The Cloud Computing: The Future of BI in the Cloud

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Abstract—**What will Business intelligence be like in the future? Rechercher believe the Cloud is a big part of the future of business intelligence. Business intelligence (BI) in the cloud can be like a big puzzle. Users can jump in and put together small pieces of the puzzle but until the whole thing is complete the user will lack an overall view of the big picture. In this paper reading each section will fill in a piece of the puzzle. "BI in the Cloud" architecture is only going to be feasible when most of user source data lives in the cloud already, possibly in something like SQL Server Data Services or Amazon Simple DB or Google BigTable; or possibly in a hosted app like Salesforce.com. Also, Cloud computing enable organizations to analyze terabytes of data faster and more economically than ever before**

Index Terms—**Cloud computing, business intelligence, platform as a services.**

I. Introduction

In the wake of the economic slowdown, organizations are increasingly looking for ways to do more with the same resources; articulate differently - to make every penny, input and contribution count. In such situations, technologies like Cloud Computing and Business Intelligence (BI) are becoming increasingly important in gaining and maintaining a competitive edge [1]. The future will be very bright for the use of BI in the cloud, both because of the advantages that underpin this new computing paradigm as well as the explosion of digital data that grows each day [2]. Cloud BI is the new way to do Business Intelligence: instead of implementing expensive and complex software on-site, the BI software runs in the Cloud. It is accessible via any web browser in a so-called software-as-a-service model. There is no need to install software, or to buy any hardware. And when you're computing needs grow, the system will automatically assign more resources. This elastic scale is what makes Cloud BI so powerful – user pay for what he use as opposed to always paying to provision for peak load. With business intelligence software running in the cloud, it is still possible to make comprehensive integration with back-end systems – both within User Company and in the cloud [3].

II. Business Intelligence

Business intelligence (BI) has been referred to as the process of making better decisions through the use of people, processes, data and related tools and methodologies. The roots of business intelligence are found in relational databases, data warehouses and data marts that help organizing historical information in the hands of business analysts to generate reporting that informs executives and senior departmental managers of strategic and tactical trends and opportunities [4].

In recent years, business intelligence has also come to rely on near real-time operational data found in systems including enterprise resource planning (ERP), customer relationship management (CRM), supply chain, marketing and other databases. "Operational" BI is meant to provision many more functions in the organization with role-specific dashboards and scorecards and is increasingly tied to the topics of performance management and business process management. Inherent to any form of BI is the notion of data quality, consistent and dependable data and the processes involved in its creation and maintenance [3]. Business Intelligence involves intelligent reporting on top of existing data which helps in prompt and actionable decision making. These decision making might involve "geography based investment decision for a multinational company" or even a "buy decision for a product by the consumer". BI has evolved over time but the key components still continue to hold true. It is still necessary to be able to aggregate the factual data from various data sources and doing involved transformations. This data then either needs to be stored in a data mart or warehouse to enable reporting and analysis on top or it could then be further aggregated into metrics which are then reported. Nevertheless the ability to perform BI involves key aspects related to data management and computationally expensive analytics or reporting [1]. Cloud computing is transforming the economics of BI and opens up the opportunity for smaller enterprises to compete using the insights that BI provides. Cloud-based analytics will impact BI by:

Accelerating BI technology adoption: the cloud becoming the default platform for evaluating new software.

Easier evaluation: the cloud enables software companies to make new technology available to evaluators on a self-services basis, avoiding the need to download and set up free software downloads [2].

Increased short-term ad-hoc analysis: avoiding data marts spawned as a result of new business conditions or events. Where short term needs [weeks or months] for BI is required, cloud services are ideal. A data mart can create in a few hours or days, used for the necessary period, and then the cloud cluster cancelled, leaving behind no redundant hardware or software licenses. The cloud makes short term projects very economical [5].

Increased flexibility: due to the avoidance of long term financial commitments, individual business units will have the flexibility to fund more data mart projects. This is ideal

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for proof of concept, and ad-hoc analytic data projects on-demand. This agility enables isolated business units to respond to BI needs faster than their competitors and increase the quality of their strategy setting and execution.

Growth considerations: As data volumes grow, for analytic cloud projects to succeed they will require a database architecture that is designed to function efficiently in elastic, hosted computing environments like the cloud. At a minimum, such databases must include the following architectural features:

- "Scale-out" shared nothing architecture to handle changing analytic workloads as elastically as the cloud.
- Aggressive data compression: to keep storage costs low.
- Automatic grid replication and failover: to provide high availability in the cloud [2].

