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Business Intelligence in the Cloud?

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Abstract

Business Intelligence (BI) deals with integrated approaches to management support. In many cases, the integrated infrastructures that are subject to BI have become complex, costly, and inflexible. A possible remedy for these issues might arise on the horizon with "Cloud Computing" concepts that promise new options for a net based sourcing of hard- and software. Currently, there is still a dearth of concepts for defining, designing, and structuring a possible adaption of Cloud Computing to the domain of BI. This contribution combines results from the outsourcing and the BI literature and derives a framework for delineating "Cloud BI" approaches. This is the bases for the discussion of six possible scenarios – some of which within immediate reach today.

Keywords: Business Intelligence, Cloud Computing, IT outsourcing, Software-as-a-Service

1 MOTIVATION

The term *Business Intelligence (BI)* denotes integrated approaches to IT based management support (Moss and Atre 2005; Negash 2004; Baars and Kemper 2008). What sets BI apart from other management support concepts is the aspect of *integration*. It is precisely the degree of integration that represents both the challenges and the potential of BI (Frolick and Ariyachandra 2006). This is also reflected in the role of a *Data Warehouse* (DWH). A DWH usually sits at the core of a BI approach and provides a subject-oriented, non-volatile and integrated data repository for a variety of analysis and reporting applications. However, BI goes beyond a mere *technical* integration – it is the integration on a *conceptual* and *organizational* level that truly unlocks its potential. Consequently, these aspects also form the central constituents of BI maturity models (Eckerson 2004; Popovič et al. 2009).

The integration comes at a price – it increases complexity and binds management capacity. The side effects of even a small change e.g. of an indicator definition or a data extraction routine can ripple through the whole enterprise. The situation becomes even more intricate with the emergence of "Operational BI systems" that mend BI and operational systems together (Eckerson 2007; Marjanovic 2007). As a result, organizations are designing sophisticated organizational constructs, most notably dedicated "BI competency centers" (BICCs) (Unger et al. 2008) and concepts for a dedicated "BI governance" (Meredith 2008; Gutierrez 2006).

Meanwhile, the development, configuration, and administration of the necessary BI hard- and software tools is likewise not getting easier, although there are good reasons to assume that tasks like installing and running a DWH tool or connecting an OLAP tool to a portal software do not rank among the core competences of the typical BI user organization. Nevertheless, the infrastructure sometimes limits the exploitation of BI, as it cannot be matched timely enough to changing business requirements (TDWI 2008). Eventually, BI hard- and software resources can become quite costly – one of the reasons being that BI often requires significant capacity buffers in order to handle peaks in resource consumption.

At the same time, BI tools have become more and more web enabled. This pertains to the user frontends, the data exchange interfaces, as well as to the configuration and administration components. On the horizon are BI applications that can be flexibly reconfigured in a mashup fashion by the use of web standards (Jhingran 2006).

Considering all this, the concept of *Cloud Computing* might become appealing for BI. Cloud Computing combines a web based IT service provision with a flexible and distributed infrastructure (Weiss 2007; Weinhardt et al. 2009; Buyya et al. 2009). However, currently there is still a serious lack of conceptualization in this area. The reasons can be found in the infant stage of Cloud Computing on the one hand and the novelty of the idea to adapt net based sourcing approaches to the domain of BI on the other.

Coming from an IT service and IT sourcing perspective, this paper takes a differentiated look at the subject of BI and Cloud Computing in order to systematically map out and explore relevant options. For this purpose it combines results from the IS literature on IT outsourcing and on BI and critically reflects the interplay of the respective concepts. The result is a "framework for Cloud BI" that can support delineating different approaches. The paper also discusses six different scenarios that range from small scale and easy-to-apply add-ons for existing BI solutions up to far reaching "mashup cloud BI" scenarios of rather visionary character.

The course of the paper is as follows: In the second section, relevant concepts and results from the literature on Cloud Computing, IT outsourcing, BI and BI services are introduced and discussed. Next, the results are bound together in the framework for Cloud BI. The framework is used to distinguish and discuss six scenarios for Cloud BI. The paper concludes with a discussion of the results and an outlook on further research steps.

