as operating, and supporting IT systems for that purpose. The providers of BI services take over full responsibility for cost and risk of implementing and operating adequate systems.

BI SERVICES FRAMEWORK

The framework for distinguishing BI services that is the basis for this research has been derived in the context of research on BI outsourcing. It is meant to structure, differentiate and to allocate activities and processes as well as responsibilities concerning BI solutions. It is motivated by an empirical study that highlights the business potential of distributing BI services across organizational borders, and thereby unbundle the complex structures of contemporary BI solutions and slice them into well defined services that can be seamlessly assigned to varying organizational units. (Kemper et al., 2007). The associated service descriptions and service level agreements deliver a basis for the allocation of responsibilities as well as information on decision rights, input rights and the accountability required by BI governance approaches.

The framework is spanned by three dimensions that are deemed indispensable for distinguishing BI services: A *component dimension*, a *business specificity dimension*, and a *life cycle dimension.*

The starting points for the framework are the software components that form the heart of BI: BI Services usually address or utilize defined subsystems like data warehouses, data mining software, OLAP applications etc. A way to specify the instances of the *component dimension* is to apply established BI frameworks (Kemper et al., 2007). The relevance of this dimension stems from the self contained nature of most of those components and the differences in the hard- and software requirements.

The second dimension *business specificity* distinguishes between infrastructure related services, like hardware provision or BI tool hosting, from those closer to business, e.g. data harmonization or the development of individual data mining solutions. The core criterion for differentiating along this dimension is the allocation of responsibilities between the provider and the user of BI services. The more responsibility for the business content is shifted to the provider, the more he needs comprehension of specific business semantics and user context. Building up on the concept of a *service stack* (Kern et al., 2002) the framework proposes the distinction of four layers:

- *Hardware* – provision and running of the relevant computing, storage, and telecommunications equipment necessary to operate one or more BI components.
- *Applications* – this relates to the BI software, from ETL tools and Data Warehouse software to dedicated solutions for reporting or data visualization.

- *Templates* – understood as preconfigured applications and prearranged contents that can be adapted to individual needs.
- *Content* – this pertains to the actual business semantics. A provider that operates on this layer takes over responsibilities pertaining to the definition, gathering, structuring, transformation, and/or presentation of data.

The third dimension that needs to be addressed is the focused phase in the application life cycle: It can be differentiated whether a service is devoted to the development of components (or parts of them) or on their operation. Although one might define an even finer granularity on this scale, differing *development* and *operation* is the most significant one, because these two phases call for utterly different tools, skills, and management practices. The *life cycle dimension* is relevant for all components and for all discussed layers of business specificity.

The resulting framework is visualized in Figure 2.

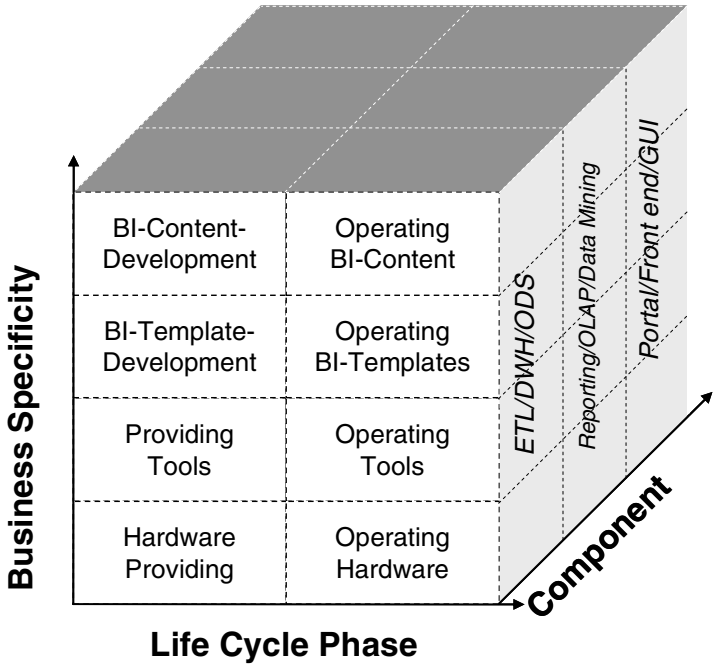

Figure 2. Framework for Distinguishing BI Services

METHODOLOGY

The aims of the research discussed here is the validation of the framework in a real life context, the evaluation of possible applications and shortcomings, and the identification of needs to embellish it. Due to the explorative nature of these objectives, it was decided to conduct qualitative case study research.