III. Cloud Business Intelligence's Perfectly Stormy Future

Cloud BI represents a way for reporting and analysis solutions to be developed, installed, and consumed more easily due to its lower cost and easier deployment. Ideally, a cloud-based business intelligence platform makes use of infrastructure-as-a-service (IaaS), complements and extends today's platform-as-a-service (PAAS), utilizes an on-demand, virtualized, elastic software and hardware environment, and delivers application-level functionality as a service (commonly referred to as software-as-a-service) [5]. Additionally, a business intelligence tool should easily deploy and even migrate from on-premise to the cloud (and back), providing a new kind of Web-based flexibility that accompanies the most modern platform architecture. Typically, a cloud-based BI platform is used to solve one of three primary customer needs [6]:

1) As a horizontal BI tool to deliver standalone, internally facing reporting and analysis applications—probably using a traditional relational database (or data mart) as the primary source data system.
2) As an application framework or pre-built reporting and analysis template for systems integrators to use for assembling customer-specific solutions more quickly. These solutions are probably function- or domain-specific and contain reusable components and application logic (but are assembled uniquely for each customer).
3) As a development platform that enables embeddable, externally-facing applications that solve a function-specific data analysis problem (for example, CRM analytics, financial analytics, or supply chain analytics). In this case, an ISV (or an enterprise IT team with appropriate skills) would probably use the BI platform to deliver reporting and analytics as a well-defined and well-featured layer within its larger application. The result is an analytic application that solves a customer problem with minimal customization and that is ideally delivered using a software-as-a-service architecture on top of a cloud infrastructure.

The Cloud Impact on Data Centers:

A mix of private and public clouds will become the norm.

Many organizations and lines of business will bypass IT to secure cloud-based infrastructure and SaaS applications.

- Virtualization and cloud-based infrastructure will become the norm.
- Power and cooling efficiency and green data centers will become critical and the norm.
- A new breed of cloud computing skills will become common in data center operations.
- Private cloud technology, such as cloud storage, will find its way to the IT organizations.
- Service oriented architectures (SOAs) will drive the IT infrastructure and application architecture.

The Cloud Impact on IT Organizations:

- We will see a transformation from programming to service integration and customization.
- With the cloud and SaaS usage-based pricing, IT budgets will transform from CAPEX to more OPEX, opening the door for immediate IT investments.

The Cloud Impact on Cloud Computing Vendors:

- Significant market growth and momentum will fuel hyper growth.
- Cloud infrastructure utilization and efficiency will become critical to success.
- Power and cooling costs will become enormously important factors to profitability.
- Cloud infrastructure and SaaS vendors will become the new giants of the industry where the IT operations shop for infrastructure and SaaS applications.
- Merger and acquisition frenzy will become the norm for hyper growth.

The Cloud Impact on SaaS Vendors:

- There will be hyper growth in the number of SaaS applications and vendors.
- Venture spending will grow significantly.
- New requirements and standards for APIs, reporting, security and service-level agreements (SLAs) will emerge.
- SaaS vendors will become the main source of applications [7].

The Cloud Impact on Infrastructure Vendors:

- Server, storage and networking customer influence will decrease.
- Server, storage and networking vendors will be selling to cloud vendors.
- Infrastructure vendors will be fighting for mind-share with both cloud and SaaS vendors.
- Infrastructure vendors will lose contact with many enterprise customers as they flock to cloud infrastructure and SaaS.
- Merger and acquisition frenzy will become the norm for survival.
- Infrastructure vendors will experience a dramatic change of business model.

The Cloud Impact on Application Software Vendors:

- Application software vendors will have to adopt the SaaS model to survive.
- They will lose business to SaaS companies.
- Software licensing will dramatically change.
- Merger and acquisition frenzy will become the norm for survival [4], [8].

