Business Intelligence Trends and Challenges

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***Abstract*-There are several Business Intelligence (BI) tools and platforms available in the market to achieve BI solutions. Organizations are facing different challenges during the implementations of such tools related to various complexities, performance and security. Hence, there is a need to look forward and improve with the modern BI technologies and successful *implementations* for solutions for data mining, mobile BI, cloud BI, column-based approach, in-memory computing, managing structured and unstructured data with the improved performance, This way the business leads could see remarkable change in performance and visualization in order to have access to the related business growth by implementing such solutions. This paper refers to current challenges that companies are facing in BI with traditional approach and changing trends in technology. It would also provide forward approaches to overcome those problems by improved solutions with use of new technologies.**

Keywords-BI; BW; ETL; OLAP; SOA; APD; NLP.

I. INTRODUCTION

Large scale organizations are targeting advanced Business Intelligence (BI) systems to drive challenging revenue and market opportunities.

Fully integrated set of BI technologies can help companies reducing business complexity, organizing and distributing information, leading competitive advantages and better decisions for an improved intelligence bottom line.

Currently, most of BI projects and implementations are suffering due to the lack of right approaches and selection or combination of right tool and technology to meet short and long term BI targets with complex integrations [26].

The article is divided into three main portions. First portion covers BI demands and challenges. Middle portion covers advanced methods and changes in BI Technology and modifications required in existing tools. Last and third portion covers approaches to adopt for successful BI projects and implementations, along with the conclusion.

II. BI DEMANDS AND CHALLENGES

A. Industry Trends and Demand

Industry research shows increased demand for different types of industry sources all over the world, e.g., oil & gas industry is passing through significant changes and companies are doing mega mergers and associated consolidations for their deliverables and services to handle big projects with extreme level of collaboration in order to meet the industry demand.

There is a tough competition seen allover the market and the companies are now looking for the ways to reduce cost of their deliverables and services as organizations are making their plans for next 10 to 15 years to compete highly volatile market.

There are hundreds of inquiries to be answered by BI systems. For example, how to deliver cost effective engineering, procurement and plant construction projects? How to increase existing plant productivity? How to increase plant life for an oil & gas plant? Or, provide maintenance predictions by using innovative advancements in the technology for a large scale business.

B. Data Consolidation Challenges

It is time for data integration and consolidation, as fragments of different types of information is scattered by different applications and different sources including corporate level databases, internet and intranet data sources, specific social media sites and globally available services.

BI architecture needs to consider all the business processes in order to achieve final results reflecting all the information required for business and to make data available for detailed information examinations and on summarized level inspections.

There is a need to do data refresh from source systems into staging databases, and then, to transform to data targets in data warehouses in regular frequency of events using process chains and to make sure that no information is lost. It is also required to process original data using data transformation and mining tools in order to convert into useful information.

ETL (Extract, Transform, Load) tools are available in the market for data acquisition and transformation from different source systems to BI data targets and to load from one data target to another data target with data processing and filtrations.

Data warehouse platforms are available to design star schema and process chains and to make multi-dimensional cubes and data providers available for end users to do analysis based on facts and figures for interactive analysis. However, the research is going on to resolve integration problems between different platforms to achieve required collaboration.

C. Data Security Risks

Companies like are doing collaboration and coming up with shared BI application landscapes to meet extraordinary business demands to beat market competitions. As a result of change, organizations are forced to share BI applications and platform to delivery partners through Internet or intranet, which is becoming a concern to the companies for possible leakage of unwanted information [27]. PETROFAC International is one of the biggest oil and gas companies in

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the world where we are working on multibillion dollar oil and gas partnership projects with other companies and are sharing systems landscape with partners for sharing analytical information and to work in collaboration.

Object level, package level, analytical level and system level security privileges need to be implemented to secure BI system. Technology is improving providing resolutions and research is going on to provide high level confidence to business owners to provide them with secure place for sharing BI platforms to deliver and execute collaborative requirements [4].

D. BI Landscape challenges

Following are few of the challenging components in BI solution need scalability, accessibility, stability, security and improved performance.

TABLE I. BI LANDSCAPE.