The selection of the cases was based on previous empirical studies. For the aim of this paper two cases are selected based on the criterions maturity, size, and complexity of the solution. The two chosen companies are also found to be complementary regarding their approaches. Both represent competitive and successful global players in challenging industry sectors that are achieving appreciable returns and employ an above average number of employees. The applied data gathering techniques were interviews, workshops, and analysis of available documents on the subject. All methods were designed to address the framework introduced above.

Case 1: Structuring and Integrating Heterogeneous BI Solutions in an Automotive Company

The first case deals with the challenges in managing the BI infrastructure of a motor vehicle manufacturer. The respective company is confronted with a variety of heterogeneous decision support systems in its business units. The systems have been for the most part autonomously designed and developed in a sequential series of projects with only few cross project coordination. Although the data warehouse platform is identical for all systems (SAP BW) to allow for an efficient

integration of the existing ERP system landscape, all solutions run upon separated instances of the software, are individually customized, and complemented by different reporting products.

So far, every project has been carried out in cooperation between the respective business unit and the centralized IT department. Over time, the BI solutions grew as well in number, data volume, and relevance for the business. Furthermore, multiple interdependencies between the different systems became apparent that were sources for blatant redundancies. Obviously, the current loose approach to handling BI had become both inefficient and ineffective, and the popular ad hoc coordination between the stakeholders had to be abandoned.

As a response to the situation, the company established a BI CoC (Center of Competence) within the IT department that acts as a linking pin between the various user departments and the corresponding IT units (cf. Figure 3).