IV. The Benefits of Cloud Computing for Business Intelligenc

Utilizing SaaS solutions are an effective way to minimize costs and maximize performance. But, there are *many* noteworthy benefits of Clouding BI and using a BI reporting and analytics tool as a SaaS application:

1) Fast, easy and inexpensive deployment: Lack of infrastructure set up means a faster Return On Investment (ROI).
2) No hardware and setup expenditure: Reduced implementation costs equate to a low Total Cost of Ownership (TCO).
3) Reliability: Cloud Computing that uses multiple redundant sites can provide reliable and secure locations for data storage and are ideal for disaster recovery and business continuity
4) No capital expenditure (lowers entry barriers): No capital expenditure normally associated with setting-up traditional IT environments means the benefits of BI can be rolled out faster to more people within your organization [2].
5) Multi-tenancy environment (do more with less): The multi-tenancy nature of Cloud Computing means that cost and resources can be spread across a large number of users
6) Free automated software upgrades and maintenance: The service provider owns and hosts the software, and so users can benefit from ongoing upgrades and maintenance without the associated costs, time constraints and drain on IT resources
7) Flexibility and scalability associated with low ongoing total software costs: Freedom from upgrade and maintenance expenses mean that it's easy to keep fiscal control over IT projects and have the flexibility to scale up or down usage as needs change
8) Only pay for what you use: SaaS ensures that users only pay for what they use, eliminating wastage, resulting in low ongoing software costs.
9) Fast and easy scalability: Cloud solutions can support large numbers of simultaneous users, meaning that customers can swiftly increase their software usage without the cost or delay of having to deploy and install additional hardware.
10) Flexibility: Cloud BI solutions have the flexibility to be altered quickly to give technical users access to new data analysis and reporting features
11) Improved data sharing capabilities: Cloud applications enable easy cross-location data sharing and remote data access as they are deployed via the internet and outside a company's firewall. [8]
12) Low risk and high reward: Low TCO and overall resource investment means that SaaS represents a low risk venture that retains high reward potential.

V. The Proposed Model

The future will be very bright for the use of BI in the cloud, both because of the advantages that underpin this new computing paradigm as well as the explosion of digital data that grows each day. "BI in the Cloud" architecture is only going to be feasible when most of user's source data lives in the cloud already, possibly in something like SQL Server Data Services or Amazon Simple DB or Google BigTable; or possibly in a hosted app. like Salesforce.com. Cloud BI is the new way to do Business Intelligence instead of implementing expensive and complex software on-site, the BI software runs in the Cloud. It is accessible via any web browser in a so-called software-as-a-service model. There is no need to install software, or to buy any hardware. And when users are computing needs grow, the system will automatically assign more resources. This elastic scale is what makes Cloud BI so powerful users pay for what they use as opposed to always paying to provision for peak load.

Starting at the back, the first objection raised to a purely 'BI in the cloud' architecture is that user has got to upload his data to it somehow. Users can use the tools and applications they're familiar with to work from anywhere. With the choice and flexibility of cloud computing, users' businesses can deploy services on-premises, in the cloud, or a blend of both. And, our solutions are all built on a unified productivity platform that's not only cost-effective, but gives user the ability to respond as business needs evolve.