BI Landscape
Infrastructure
• Required hardware and operating systems • Database environment • Application and Web servers • Technical security and systems performance • Network and middle ware • Storage and capacity planning • Desktop and browsers
Data Warehouse Environment
• ETL tools/methods for Data extraction, Data Transformation, Data Staging and Data Loading • Data Modeling, Data Quality, subject oriented and integrated data marts as Data Management • Management processes like Data Archiving and backups, Batch and Change management along with version control
Front End Applications
• Presentation tools like reporting, Portals, Dashboards, report distributions and alerts • OLAP Analysis, Data Mining, Predictive analysis and Web Analysis • Business Application and MS office Integrations, Performance management applications and Systems connectivity • Visualization • Data Discovery and exploration tools

BI landscape is facing major changes with new approach for implementation and new innovations in technology coming up in the market. Business application vendors are also coming up with data ware housing and ready-made BI contents as part of their product suits, so emerging further needs to come up with one competitive and complete BI and Business Warehouse (BW) solution on single platform including integration capabilities with ERP and legacy systems in addition to the common data ware housing engine along with ETL and intelligence capabilities.

E. Cost of Ownership

Cost of ownership is different for different BI platform vendors. It includes total license cost, total implementation cost, IT administration and business administration cost. We also consider aspects related to integration, product quality, ease of use for developers, single user implementation cost etc.

As BI technology is changing fast so it is important now to get ready with related investigations to acclimatize the change and to consider the value of services using BI Cloud, SOA (Service-Oriented Architecture), Column-based approach for performance, Mobility, etc.

When we do cost-benefit analysis and compare cost of ownership with respect to the Returns on Investment (ROI), many other thought-provoking things are there to consider during analysis.

F. Performance Bottleneck

Information needs to be reported, analyzed and distributed to a group of targeted people at the right time and in the right required format with the vision necessary to make better and faster decisions.

There are different scientific methods available listed below to overcome analytical performance,

- Query design for optimal performance
- Using variables and dropdown lists in front-end design
- General guidelines for optimization
- OLAP (Online Analytical Processing) caching techniques for optimal query performance [6]
- Using Aggregates and data manager techniques
- Complex result of queries and OLAP process to keep in cache.
- Least-Recently-Used-Algorithms [28] and Caching techniques
- Use of query monitors and cache monitors
- Delta caching [5]
- Parallel Processing techniques during Query Execution
- Calculations in database layer rather than application layer.
- Settings related to query drilldown with read modes like read all data or read data during navigation trade-off for number of DB accesses
- Using query runtime statistics, data load statistics, query monitor, trace tools, etc. in order to monitor, analyze and improve performance
- BI accelerators using special hardware to achieve faster performance [13]
- In-memory analytics [11][17]

G. Economic Challenges

By changing trends, business owners are keeping an eye on some of the below economic challenges to achieve ultimate BI solution and related change management for cost and scope management.

- Unpredictable Economy (BI is dead without business)
- Pricing is a huge obstacle for BI deployments
- Pricing for every user licenses (Inside organizations or when extending BI to other parties and partners)
- Organizations looking for quick-win technology projects

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- Large strategic projects becoming failures
- Diverse Justifications and business benefits
- Change control management and associated cost
- Like-for-Like comparisons for initiatives

III. BI ADVANCED METHODS

A. Move to Data Analytics

Many companies in the previous years have already adapted BI platform; it is time now for data analytics.

In recent years, companies were targeting to historical data to see business performance; but, today's Analytics is leading towards predictions and goes beyond insights to create business impact.

Predictive models and algorithms not only allow you to predict the most likely outcomes but also suggests for the best that could happen, So, predictive analysis is going to help business to make decisions based on facts rather than judgments and interpretations as business seeks forward-looking rather than back-ward looking.

Approximately 30% of the companies in 2014 will align analytics matrices completely with business drivers [9].

B. Data Mining Methods

Effective use of some of below data mining methods/algorithms for analytical business solutions could produce brilliant profitable BI results for organizations.

TABLE II. DATA MINING METHODS.

Data Mining Methods		
S No	**Category**	**Mining Methods**
1	Predictive Methods	Decision Tree Regression Analysis
2	Informative Methods	Clustering, Association Analysis, ABC Classification, Weighted Score Tables

Different BI platforms provides tools to implement these methods; for example, SAP provides Analysis Process Designer (APD) and Data mining workbench [8] to implement data mining methods in order to create related data mining models with customization settings to control related security and amount of detail generated during data execution.

SAP launched a new product "SAP Predictive Analysis" [21][23]. This tool is used to implement advanced business cases from data scientists, advanced business users and analysts to achieve data mining capabilities, statistical modeling & visualization.

C. Story-Telling Predictive Analysis

There are four types of dimensions which determine the type of story you are telling with available analytical data

TABLE III. STORY TELLING DIMENSIONS.