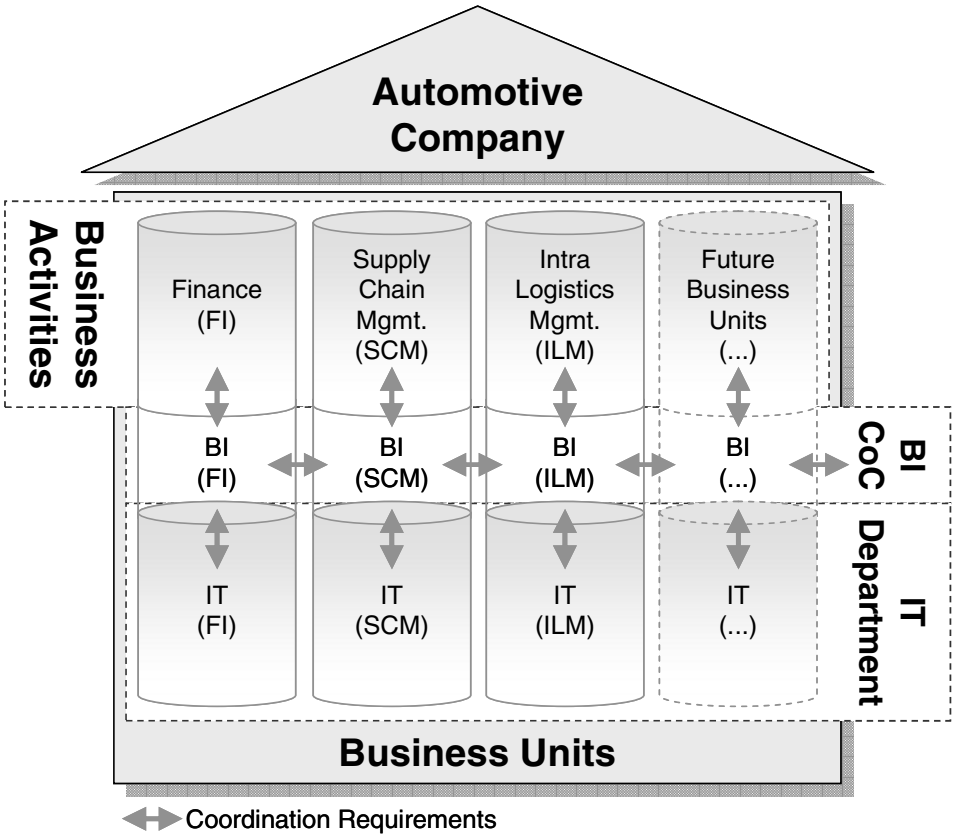

Figure 3. BI related coordination requirements in the automotive company

Hardware provision and operation

On the hardware side the solutions suffer from the intransparent and unplanned growth of the systems both regarding size and usage. As a consequence, the response time of several systems has become inadequate.

The government facet of these problems lies in the need to establish structures and processes that design, monitor, and control the hardware services needed for the complete *spectrum* of BI applications – under consideration of efficient resource allocation. This in turn means that information is needed both on the current and planned hardware provision services as well as on the demands coming from the higher business specificity layers.

Application and template provision and operation

The application provision is characterized by parallel implementations of reporting components with identical functionality (e.g. templates, GUI designs) in the different business units. Moreover, there are unnecessary differences between the applications. All this leads to avoidable efficiency losses and calls for scrutinizing possibilities to define *standardized* templates and applications that can be reused for or even shared among various applications. A prerequisite for this is the decoupling of the often highly individual content from the reporting software.

Content development and operation

Standardization is also an issue on the content side: Differing and inadequately harmonized process models for developing BI solutions cause inconsistent data architectures and heterogeneous name spaces with the effect of avoidable syntactical and semantic incompatibilities. The latter block the path to cross functional analyses solutions and are a source of inconsistencies in reports. Another problem area is missing information on data ownership and persons in charge of data quality.

Again, there is a lack of structures and processes that ensure defined building blocks for the solution – and which in turn need to rest on standardized and clearly specified templates and applications that can be (re)used across individual solutions. Relevant information pertains to the data to be kept, the data models, and the metadata including information on data volume, semantics, data ownership, and data usage.

Life cycle – operation

The current operations are hampered by insufficient documentation about assignments and allocations of persons in charge of system administration and coordination. Furthermore, the time periods for technical maintenance and updates is challenging as the solutions are used heavily across the globe and therefore across time zones.

These problems are not unlike those with other systems in the IT domain. A way of tackling this area might lie in the implementation of established processes from frameworks like ITIL.

Discussion

The case clearly indicates that the strategic relevance and the company wide importance of truly *integrated* BI systems had not been foreseen: With the growth of individual BI solutions comes an urgent need for adequate BI governance regulations. It needs to be pointed out, however, that the problems discussed above cannot be tackled with a simple set of regulations: Even the BI CoC acknowledges that the individuality of the existing BI solutions is only partially founded in missing regulation. The major part of individuality can be justified by the significant differences in the business units' requirements. The arising challenges are described by one of the members of the BI CoC staff:

> *"What has to be regulated and which regulations are necessary and adequate? And how do we tell our customers that they might no longer be supposed to do, what they did before?"*

The case supports a modular approach that aims at identifying and isolating reusable and standardized services. It also shows that there is a need for units that keep an overview of the spectrum of services and that regulates the service composition to integrated solutions to ensure reuse. The framework is deemed as a valid approach – if understood as a starting point to tackle the overarching compositional tasks.

Case 2: Documentation and Lifecycle Support for the BI Solution in a Stock Exchange

The second case highlights life cycle aspects of BI solutions. The company looked at is a former national stock exchange that has over time turned into one of the largest stock exchange organizations in the world. By the end of the last century the company not only faced new environmental conditions like increased dynamics due to the rise of internet-based trading, but also stronger demands of internal and external stakeholders for precise, trustworthy and real time decision support content. The developed BI solution is a real time data warehousing solution that acts as a hub for information distribution to a worldwide financial community. It moreover permits internal and external users a prompt analysis of market related mass data.

