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# Business Intelligence Center Concepts

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## ABSTRACT

The approach of Business Intelligence (BI) as a support function for management decisions is established in practice and theory. BI can not just be considered as a simple sequence of isolated single projects. Its coordination requires permanent efforts to keep the BI function and the business organization in alignment. In the context of the present empirical study, BI organizations have been analyzed for the diffusion of BI units and their distinct characteristics. Furthermore these organizations have been classified in different types of BI centers based on development and operational tasks. The results indicate a wide spread implementation of BI units in companies with a multifaceted range of duty. Thereby conclusions for the practical constitution of BI centers are deduced from the results.

## Key Words

Business Intelligence, Center Concepts, Empirical Study, Business Intelligence Lifecycle

## 1 MOTIVATION AND OBJECTIVES

The term Business Intelligence (BI) has its origin in consulting practice. It was initially put forward by the Gartner Group during the mid nineties. Gartner defined it to be: "... 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, Anandarajan and Srinivasan, 2004). After years of controversial discussions, the term Business Intelligence has eventually been established both in research and practice (Arnott and Pervan, 2008; Burke, 2003; Gessner and Volonino, 2005; Jordan, Rainer and Marshall, 2008; Moss and Atre, 2005; Williams and Williams, 2007; Wixom, Watson, Reynolds and Hoffer, 2008). It is now commonly understood as an integrated, company specific, IT based concept for managerial decision support (Baars and Kemper, 2008; Turban, Aronson, Liang and Sharda 2007).

Business Intelligence requires a framework which has to be developed and implemented under consideration of the individual organizational characteristics of a company. The framework should encompass areas of the strategic planning of BI usage, the development of the BI data architecture, the generation of BI project portfolios, the definition of basic conditions for BI development and the planning of technical BI infrastructures. Additionally, a continuous BI improvement process has to be established to ensure a regular adaptation of the framework to the changing context requirements (Baars and Kemper, 2008; Gonzales and Wells, 2007; Miller, 2007).

A closer look at the nature of these tasks and the respective solution reveals that in the BI context

- ultimate, time stable solutions cannot be developed,
- these tasks have crucial impact on the whole company,
- solutions require a distinctive coordination and
- employees should have interdisciplinary skills.

Considering the infrastructural, integrated, and cost-intensive nature of BI, it is obvious that the management of BI needs to go beyond the control of a simple sequence of isolated BI development projects (Cunningham and Elliott, 2005; Eckerson, 2006; Geiger, Hill, Loftis and Ton, 2007; Miller, Braeutigam and Gerlach, 2006; Strange and Hostmann, 2003).

The concept of Business Intelligence centers focuses on the associated challenges. BI centers are specialized organizational units with a formal and permanent structure. They assume the responsibility for cross-functional tasks concerning the effective and efficient development, operation and support of Business Intelligence across a company (Miller et al., 2006; Zeid, 2006).

The main goal of this article is to analyze the types of BI centers. This research can serve as a starting point to identify practically proven variants of organizational implementation structures for BI service delivery in companies. Hence, different types of BI centers are identified and classified. The results can be applied in several ways. There is an *orientation function* by revealing the possible scope of the organizational implementation. Furthermore, the results can be used for the *analysis* and the *comparison* of existing BI centers. In addition, the systematic *selection* of one special variant can be supported.

The article comprises several sections. After the explanation of the design of the exploratory study, the empirical results are presented to gain insight into the diffusion of BI units, the characteristics of their organizational implementation and the range of activities provided by those units. Moreover, there is a contribution by the identification and classification of different types of BI centers. The empirical findings motivate the delineation of a framework, which allows for the analysis of the allocation of BI tasks to possible task owners. Its application is demonstrated with the discussion of five exemplary scenarios. The paper concludes with an outlook on further research activities.

## 2 THE EMPIRICAL STUDY – CONCEPTUAL DESIGN

### 2.1 Objectives and Execution of the Empirical Quantitative Study

The empirical study in discussion has been carried out in the year 2006 as an internet based online survey. It was designed to follow the paradigms of exploratory research (Schwab, 2005). It addresses the following research questions:

- How common are specialized BI units in BI using companies and which characteristics do they have?
- Which types of specialized BI units can be identified within the companies?
- Which functions are taken over by BI units?

812 persons opened the online questionnaire and the answers of 403 attendants have been considered for the analysis.<sup>1</sup> The response can be seen as an indicator for the high relevance of this subject. The respondents are primarily experienced BI experts: The sample has been composed of practitioners with a professional relation to the field of Business Intelligence and data warehousing. Contact details have been provided by the TDWI Germany (The Data Warehousing Institute). The companies of the sample belong to manufacturing industry (26%), financial services (23%), telecommunication and media (11%), wholesale and retail industry (10%), IT services (9%) and other sectors (21%).

### 2.2 Reference Framework of the Study

The study is based on a framework that structures previous knowledge on the subject of BI organizations (cf. Figure 1). It is also applied to define the relevant groups of variables and to point out assumed relationships (Anfara and Mertz, 2006).

According to Strauss and Corbin (1990), a framework needs to differentiate a causal condition, the phenomenon, its dimensions to be examined, and context conditions. It is assumed that the BI governance concept of a company determines the implementation of a BI unit in the company's organization. In this context, BI governance is derived from IT governance (Grembergen, Haes and Guldentops, 2004; Gutierrez, 2006). BI governance includes the organizational integration, the process design and the overall management of BI to ensure a consistent alignment of a company's BI concept with the business strategy.