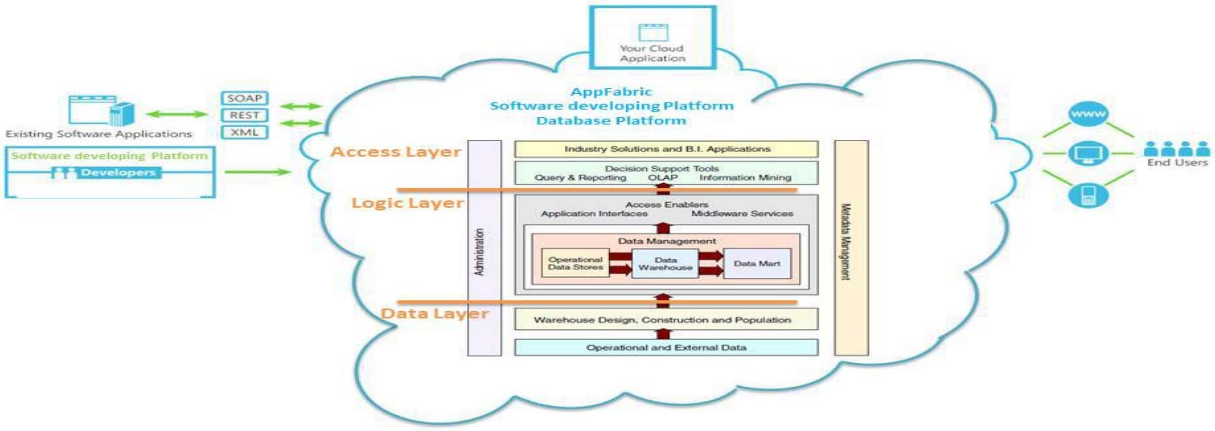

Fig. 1. Business intelligence proposed model

Component of the proposed model (Business Intelligence in the Cloud The proposed model represents a new environment atmosphere for the business intelligence to make the ability to shorten BI implementation windows, reduced cost for BI programs, Ability to add environments for testing, proof-of-concepts and upgrades. This environment represented as follows:

A. Cloud Computing

The cloud provides a virtually unlimited pool of computing power, storage and memory. However, these resources are delivered in discrete modules. Each node consists of "standard" units of processing power, storage space and memory. While the amounts may vary (by service provider, price point, etc.) and they may increase over time, the Cloud's pool of resources is a large grid of interchangeable, industry-standard computing resources. Achieving true scalability requires a database architecture that can fully maximize this pool of resources.

A shared nothing, massively parallel database architecture is particularly designed to take advantage of multiple units of computing resources. In the proposed model we use Microsoft windows azure and we describe how cloud computing can be affected by the business intelligence?

B. AppFabric

Helps connect applications and services in the cloud or on-premise, for example applications running on Windows Azure, Windows Server and a number of other platforms including Java, Ruby, PHP and others.

C. Platform as Services

Platform as services is a cloud services operating system that serves as the development, service hosting and service management environment**.** It is a flexible cloud–computing offering that lets user focus on solving business problems and addressing customer needs. No need to invest upfront on expensive infrastructure. Pay only for what user use, scale up when he need capacity and pull it back when he don't. Users handle all the patches and maintenance all in a secure environment. Cloud computing as a platform supports multiple languages and integrates with existing on-premises environment. In addition, it supports popular standards, protocols and languages.

1) Database Platform

Business intelligence can be moved to cloud using Platform as services. It is a cloud-based relational database service built on database technologies. It provides a highly available, scalable, multi-tenant database service hosted in the cloud. Platform as a services helps to ease provisioning and deployment of multiple databases. Users do not have to install setup and patch or manage any software. High availability and fault tolerance is built-in and no physical administration is Database Platform of their existing on-premises databases. Database Platform delivers scale to meet the needs of the entire organization and provides IT with flexibility to respond quickly to the evolving needs of the business. Organizations can bring great new experiences and empowerment to their end users on a familiar IT infrastructure that's more manageable and cost effective. Database Platform includes features to help user manage critical data assets company-wide and across diverse systems, helping to ensure integrity of information. Mostly master data is maintained into the permanent staging database and synchronized with delta from extracts and this piece of data is not that huge too. With a proper design and dissecting permanent staging area into two parts, by moving master tables to the cloud and delta records to a temporary staging area, the intermediate need of a staging server can be eliminated. Database Platform is a fit for this, as we just need to store the staging data and queries are not that complex. And just for storing of this staging data, we do not need an enterprise level database and access to this data is not that frequent too.

2) BI Infrastructure

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 data warehouse (DWH) [3]. 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". Many current realizations of DWHs are based on so called core DWHs .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. ODS/DWH architectures allow to build Closed-loop and Active Data Warehousing solutions. 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. For the storage and administration of unstructured data, Content Management Systems (CMS) and Document Management Systems (DMS) are inserted into the data layer [8].

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: 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. Data mining and similar model based tools are also referred to by the term Advanced Analytics [4].

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.

VI. Conclusion and Future Work

The development of business Intelligence field cannot ignore the cloud computing trends. There are many benefits from using the cloud computing for business intelligence. It influences the way business intelligence software projects are managed which it provide a virtually unlimited pool of computing power, storage space and memory for the business intelligence infrastructure, so our proposed model represents a new environment atmosphere for the business intelligence that help in shortening BI implementation windows, reduction of cost for BI programs, enabling to add environments for testing, proof-of-concepts and upgrades. Business Intelligence in the cloud has been developed in order to enhance the efficiency and productivity of business intelligence and increase the performance of BI software. In the future we are aiming to develop business intelligence by using web 3.0 technologies. In the future we are aiming to develop business intelligence by using web 3.0 technologies.

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