The complexity of the given environment derives from the dynamics in the worldwide financial markets. Flexibility is crucial for providing decision relevant information. For internal and external customers the shortness of the timeframe between the identification of an informational deficit and the information delivery is a critical success factor. Therefore the stock exchange's success depends on its ability to professionally manage the complex processes of analyzing requirements, and implementing and operating customer specific BI solutions.

In order to be capable of fulfilling these demanding requirements, the BI system was designed as a best of breed approach with combined products from various suppliers (Informatica, Microstrategy, Microsoft etc.). Operating and maintaining the system requires varying qualifications and intensive coordination among the responsible staff. To support professionalism and to enable flexible adaption by reducing these coordination needs, the company bundled BI specific knowledge and responsibility in a discrete BI Center of Competence (CoC). This organizational unit carries out all activities concerning the real time BI solution except for hosting the hardware infrastructure, which is run by an internal data centre.

Over time not only did the requirements for the provision of informational products become more diverse and increasingly demanding, but also steps to transform the CoC into an outsourcing provider for BI services posed heavy requirements on the ability to quickly design, develop and deploy new solutions based on the given infrastructure. According to the framework the following conclusions need to be highlighted:

The *hardware provision services* are under the responsibility of the data center which works against tightly defined service levels. In the given case the two lower business specificity layers are already decoupled based on well defined interfaces.

Up until recently, the dominant services of the CoC were residing on the *content provision and operation layer* – the development of informational products, like market indicators, cubes for financial analyses, data enrichment services etc. The stock exchange was responsible for the correctness and timeliness of the information products.

The *application and template provision* turned out to be not as well defined as the other levels, as the respective activities were contained within the firmly interacting team of the CoC. Coordination requirements were also curbed by the use of a defined set of optimized software solutions and a well established distribution of tasks and specializations. However, with the increased variety of the information products on the content layer on the one hand and the move to offer the design, implementation, and operation of BI solutions for external customers on the other, the lack of transparency on this layer became a roadblock: The new services needed to be integrated technically and organizationally in the given environment and designed in alignment with the given infrastructure.

Discussion

Compared to the automotive company, the predominant challenges for the stock exchange lay not in *composing* solutions based on an originally heterogeneous system landscape but rather in *decomposing* an originally homogeneous solution to be able to react to more heterogeneous requirements – in a small time frame.

The stock exchange actually applied the framework presented above to capture its service landscape. But when trying to adapt the concept to the development of new solutions some demands for enhancing the approach became apparent. The head of the CoC explained:

> *"We had to realize that we cannot fill out the service descriptions right from the start, because the customers we deal with usually do not exactly know their needs beforehand, or lack the previous knowledge necessary to define the requirements for such complex BI solutions."*

The CoC members highlighted that there was a clear demand for a service based documentation which traces the actual composition and configuration of an individual solution from a customer and service level perspective. They also demanded an IT based support to efficiently capture and track the services – including the interdependencies – on all levels.

COMPARING THE CASES

The main differences between the two cases lie in the structure of the current solutions, their respective history and thereby current concerns.

Nevertheless, in both cases increased complexity led to the demand for a systematic delineation of services that act as modular building blocks for solutions required by a variety of internal or external customers. Furthermore both cases deal with the interaction of various partners: In the case of the automotive company the BI CoC, the IT units, and the diverse business units. For the stock exchange the CoC, the data center, internal and external users of informational products and users of outsourcing services.

Both approaches were designed to address specific *BI issues* embedded within existing IT governance approaches. In the cases it became obvious that a core requirement to such specific governance implementations lies in getting a complete and transparent overview on the services and their interplay. The automotive case unveiled the need to address the composition of the services to solutions under strong consideration of service reuse. As shown in the stock exchange case, a concept for

managing services also needs to address ways of stepwise collecting information starting at the first phases of requirements design, and tracking it along the life cycle.