2 LITERATURE REVIEW AND FUNDAMENTAL CONCEPTS

Recently, the colorful term "Cloud Computing" has gained significantly in popularity and entered not only academic conferences and scholarly publications but trade journals and newspapers as well (Google Trends 2010) – either despite or because of its still "cloudy" nature. In fact, there is a wide spectrum of definitions (Weinhardt et al. 2009; Creeger 2009). While many authors see the phenomenon primarily technical, either by emphasizing virtualization (Boss et al. 2007) or the vicinity to "grid computing", i.e. an approach to distributed computing (Webopedia 2010; Vouk 2008), others are abstracting from the technology and stress that Cloud Computing refers to a business model based on an Internet based service provision (Hayes 2008). In the latter case, Cloud Computing comes close to the concept Software as a Service (SaaS) resp. Application Service Providing (ASP) (Lawton 2008).

When juxtaposing the various definitions, two themes emerge – a business theme and a technical theme:

1. An Internet based service provision provided on a fee bases.
2. A distributed, net-based architecture where resources can be dynamically rearranged. This promises increased cost efficiency (as a result of a higher degree of resource utilization), as well as higher degrees of performance, stability, scalability, and flexibility.

When considering the first aspect, it is striking that there is obviously no consensus yet regarding what *types of services* are actually subsumed under Cloud Computing. In total, three different options are discussed (Creeger 2009):

1. A provision of hardware based on virtualization. By this definition, Cloud Computing turns into a variant of Database or Application Hosting (Kern et al. 2002), approaches that are recently also referred to as *Infrastructure as a Service – IaaS*.
2. The provision of applications; in this case Cloud Computing is in large parts synonymous to *Software as a Service (SaaS)* (Benlian et al. 2009) or the older ASP (Kern et al. 2002).
3. The provision of runtime and development services – *Platform as a service (PaaS)*.

In all three cases, however, Cloud Computing is an instrument for an IT sourcing policy, or to be more precise: a form of *netsourcing*, i.e. net based outsourcing (Kern et al. 2002).

2.1 Cloud Computing in the context of IT sourcing

Before moving to Cloud Computing, it is recommendable to consult the large and mature body of knowledge on IT outsourcing (Lacity et al. 2009; Dibbern et al. 2004; Lacity and Willcocks 2003). There are some general findings that are of immediate relevance for Cloud BI.

One of the core conclusions from several decades of IT sourcing research is that IT-outsourcing needs to be considered as a multilayered and complex phenomenon and that a selective approach to outsourcing is usually more reasonable than a total outsourcing (Lacity et al. 1996; Lacity and Willcocks 2003). The prerequisite for this is that IT needs to be managed as a *portfolio* of activities and capabilities (Lacity and Willcocks 2003). For specifying a Cloud BI approach, this entails the need to decide how finely grained the sourced elements in the portfolio actually are (services, infrastructure components, or complete solutions).

Prone to be outsourced are highly-standardized and non-core activities because such services can be easily defined, priced, and transferred and don't incur high risks (Lacity and Willcocks 2003). Based on this rationale, lines can be drawn between more commoditized infrastructural services and others that are rather oriented towards a "business process outsourcing". Building up on these ideas, Kern et al. derive a "stack" model for netsourcing (Kern et al. 2002). The relevance of this stack for Cloud Computing becomes apparent when one recognizes that its central section is mirrored in the distinction between IaaS and SaaS.

Consistent with the general outsourcing literature, empirical data indicates that SaaS is currently primarily adopted for unspecific, non-core and uncritical applications (Benlian et al. 2009). However, that does neither mean that the situation is not going to change with growing confidence in net based sourcing models nor that BI is per se unsuited for Cloud Computing.

Of vital importance for the success of an outsourcing venture are the choice of the service partner as well as the design and the management of the outsourcing arrangement including the contractual agreement (Kishore et al. 2003; DiRomualdo and Gurbaxani 1998). Even in the case of BI that is often concerned with highly confidential data, issues of partner selection and trust can be mitigated if the service is delivered via a neutral partner who is established in the respective industry. This can be observed in cases where BI across organizational borders is reality today, e.g. at the German Stock Exchange that provides BI solutions for its institutional customers (Detemple et al 2006; Horakh et al. 2008), the gas retailer Agip that runs a central DWH service for its franchise partners (BARC 2007), or at the BKK (representing an association of company health insurers) which offers DWH and analysis solutions for its members (Teradata 2007).