The BI unit can be involved in the process of BI development and supports the operation of BI solutions in functional and technical aspects. Furthermore, the direct user support is a relevant task assigned to the BI unit. The context conditions are determined by the current BI systems landscape, the BI user environment, as well as by the business context.

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<sup>1</sup> The survey included mandatory and optional questions. Therefore, the number of participants may vary for different questions. The actual number is stated for every examination.

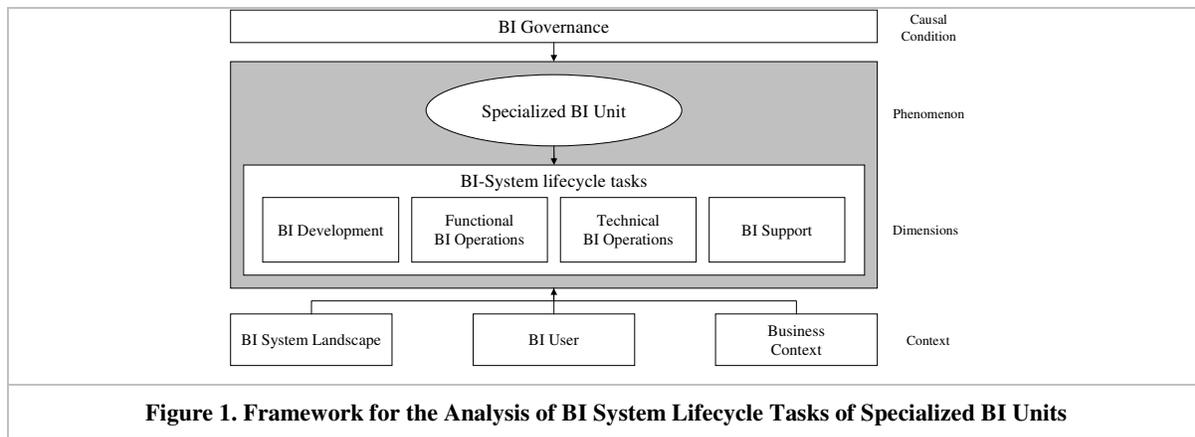


Figure 1. Framework for the Analysis of BI System Lifecycle Tasks of Specialized BI Units

### 3 RESULTS OF THE STUDY

Documentation and interpretation of the results are divided into two sections. First, the phenomenon of the BI units is examined with respect to the presented framework. It is focused on the *diffusion* and the constitutive *characteristics* of BI units. Special consideration is given to their organizational integration, their dimension and the supported BI implementations. In the second section, different *configuration types* of BI centers are derived empirically based on a cluster analysis. The used classification criteria are the lifecycle tasks of BI systems from the reference framework.

#### 3.1 BI Units – Diffusion and Characteristics

Business Intelligence is not a new innovation within the interviewed companies. 75% (n=326) of the respondents stated, that their companies have already been developing and using BI solutions for four years or more. It therefore can be concluded that the employed BI concepts already reached a state of relatively high maturity. Additionally, 87% (n=330) of the companies declared that their BI concepts already left the development and implementation phase and that they entered growth and/or consolidation phases. Among the used BI solutions (n=318, multiple answers admitted), reporting systems (89%) and ad hoc analysis systems (82%) are dominating. Furthermore, model based analysis systems (45%), free data analysis (49%) as well as analytical systems supporting business processes (46%) are applied.

Consistent with the results on diffusion and maturity, a high acceptance for specialized BI units is indicated. Just 24% of the interviewed companies (n=403) claimed that they do not perceive a need for the implementation of a BI unit. In contrast, 76% have already established independent BI units (65%) or plan to do so (11%). Furthermore, a statistically significant correlation between company size and an existent or planned BI unit can be detected as shown in Table 1. Thus, it appears that the majority of the interviewed companies has a need for independent BI units. Especially large and very large companies promote the establishment of these units.

		Company Size Measured by Total Turnover			
		under 100 m Euro	100 m up to under 1 bn Euro	1 bn up to under 10 bn Euro	10 bn Euro and more
<b>BI Unit Exists or is Planned</b>	Yes	68.7%	67.2%	85.2%	84.4%
	No	31.3%	32.8%	14.8%	15.6%
Total		100%	100%	100%	100%
n		32	64	88	45
$\chi^2=9.629; df=3; p=0.022^*$ ; n=229 <sup>2</sup>					

Table 1. Company Size and Existence of BI Units

<sup>2</sup>  $\chi^2$ : Chi square value; df: degree of freedom; level of significance: p≤0.05\*, p≤0.01\*\*, p≤0.001\*\*\*

**Finding 1**

A large number of companies have entered growth and consolidation phases for their BI implementations. They are highly aware that the development and the operation of BI application systems as time stable tasks require adequate and dedicated BI support units.

With respect to reporting structure, the results of the study indicate that BI units are currently primarily assigned to IT: In 71% of the companies (n=288) BI units are part of the IT division. 14% of the companies answered that they have implemented the BI units directly below the executive level and 15% of the companies assigned the BI unit to a functional division.