The differences between the cases are juxtaposed in Table 1.

	Case 1: Automotive Company	Case 2: Stock Exchange
Partners interacting with the CoC	• Business Units (users) • IT Departments	• Data center • Internal customers of informational products • External customers of informational products • Customers of application service providing solutions
Focus	• Solution composition based on modular services to enhance efficiency	• Solution decomposition to enhance flexibility
Challenges	• Gaining transparency regarding applications, content, and hardware requirements • Reuse of hardware • Reuse of reporting applications and templates • Integration of data models • Information on roles and responsibilities	• Gaining transparency regarding the application provision • Shortening the time to capture user requirements and develop new solutions • Defining self contained services for application provision

Table 1. Comparison of the cases

DERIVING A CONCEPT FOR BI SERVICE MANAGEMENT

Based on the requirements given in the section above, the framework for delineating BI services is enriched with concepts for service composition and life cycle management.

Service Composition: Solutions versus Services

As the cases show, a (de)composition approach to BI solutions becomes necessary when customer requirements vary, as solutions for decision support are highly depending on user needs. As indicated by the cases, even within one company, requirements of internal customers might differ so much, that a monolithic solution might not be a valid option.

However, the matter of discussion between the BI users and the BI service providers is at first not the individual *BI service* but a rather holistic *BI solution*, which contributes to the user's business processes. From a governance perspective, however, these solutions need to be understood as bundles of individual BI services that have to be compiled to form a solution – under consideration of consistency and reuse.

A solution could for example be an "*OLAP system for the marketing of business unit XY*" which comprises of services like "*Providing the data base hardware and storage infrastructure for the data warehouse*", "*maintaining the OLAP solution*", or "*data extraction, transformation, and quality assurance for the provision of sales data*". The services are the building blocks needed to efficiently design solutions for a multitude of customers and they are used to define and communicate roles, responsibilities, and performance measures.

The correlation of services and solutions is illustrated in Figure 4.

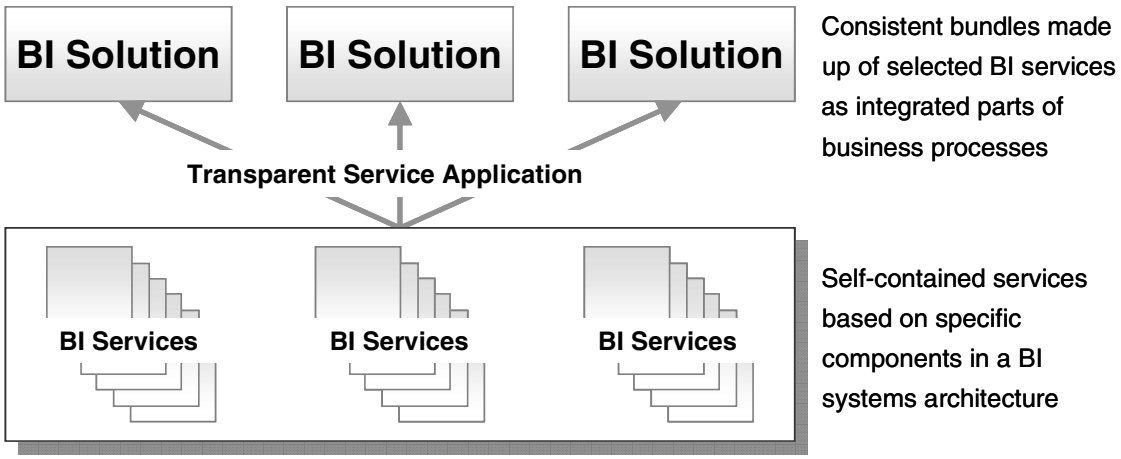

Figure 4. BI Services and BI solutions

To be able to handle the complexity of this compositional approach, the BI CoC needs to be supported with information on existing and planned services – a *BI services library*. Furthermore, information needs to be kept on what users are provided with what solutions – including information on service levels, roles and responsibilities, and interdependencies.