Regarding the *benefits* of IT outsourcing, it needs to be mentioned that quite a few souring projects aim beyond mere cost cutting objectives. There are several desirable nonmonetary effects such as a higher flexibility and system quality (Dibbern et al. 2004) – some of which are also central promises of Cloud Computing. The examples for cross-company-BI bring in another benefit dimension: In all three cases, the central BI provider offered additional value by *integrating information* from its clients, e.g. for benchmarks, industry reports, or analytics across enterprise borders. Going even further, IT outsourcing is sometimes even seen as a strategic lever and used to add new capabilities or to introduce structural changes (Linder 2004). Acquiring external BI services might become such a "transformational outsourcing" e.g. by adding new analytical capabilities to the firm.

2.2 Business Intelligence infrastructures

In order to fathom the potential of Cloud BI, the structure and characteristics of the affected infrastructures need to be considered. The foundation of the following discussion is the three layer architecture introduced by Baars and Kemper (2008) (cf. Figure 1). In the following, the layers are discussed in further detail.

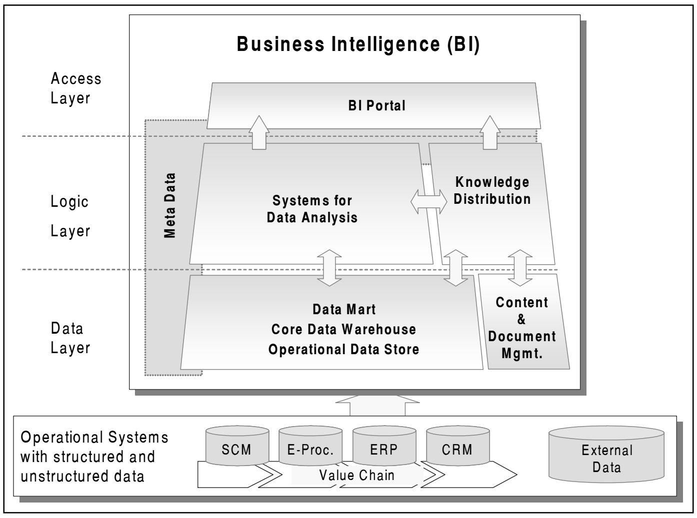

Figure 1. Three layer BI architecture (Baars and Kemper 2008)

2.2.1 The Data Layer

The *Data Layer* is responsible for storing structured and unstructured data for management support. Regarding *structured* data, the central component is the DWH. A DWH is commonly defined as a "subject-oriented, integrated, time-variant, and non volatile collection of data in support of management's decision-making process" (Inmon 2005). Many current realizations of DWHs are based on so called *Core DWHs* that are designed for an application independent storage of management support data. Core DWHs are usually not used as a direct source for analysis systems, but rather distribute data to individual *Data Marts*. Data Marts keep excerpts of application specific data.

More recently, there has been a shift towards DWH infrastructures that are integrated with operational systems. This is usually achieved by the introduction of an *Operational Data Store* (ODS) that is designed to keep real time data on a transactional level for time critical tasks (Inmon 1999; Kelley and Moss 2007). ODS/DWH architectures allow to build Closed-loop and Active Data Warehousing solutions. In Closed-loop Data Warehousing, results from analytical processes are directly fed back into DWHs or operational systems while an Active DWH can automatically trigger actions in the operational systems (Brobst 2002).

To feed the various data storages, *ETL (Extract-Transform-Load)* tools are needed. An ETL tool supports the extraction and transformation of data from heterogeneous source systems. The transformation includes filtering out syntactical and semantic errors, harmonizing data from different sources, as well as aggregating and enriching it (Kemper 2000). For the storage and administration of unstructured data, Content Management Systems (CMS) and Document Management Systems (DMS) are inserted into the data layer.

It would be preposterous to assume that larger enterprise ODS and DWH installations – that can hold tera or even peta bytes of data (Lai 2008) and that need to work under tight time constraints (e.g. for Active Data Warehousing) can be moved out to the Internet within the foreseeable future. Neither the latencies or the bandwidth, nor the reliability of the Internet can possibly meet the required service levels. However, it needs to be taken into account that most DWHs in practice are still by at least two magnitudes smaller then the behemoths on the upper side of the scale (Unger et al. 2008) and that approaches for Operational BI are still considered exotic. Furthermore, a Cloud approach is also applicable on the Data Mart level which often relies on quick application provision.