A more detailed analysis shows a statistically significant correlation between the hierarchical allocation of a BI unit and the company size (according to total turnover). The results of the analysis are depicted in Table 2.

It becomes obvious that smaller enterprises (total turnover < 100 m Euro) prefer the integration of independent support units directly below the executive level. With increasing size of the enterprise, there is also an increasing tendency to understand the BI units as a part of the central IT division and integrate them into these organizations.

A possible explanation can be found in the different modalities for assuring an adequate IT supply in the firms. IT divisions of smaller enterprises are often run by IT generalists who are responsible for the coordination and the quality management concerning *externally sourced* IT services (Southern and Tilley, 2000). In such environments, specialized BI units can hardly be integrated efficiently in the IT divisions. In contrast, medium to very large enterprises mainly bring along sufficiently large own IT departments and IT know how. In these cases, an integration of BI units into the central IT division can be accomplished much smoother.

Hierarchical Integration of specialized BI Units	Total Turnover				Total
	under 100 m Euro	100 m up to under 1 bn Euro	1 bn up to under 10 bn Euro	over 10 bn Euro	
Executive Level	47.4%	17.5%	6.9%	0%	12.5%
Functional Division	21.1%	17.5%	17.8%	5.6%	15.5%
Central IT Division	31.5%	65.0%	75.3%	94.4%	72.0%
Total	100%	100%	100%	100%	100%
n	19	40	73	36	168

$\chi^2 = 35.892; df=6; p<0.001^{***}; n=168^3$

**Table 2. Company Size and Hierarchical Integration of BI Units**

**Finding 2**

The integration of the BI units into or nearby the IT division is preferred by most of the interviewed companies. Additionally, a highly significant correlation between company size and organizational integration has to be considered.

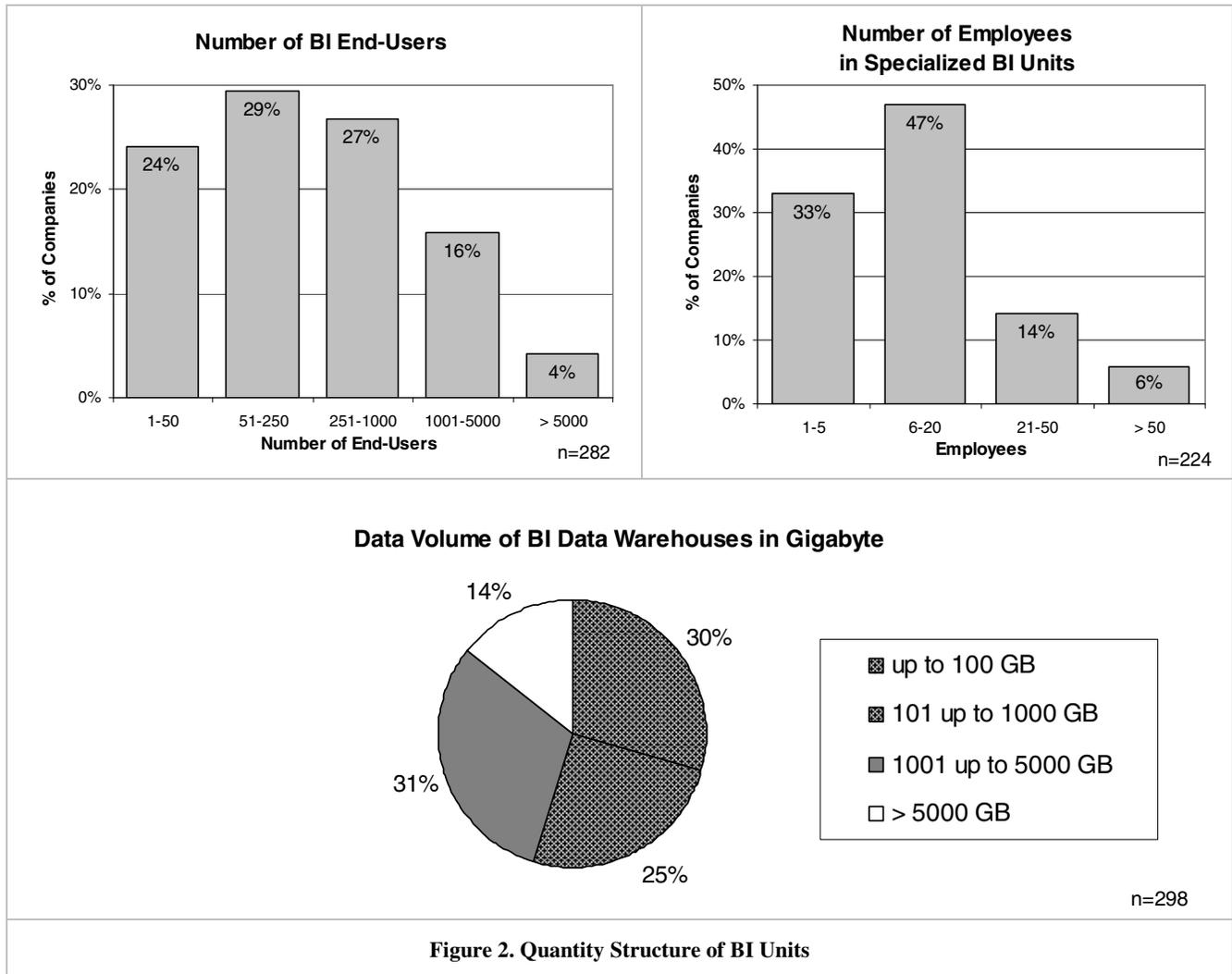
One part of the online questionnaire was focused on the size of BI units and the types of BI applications. The data for the allocation of the BI staff, the number of supported end-users, and the BI data volume is shown in Figure 2. It becomes clear, that the majority of BI units (approx. 80%, n=224) has up to 20 employees. Only 6% of the asked companies are operating very large BI support units (more than 50 employees). These BI units are concentrated in the sector of larger companies with more than 2000 employees.