Tracking the life cycle

The second core conclusion is that there is a need to provide for a support of a deft information gathering regarding required BI solutions and the entangled BI services. This makes it necessary to be able to stepwise define services, starting from a more overarching solution view which later is incrementally broken down to individually and well defined services – which are whenever possible taken from the existing service library.

To keep the service library and the information on the solution up to date, changes need to be tracked. As in the domain of IT service management for operational systems, a systematic change management needs to be implemented, that defines processes and structures for dealing with change requests while keeping the information base on services and solutions consistent with the actual situation.

The resulting approach is depicted in Figure 5.

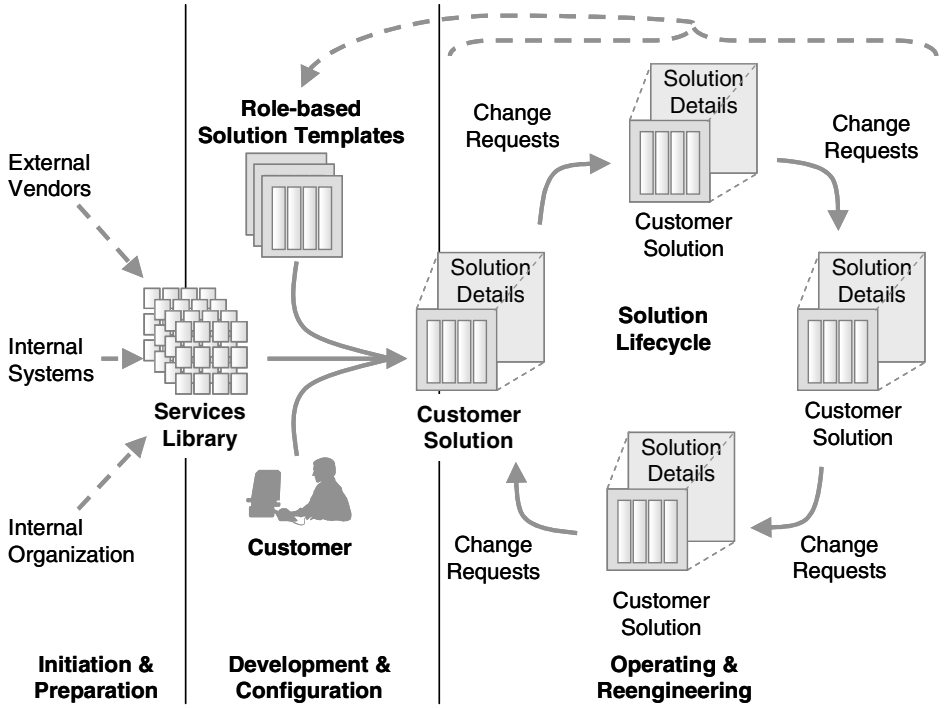

Figure 5. Resulting Concept

OUTLOOK

The described concept has already been discussed with practitioners and is currently being concretized in ongoing case study research. Another focus of the ongoing research addresses the application of the framework in small or medium sized companies with fewer resources for realizing more challenging BI solutions. This is of particular interest for loosely coupled organizations with shared data like franchise environments or organizations which are bound together by regulatory pressures to exchange data. Vivid examples for such company-spanning solutions can already be found in the convenience stores industry and in the health care sector.

Simultaneously heavy attention is paid to a tool support which is build upon the idea of a structured library of BI services and BI solutions. The tool is conceived to support

- the documentation of existing services,
- the development of planned and the reengineering of existing solutions,
- the communication between the cooperating providers of BI services and the BI users,
- monitoring the current status of the service landscape, and
- analyzing the performance of the BI units.

Based on those objectives, it has been decided to apply BI tools and develop an OLAP solution that allows flexible, multidimensional views on the data regarding the services and their behavior.

A second, interrelated string of research deals with the integration of the BI service management concept into existing IT service management approaches, and with the consequences for the design of a further-reaching BI governance approach.

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