An interesting option for Cloud Computing might also be the inclusion of web based ETL routines for master data cleansing, transformation or additional enrichment – there are already providers for such services. Also, CMS and DMS are rather well suited to a web based approach as their document oriented nature is often already well aligned with web technologies.

Eventually, in the long term future the picture might change even for large Core DWHs. For one, there are already technologies available to manage high volumes of data efficiently based on Internet grids (Dean, J. and Ghemawat, S. 2004). Second, the operational systems that feed the DWH are becoming more and more virtualized and distributed themselves. Third, the number of external and distributed data sources grows (e.g. RFID/NFC, distributed SCM systems, sensor networks, smart meters and appliances, smart phones) and those are increasingly attached directly to the DWH. A physically distributed DWH might be the more stable alternative for such environments.

2.2.2 The Logic Layer

The *Logic Layer* provides functionality to analyze structured data or unstructured content and supports the distribution of relevant knowledge among different users. The most salient tools in BI environments are *reporting*, *data mining*, and *OLAP* tools (Moss and Atre 2003): Reporting tools present quantitative data in a report-oriented format that might include numbers, charts, or business graphics. OLAP denotes a concept for interactive and multidimensional analysis of aggregated quantitative business facts. Data mining tools support the identification of hidden patterns in large volumes of structured data based on statistical methods like association analysis, classification, or clustering (Baars and Kemper 2008). Data mining and similar model based tools are also referred to by the term Advanced Analytics (Bose 2009).

Using Cloud Computing on the Logic Layer is highly interesting. Most analysis tools now come with web font ends and components ready for a web based integration. Ideal candidates to be sourced from a distributed web infrastructure based on flexible resource allocation are especially computing intensive Advanced Analysis components. In the case of dealing with unstructured information (e.g. for information retrieval) an integration of web based services is already a common approach.

2.2.3 The Access Layer

The *Access Layer* allows the user to conveniently use all relevant functions of the Logic Layer in an integrated fashion – within the confines of defined user roles and user rights. Usually the Access Layer is realized with some sort of Portal software that also provides a consistent web based user interface. The proliferation of standards like JSR 2003 and JSR 2008 allows a flexible integration of BI analysis components. Portal software meets many criteria that can foster a SaaS (and therefore Cloud) approach – it relies on standards, is relatively unspecific and usually uncritical.

2.3 Business Intelligence services

Most of the components introduced in 2.2 might be subject to a Cloud Computing approach sooner or later – either in isolation or in combination. However, it has been argued that a pure component based approach is not specific enough to adequately structure, differentiate, and allocate BI activities, processes, and responsibilities. By adding two dimensions, *BI services* can be delineated more specifically – and be later combined to *BI solutions* with a defined distribution of responsibilities.

The resulting "BI service grid" and its three dimensions (component, business specificity, life cycle) are visualized in Figure 2. It has been developed for the management of BI sourcing and BI governance approaches (Baars et al. 2007; Horakh et al. 2008).

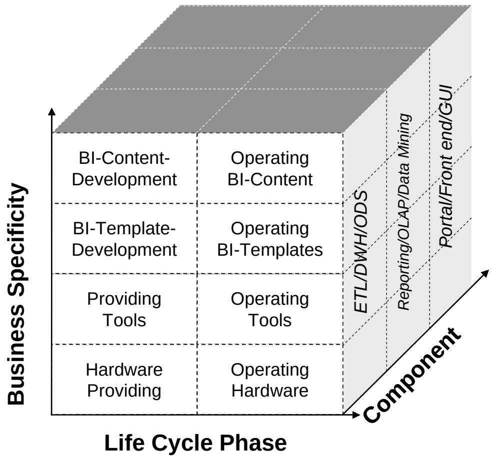

Figure 2. BI service grid (Horakh et al. 2008)

The starting points for the BI service grid are the software components in the BI infrastructure, e.g. based on the three-layer architecture introduced above. The components can also be adapted to individual needs or be further broken down if necessary.