There is a large variation in the quantity of supported end-users. It ranges from a handful to a few thousand users. The highest numbers which go beyond the number “5000” need to be considered to be exceptions, however. An examination of the supported BI environment on the basis of the data volume shows that many companies (approx. 45%) are operating large

<sup>3</sup>  $\chi^2$ : Chi square value; df: degree of freedom; level of significance: p≤0,05\*, p≤0,01\*\*, p≤0,001\*\*\*

scale data warehousing systems (> 1 terabyte). Also data warehousing systems with more than 5 terabyte data volume can be found in some of the interviewed companies (approx. 14%).

Interestingly, a more extensive analysis (cross tabulation) showed that the number of supported end-users and the data volume are an inappropriate base for the estimation of the staff size. There is a large variation in the ratio end-users per support employee. Sometimes very small BI units (employees < 5) support very large scale BI data warehousing systems.



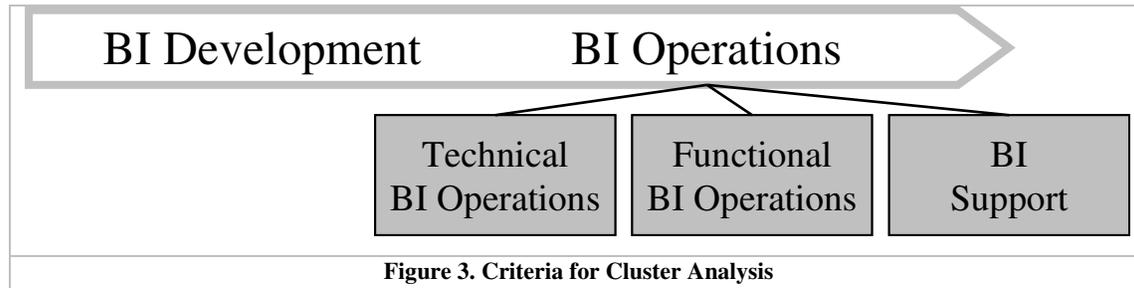
On the first view this variance may seem surprising. But it can be explained by the range of tasks provided. On one hand, the modality and the scope of the BI unit's tasks are spread. The tasks can encompass everything from a simple data support to a complete, lifecycle oriented full service support. On the other hand, the complexity of the applications and the number of users are extremely heterogeneous. For instance, the efforts for the development and operation of complex data mining applications for a limited number of users can not be compared with applications for the provision of simple, standardized reports for a large number of users.

**Finding 3**

The majority of the BI units has up to 20 employees, supports up to 1000 end-users and is responsible for data warehouses up to the size of several terabytes. Significant causalities between end-user number, data volume and staffing of the BI units are not ascertainable due to the heterogeneity of their tasks.

### 3.2 Configurations of BI Centers

Center concepts are increasingly applied for the organizational implementation of specialized functions in enterprises. A center can be considered as an organizational unit which is responsible for the provision of defined services. It takes over cross-functional tasks so that a service transfer occurs between the center and several internal customers. Center types can be differentiated by the configuration of assigned tasks (Krueger, Werder and Grundei, 2007). A cluster analysis was conducted to identify different types of BI center configurations. The purpose of clustering is to group the analyzed cases on the basis of similarity according to predefined characteristics into homogeneous groups (Aldenderfer and Blashfield, 1984).



According to Baars, Horakh and Kemper (2007), relevant tasks of the BI systems lifecycle are used as criteria for the cluster analysis. The lifecycle is structured in the two phases of **BI development** and **BI operations** (cf. Figure 3). “BI development” covers the design and change of BI systems in terms of IT development projects which are characterized by limited durations. The “BI operations phase” covers tasks which are required to provide BI applications to end-users. These tasks have to be served continuously until the decommissioning of the respective BI application. BI operations tasks can further be broken down on the basis of their proximity to the supported business processes: **Technical BI operations** contain the management of the technical BI infrastructure, e. g. networks, servers, operating systems, database management systems or the basic administration of BI software. **Functional BI operations** subsume the management of the various BI applications. For this, BI specific IT services need to be delivered, e. g. planning, operation and monitoring of extraction, transformation and loading processes (ETL), the administration of data warehouses, the implementation of smaller functional changes or the delivery of OLAP cubes and reports. The **BI support** is responsible for the direct contact to end-users in form of a help desk and an incident management for BI applications, answering end-user requests and managing the knowledge transfer.

The cluster analysis<sup>4</sup> was conducted to examine the relative share of the BI lifecycle tasks assigned to different BI center types. Altogether there is a large share of BI development activities located in all identified types of BI centers. The mean values of the share of BI centers in the respective areas of activity are shown in Table 3.

The following five clusters could be identified in the sample:

- **Assistance centers** primarily take over moderating and coordinating functions at the interface between IT and functional divisions. This results in a differentiated task-sharing with other functions. There is a close collaboration with the functional divisions which are doing the main part of functional BI operations and BI support. The tasks of the technical BI operations are handled in cooperation with the central IT division.
- A **full service center** acts as the central BI service provider for all examined BI lifecycle tasks. Because of this, full service centers need to have wide spread know how in the field of BI.
- A **functional operations center** is characterized by a high amount of functional BI operations and BI support. However, the technical BI operations, e. g. the hosting of the infrastructure, are predominantly assigned to a central IT division.

<sup>4</sup> The following procedure was chosen for the accomplishment of the cluster analysis: With a foregoing single linkage clustering a statistic outlier has been excluded (Backhaus, Erichson, Plinke, and Weiber, 2003). For the identification of the clusters Ward’s method with a squared Euclidian distance for the distance measure was used. Finally the k-means algorithm was used for the optimization of the assignment of the cases to the clusters (Milligan and Sokol, 1980).

- **Hosting centers** focus mainly on operating the technical BI infrastructure compared to the other centers. Additionally, hosting centers may take over parts of the functional BI operations and the BI support in cooperation with the functional divisions.
- **Development centers** are focused on the design and development of BI systems. The tasks of the lifecycle phase “BI functional operations” are only marginally covered by the development center.

BI Cluster Notation	Mean Values of the BI Units' Shares of the BI Lifecycle System Tasks				n
	BI Development	Technical BI Operations	Functional BI Operations	BI Support	
Assistance Center	74%	49%	46%	26%	24
Full Service Center	95%	88%	96%	98%	41
Functional Operations Center	95%	18%	88%	81%	38
Hosting Center	91%	92%	63%	69%	32
Development Center	94%	0%	4%	4%	12
<i>n</i> <sub>total</sub> =147					

**Table 3. Empirical Classification of BI Units**

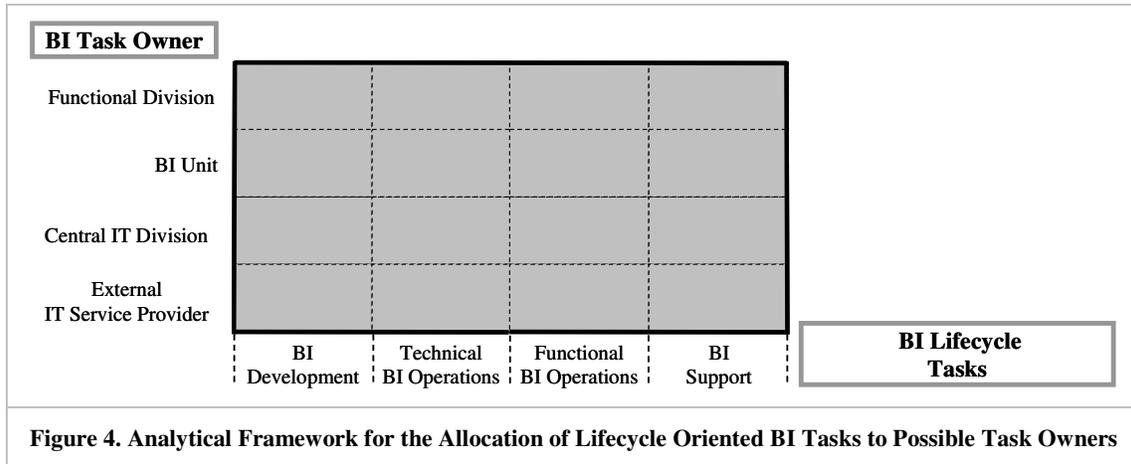
Four of five clusters show a close relationship between the amount of functional BI operations and BI support (correlation according to Pearson:  $r=0.584$ ,  $p<0.01^{**}$ ). There is a preference in assigning both tasks in the same amount to one BI unit. A more detailed, opposing analysis of the identified clusters did not deliver significant correlations between the context conditions of the BI system landscape, the BI users, and the companies. This indicates that in companies, the decision for one BI center type is not dominated by a single factor. Rather the decision is based on a set of factors, rated as relevant by the company itself.

**Finding 4**

BI centers can be found in form of assistance centers, full service centers, functional operations centers, hosting centers or development centers. They are distinguished along the relative weight of the assigned tasks for BI development, technical and functional BI operations, and BI support. However, a significant correlation between the choice of one organizational variant and the companies' specific context cannot be detected.