The second dimension *business specificity* builds up on the concept of the "service stack" by Kern et al. (2002) and distinguishes between infrastructural services, like database hardware provision or BI tool hosting, and services closer to business, e.g. indicator definition or the development of a report. 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 (s)he needs comprehension of specific business semantics and user context. The grid proposes the distinction of four layers:

- *Hardware* – provision and running of the relevant computing, storage, and network equipment necessary to operate one or more BI components. In the web based context of Cloud Computing, handing out this layer corresponds to an IaaS approach. Here, virtualization brings flexibility regarding both the physical location and assigned resources like CPU power or storage – highly relevant arguments when considering the volatility of resource consumption in BI. Hardware abstraction is especially interesting for facilitating scalability and portability and it might give medium sized enterprises access to hardware power that was otherwise be out of reach for them (e.g. because they cannot afford "DWH appliances" (McKnight 2005)). There is a catch: As discussed above, high-end requirements on the DWH side (latencies, data volume) are often at odds with an Internet based provision model. It can therefore be doubted that virtualization relieves of the cumbersome installation, tuning, and operation tasks for truly demanding ODS/DWH installations.

- *Software tools* – this relates to the BI software, from ETL tools to data visualization packages. For Cloud Computing, services on this level incur a SaaS approach. As discussed above, the resolution of the portfolio of managed components needs to be adjusted to individual needs. The software units in discussion can range from complete applications down to atomic functional blocks that are delivered as web services.
  A facilitator for applying Cloud concepts on tool level is the fact that most state-of-the art BI software products now come with rich web interfaces that match or even surpass the former stand-alone clients. However, with respect to the distribution aspect of Cloud Computing, it needs to be acknowledged that many BI tools on the data and analysis layers still lack multi-tenancy capabilities, let alone mechanisms for handling multiple instances or for load balancing. This doesn't inhibit a Cloud approach (as it can be circumvented with hardware virtualization) but it surely makes its application more difficult.
- *Templates* – understood as preconfigured applications and prearranged contents that can be adapted to individual needs. Several larger BI suites deliver ready-to-use templates and include features to build own ones. Templates have become a powerful tool in BI to reduce development cycle time, foster reuse, and impose rules regarding application development on the user side. However, they are still tightly bound to the BI software tool products. An uncoupling of the layers is therefore currently not of much relevance for Cloud BI.
- *Content* – this pertains to the actual business semantics. A provider who operates on this layer takes over responsibilities for the definition, gathering, structuring, transformation, and/or presentation of data. As Cloud Computing is here understood to be a means for outsourcing hard- and software, the content layer is excluded from the further discussion.

The third dimension that can be addressed refers to the *application life cycle*: It can be differentiated whether a service is devoted to the development of components or on their operation. This dimension becomes relevant in Cloud Computing when components allow or even foster a web based development, e.g. by making use of PaaS and technologies like mashups.

3 A FRAMEWORK FOR DELINEATING CLOUD BI SCENARIOS

The diverse constructs introduced above lead to a framework that can help with identifying, combining, and eventually evaluating potential BI services. The framework is visualized in Figure 3.

3.1 Structure of the framework

Spanning all possible Cloud BI variations is an *umbrella of general provider and contract related issues*. As in all outsourcing agreements, it needs to be thoroughly tested whether the provider is trustworthy. Besides, the contractual agreement has to pinpoint the Cloud promises of high availability, data security, flexibility, scalability, and reliability in form of defined service level agreements. This is of pivotal importance for BI solutions where the content in discussion is highly sensible and which are – unlike the currently prevailing Cloud Computing examples (office software etc.) – truly demanding regarding performance, customizing, and administration requirements. As has been discussed, the *provider* can either be an established partner or an anonymous and possibly interchangeable entity from the market, e.g. a larger IT service provider.