**4 DISCUSSION**

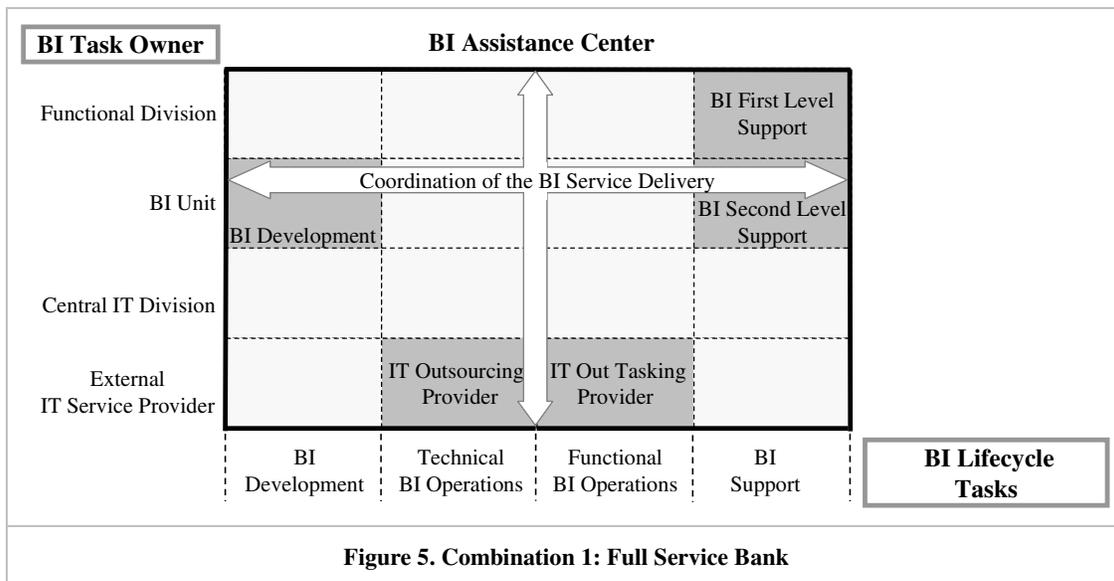
Companies facing the decision to define or realign the context of BI centers require an analytical framework, which enables them to structure and analyze the present situation and to deduce a target scenario. For this purpose the framework depicted in Figure 4 has been derived. The **lifecycle based BI tasks** are identical with the criteria used for the cluster analysis above. The possible variations of **organizational BI task owners** build one dimension of the framework. The possible BI task owners are functional divisions, specialized BI units, central IT divisions, as well as external IT service providers. Every field in the analytical framework represents the relative share of a BI task owner in the respective BI task.



The analytical framework is understood to be a complexity reduction tool that allows for a decomposition of the organizational design of Business Intelligence units. It can be used to structure and evaluate the actual configuration of the BI organization in a company as well as relevant possible future options. It may also be used for the analysis of responsibilities and organizational interfaces.

In the framework, the five types of BI centers are seen as typical configurations. The adaptability and the benefit of the analytical framework shall be illustrated by the following exemplary combinations which are derived from real cases.

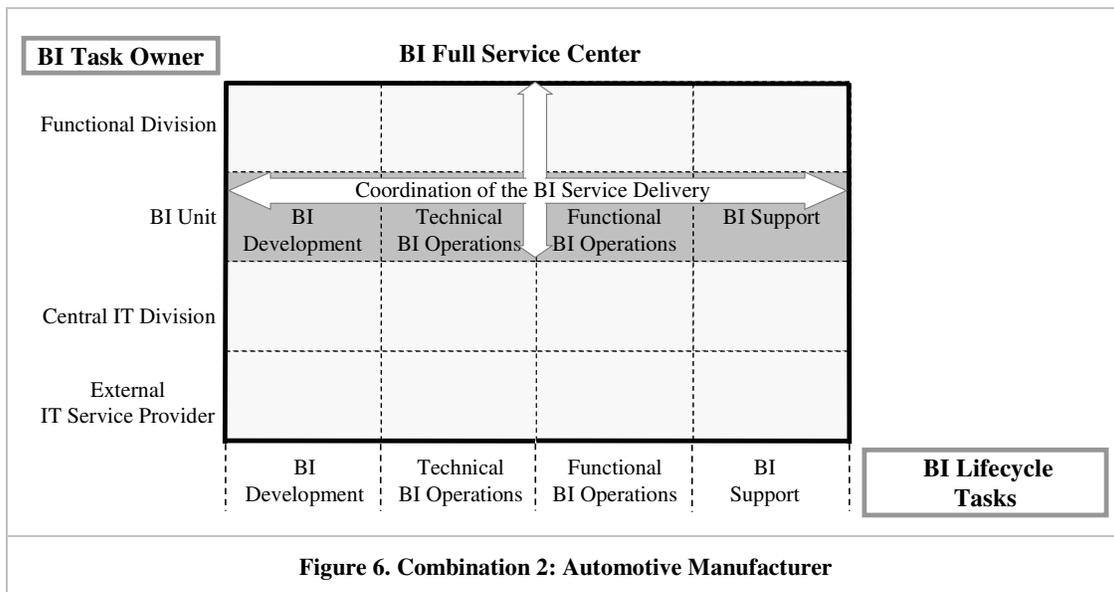
The arrows in the figures represent a coordinating function which supports BI service delivery. The horizontal arrow shows which BI lifecycle tasks have to be coordinated (BI development, technical BI operations, functional BI operations, and BI support). The vertical arrow illustrates which BI task owners are involved in the BI service delivery (functional division, BI unit, central IT division, and external IT service providers). The positioning of the horizontal arrow in one line of the framework indicates which BI task owner is responsible for the coordination of the BI service delivery.



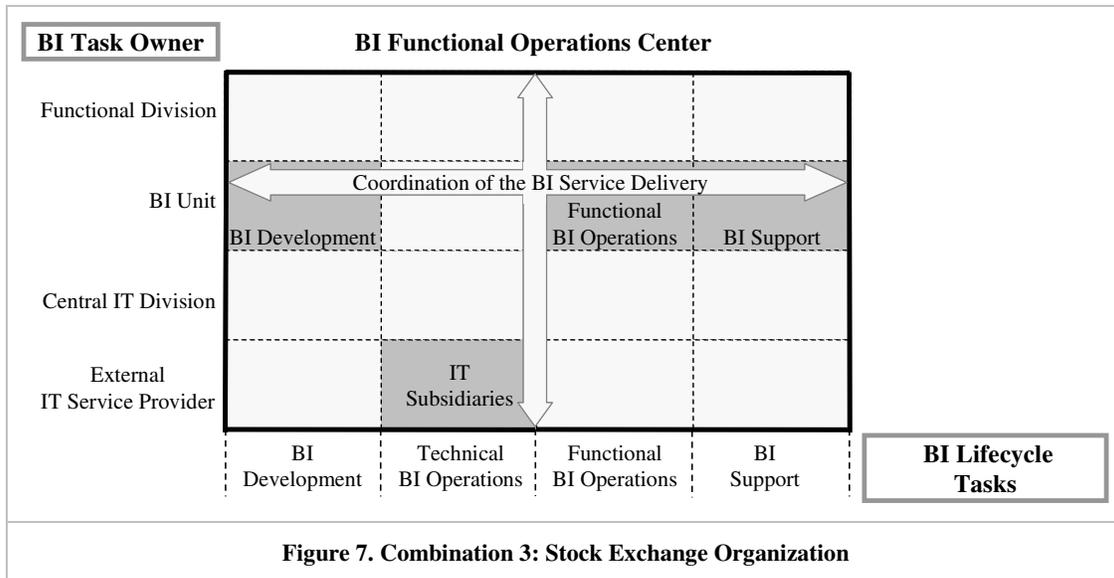
**Combination 1:** An international full service bank is using analytical, data-mart based customer relationship management applications. A **BI assistance center**, linked to the central IT division, is in charge for the coordination of the BI task owners

and the BI lifecycle tasks. As illustrated in Figure 5, the assistance center generates the development and second level support of BI applications. The functional division is operating the first level support. The technical infrastructure is hosted in the data processing service center of an IT outsourcing provider. Functional operations like the delivery of reports and OLAP cubes as well as the scheduling of the ETL processes are provided by another external IT out-tasking partner (cf. Figure 5). This variant can be selected e. g. by enterprises with multiple BI task owners and extensive BI outsourcing activities. A disadvantage of this alternative may be a reduced flexibility and rapidity of BI service implementation and delivery because of considerable coordination efforts.

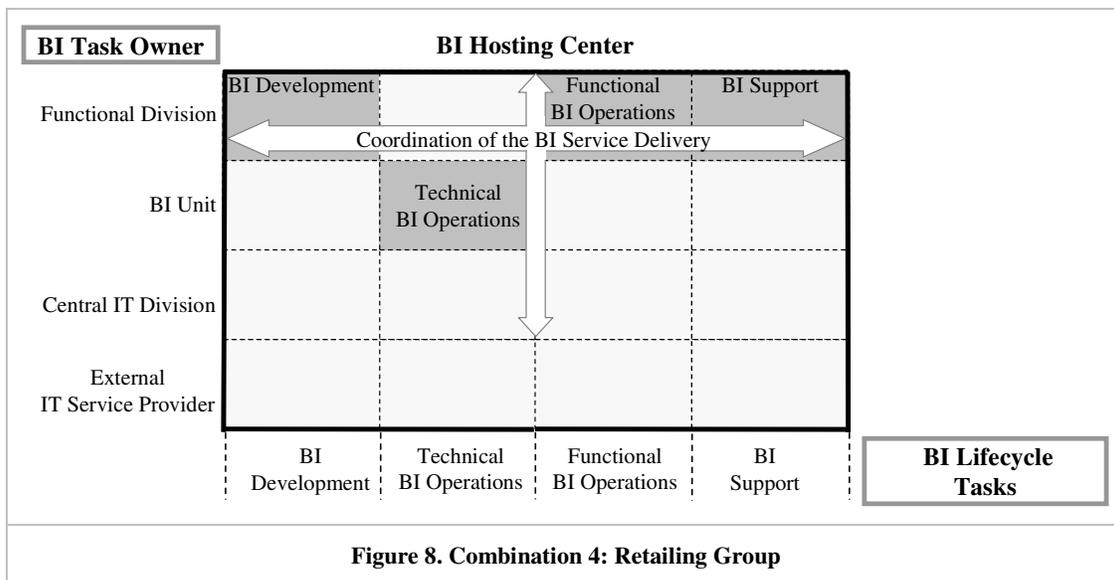
**Combination 2:** An automotive manufacturer is operating multiple core data warehousing systems with several attached BI applications. A **BI full service center**, which is integrated into the central IT division, has taken over most of the BI development and BI operations tasks. The coordination of the BI lifecycle tasks is primarily managed internally by the BI full service center (cf. Figure 6). This variant may be chosen when there is a need for a flexible, frequent and fast implementation and delivery of new BI services. The employees with the appropriate skills are working closely together in a single organizational unit and can ensure one-stop fulfillment. In this variant, the BI unit has relative few interfaces to other BI task owners. It was observed in some companies that due to this fact there is only a low urgency for clear internal process definitions. This can also be a potential drawback leading to an ad hoc collaboration within the BI unit.