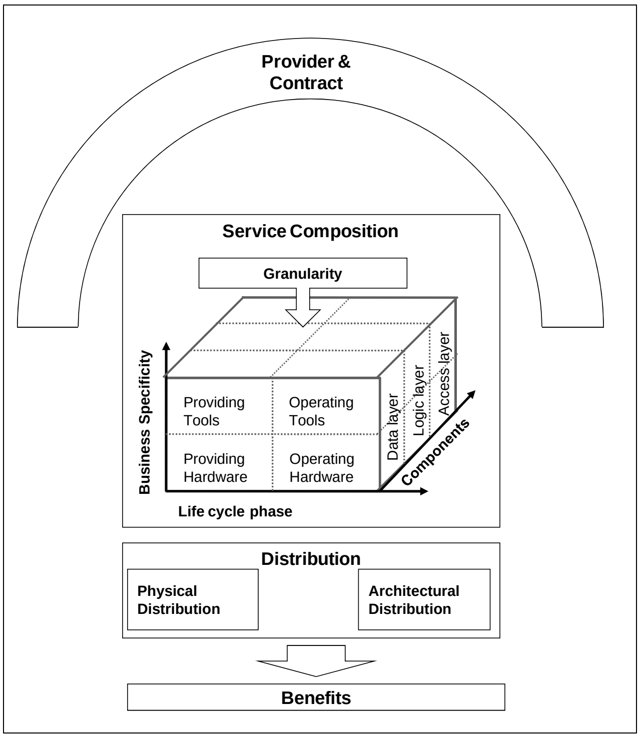

Figure 3. Cloud BI framework

The next building block in the framework is the actual *composition of the service*. As discussed above, this can be achieved by specifying the applied granularity on the tool layer (solution, component, or web-service) and by defining the subsumed BI services with the help of the dimensions component, business specificity, and life-cycle phase.

While the type of service is implicitly part of the service composition, the second defining Cloud aspect is the *distribution*. In BI, this actually has two sides to it: The physical distribution (with the options of confining the data storage locations to the premises of the provider, to keep the data in a network of business partners, or to freely distribute it on Internet level) and the architectural distribution (with the extremes of an end-to-end service provider on the one side and a best-of-breed solution composition that combines services of several providers on the other).

Eventually, the *intended benefits* have to be reflected upon. This can refer to classical cost based outsourcing rationales or to harnessing the qualitative traits of the Cloud approach (introducing flexibility, scalability, performance, or additional functionality). Besides, there might be informational benefits (through add-on data integration services from the provider) or even transformational effects (by adding new capabilities).

3.2 Possible scenarios for Cloud BI

The application of the framework is illustrated by applying it to six different scenarios. While the first four are motivated by existing BI sourcing arrangements, the last two are directed to a situation that might become realistic in the mid or long term future. Table 1 gives a brief overview on the scenarios (without the life cycle dimension).

3.2.1 Add-on services scenario

The add-on services scenario is the most conservative among the six. It refers to the inclusion of selected functional blocks from the Cloud into the BI infrastructure. Examples are components for web information retrieval, web services for preprocessing qualitative data (e.g. with object or face recognition algorithms), data visualization components etc. By applying grid technologies on the provider side, even computation heavy features become affordable. The approach is relatively risk free because of its small scale. Also because of this, the service provider can be very well chosen freely without a predating business relationship.

	Provider & Contract		Composition of Service			Distribution		Benefits
Scenario	**Contract**	**Provider**	**Granularity**	**Business Specificity**	**Components**	**Physical Distribution**	**Architectural distribution**	
Add-on services	Short term	Free choice	Web service	Software tool	Selected: Primarily access and analysis layer, maybe ETL also	Internet	Best-of-breed	Functionality, Flexibility
Tool replace-ment	Long term	Trusted vendor	Component	Hardware or Software tool	Selected	Provider data center	Best-of-breed	Costs, Performance
Solution provision	Long term	Pre-existing relation-ship	Solution	Software tool	All	Provider data center	End-to-end	Costs, Functionality, Time, Performance, Transformation
Business network	Long term	Pre-existing relation-ship	Solution	Software Tool	All	Business network	End-to-end	Costs, Functionality, Time, Performance, Information, Transformation
Best-of-breed	Long term	Trusted vendors	Component	Software tool or Hardware	All	Possibly internet	Best-of-breed	Costs, Functionality, Time, Flexibility, Performance, Transformation
BI mashup	Short term	Free choice	Web service & Component	Software tool	All	Internet	Best-of-breed	Costs, Functionality, Time, Agility, Performance, Transformation

Table 1. Scenarios for Cloud BI

3.2.2 Tool replacement scenario

In the second scenario, the Cloud idea is applied to a complete software tool, e.g. a Portal, a Data Mart or an OLAP tool. As discussed in Section 2.2.1, in the long term this scenario might even become interesting for larger DWHs. The tool replacement conforms to the SaaS idea with possible benefits being a more favorable cost structure, higher service levels and – for some tools – also performance (e.g. when applied to complex analysis tools). Depending on the type of tool that is moved to the Cloud, this can become a critical cut into existing BI infrastructure with far reaching implications. Long term contracts with trusted vendors and a curbed data distribution seem suitable for this scenario.