**Combination 3:** The real time data warehouse of a stock exchange organization is providing statistical financial information for internal and external customers. A **BI functional operations center** which is linked to the central IT division is responsible for coordination of the BI service delivery. The BI lifecycle tasks development, functional operations and support are provided by this center. The technical BI operations are outsourced to an IT subsidiary, which is also under control of the central IT division (cf. Figure 7). The BI functional operations center is similar in certain aspects to combination number 2. It bundles the BI expertise in one unit and offers an integrated fulfillment. However, more technical oriented operations tasks are assigned to an IT service provider. This variant can be chosen e. g. by enterprises with large, terabyte-sized BI environments and a clear distinction between functional and technical BI task accomplishment. In this case, the highly specialized IT subsidiary guarantees fast accessibility, high scalability, and eminent levels of security as well as BI service reliability.

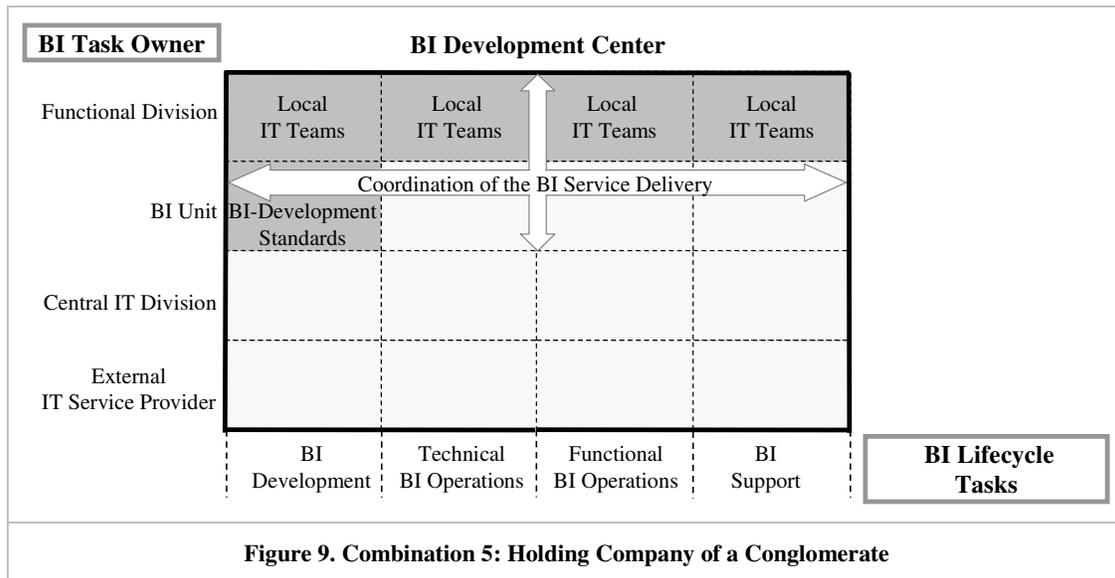


**Combination 4:** The central IT division of a retailing group is operating the technical BI infrastructure for all other divisions. The IT staff with the required know how is assigned to a **BI hosting center**. Because of the technical orientation of the hosting center, the coordination of the BI lifecycle tasks and the BI task owners is assigned to the functional divisions. Also the BI development, the functional BI operations and the BI support is primary provided and coordinated by the functional divisions (cf. Figure 8). This alternative could be applied, when the functional divisions have a high degree of self-government and BI skills. However, the divisions may follow different BI trajectories over time without an enterprise-wide BI strategy.



**Combination 5:** The holding company of a conglomerate is operating a **BI development center** which is responsible for the implementation of standards for the BI development. The implementation of enterprise-wide standards is required for the rapid integration of further subsidiaries and the harmonization of financial reporting interfaces between the holding company and the subsidiaries. Also the basic coordination of the BI service delivery and the task owners is assigned to the central BI development center. All other BI specific tasks are realized by the local IT teams of the subsidiaries (cf. Figure 9). This

variant may be used in large enterprises that consist of widely unrelated business sections, in which strong cross-divisional BI integration efforts would not be profitably.



**5 CONCLUSIONS**

This discussed exploratory empirical study analyzed which tasks regarding the design and the operation processes of Business Intelligence solutions are taken over by specialized BI units. It highlighted that the majority of the interviewed companies already operates wide range BI application systems and has already implemented stable BI units for those purposes. By using a cluster analysis, an empirical classification of BI center types was performed. The results of the study showed, that a variety of possible organizational types for BI centers is applied in the sample of companies.

Because of missing statistical significant correlations between the decision for a specific organizational configuration and the examined company specific conditions, there is a need for further research. It is especially relevant to elicit, which factors are considered by companies for the allocation of the BI development and the BI operation tasks to several BI task owners. They may include the existing BI know how in the functional divisions, the amount of self-government of the functional divisions, or the degree of decentralization of IT service provision. Promising results may also come from detailed analyses with currently performed case studies.

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