3.2.3 Solution provision scenario

The solution provision scenario comes close to a classical ASP agreement with the provider being responsible for the complete hard- and software of an isolated solution – end to end and across all layers. The motivation for this scenario is similar to the tool replacement, although the scope is much larger. The solution provision scenario has disadvantages as it possibly introduces a centrifugal force to an integrated BI infrastructure. It might however be suited for special-purpose solutions that need to be set up fast, e.g. for a time-restricted data mining project or for piloting new types of applications.

3.2.4 Business network scenario

The fourth scenario builds up on the examples introduced in 2.1. Here, the solution provider comes from and acts within the confines of a business network. This might be a B2B-marketplace, a franchise operation, a supply chain etc. The service provider is preferably a central and neutral partner in the network and provides solutions geared at the different members. The Cloud aspect lies in the physical abstraction with the provider infrastructure being virtualized, i.e. by connecting the data center resources of the network members. This scenario also allows for information integration benefits.

3.2.5 Best-of-breed scenario

Behind the best-of-breed is the idea of pushing the tool replacement scenario further up to the point where *all* components of the BI infrastructure are delivered by external providers. The result is a fully virtualized BI infrastructure that reaps all benefits of a best of breed resource allocation. As discussed in section 2.3, this scenario is currently still hampered by the Cloud capabilities of some BI tools.

3.2.6 BI mashup scenario

The most far reaching scenario distinguished here is the BI mashup scenario. This vision assumes a freely composed BI solution sourced from a global Internet market space. Compared to the best-of-breed scenario, it adds a finer granularity as well as a stronger focus on (re)combinability and quick development (the development life cycle phase). The additional benefits primarily lie in its extreme agility.

4 DISCUSSION AND OUTLOOK

As section 3 highlights, some scenarios for a "BI in the Cloud" are in reach today as they just extrapolate existing sourcing relationships to a more virtualized, Internet based infrastructure. This might be done based on classical outsourcing rationales but it might also bring added functionality, scalability, and flexibility. Particularly interesting are arrangements in business networks that can built up on established trust relationships and that have the option to lever shared information and resources. A completely virtualized BI infrastructure that is composed as a mashup of internet services is surely rather long term vision than midterm reality – but it still needs to be watched out for.

The discussion also revealed several severe limitations to Cloud BI – be it on the side of the tools that still lack some necessary prerequisites or on the side of the often demanding data requirements – let alone issues of acceptance for moving strategic data to a nondescript "cloud". An ODS and a Core DWH will surely stay within the confines of the home enterprise for quite a while. This leads to a core shortcoming of a Cloud BI approach: Those BI services that would benefit most from the flexibility and performance of an Internet grid-based service provision are also the ones where the approach is least applicable.

As Cloud BI is not even in its infancy yet, ongoing research activities should focus on further structuring, detailing, and evaluating possible scenarios. The presented framework is seen as a first contribution to this process. Although it is surely limited by all the problems associated with a mere conceptual approach, it provides a valid starting point for further research steps as it draws from IS research on outsourcing and BI alike under consideration of real world BI landscapes.

There are manifold options for subsequent research steps: The framework needs validation and detailing, e.g. based on expert interviews both with qualified members from the BICC and from the IT sides. Research is also required on the contracting aspect for virtualized and outsourced BI infrastructures. Furthermore, there is a necessity for action and design oriented research in order to gather real-life experiences and to come to adequate designs.

The relevance of such research is obvious: The potential benefits of focusing resources on conceptual and organizational issues rather than using them for building and operating hard- and software tools plus the sourcing and flexibility advantages of Cloud BI are simply hard to ignore.

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