Story Telling Dimensions	
Type	**Description**
Time	Time dimension is to do data analytics about past, present and future. Stories about past are reporting stories , stories about present are to involve different forms of surveys data and stories about future are predictions
Focus	This dimension is to bring important factors from analytics like what happened, why something happened and how to address the issues
Depth	This involve in-depth analytical search to find solution to a complex problem
Method	These are the stories based on different analytical methods where we try to bring correlation stories and causation stories to determine how relationship of variables can cause rise and fall to outcomes. Data mining methods mentioned in section B would also help to achieve the outcomes.

How to condense data into a good story is an art and technique in BI. Instead of presenting data in tabular form to get predictive results for business leaders, companies are looking forward for the implementation of story-telling techniques of analytics where the information outcome is in demand after analyzing insight data in a descriptive form along with visualization.

There are some requirements to enhance BI analysis tools for creating BI stories.

TABLE IV: STORY TELLING CAPABILITIES TO ACHIEVE.

Story Telling Capabilities	
Capability	**Description**
Visual Aid	To draw attention on visualization data by arrows and by doing coloring, notating, highlighting, zooming etc. to support narration
BI Story Templates	BI stories would have some structure. There is a need to have templates with annotated dashboards.
Reusability	We need to have similar set of BI story templates for different set of data. It would be very easy in case the tools provide the facility to create reusable structure of stories.
Interactive Visualization	Shared reports need to be interactive and to be supported by storytelling tools by linking and brushing options
Transition	It is highly required to convert visualization into stories by some transition tools to save time and cost.

D. Artificial Intelligence and Computational Intelligence

There are many examples of latest Smart phones, like Google, with location support services; Google glass applications are providing information based on your present location.

These projects use natural language [22] to process questions or requests and you do not have to talk in code language to get the required answers. These applications can learn and adapt new words in any language from the user. This is an example of computational intelligence which is same as an artificial intelligence.

This technology would be extensively used to provide BI answers rather than presenting complex dashboards to the business owners.

BI analysts can do research on available business data and are required to do brainstorm to bring prediction by different available data mining methods with combination of story-telling art and intelligence to convert the results in speeches to answer business leaders. Outputs can be converted to perform some mechanical activity to achieve artificial intelligence.

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E. Mobile BI

Companies are now planning to move to mobile BI and stability and maturity is expected in this area in 2014 [4]. They want to take the full advantage of advanced technology to achieve insight into big data with the help of smart phones to get better information anytime anywhere and to analyze the data for faster decisions.

Using mobile technologies, information delivery from corporate data is not limited to desktops. It's time now to incorporate real time data available within the smart phones to take real time decisions.

There are large varieties of tools like Oracle Business Intelligence Mobile Application Designer to create mobile applications and to bring analytics. Many BI vendors in the market that are coming up with complete solution with security measures.

Exploration is still going on and improvements are required in Mobile BI in following areas

- Security
- Offline Support
- Authentication and authorization
- HTML5 versus Native applications

F. Cloud BI

Cloud computing is becoming populate now a days but adoption rate of cloud business intelligence is low. Business leaders are doing investigations in data integration and security on cloud. Query will be more accessible, as web services have given an innovative approach to marry cloud data with legacy application data sources, which are not available on cloud.

Some BI leaders provide faster and value added solutions to move implementation and maintenance for BI solutions with administration tasks to Cloud and ability to change analytics on the fly [10]. Research on technology is providing solutions to secure enterprise data on cloud. However, lack of awareness on security rules or business practices could cause very high impact on business and business owners are not getting decisive confidence as a result to move BI on cloud.

Enterprise Proof of Concept on different scenarios with pay-as-you-go [17] towards more integrated and complex scenario approach would provide solutions to problems and confidence level in BI cloud adoption.

G. Cloud BI Architecture

For example, SAP HANA Cloud application Platform [29] enables customers to initiate small BI projects for quick and running business solutions with massive data and provide continuous growth capabilities by adding new BI business cases with minimal IT investments.

SAP HANA Cloud platform is one of the examples and provides full set of developer application services including social and collaboration services, analytics, portal and mobile services. It also provides highly scalable database, transaction processing, real-time advanced predictive analytics and text mining capabilities.

Cloud-based implementations are now starting where cloud architecture is able to integrate with any technology, including SAP (ECC 6.0 and BW), Oracle, SQL Server and non-SAP systems.

Cloud architectures are providing best services for ETL tools. BOBJ data services are able to do data extraction from source systems to BI cloud. RFC connectors are used to extract data from SAP ECC 6.0 or from data warehouses. Data Services also supports different types of connections for data extraction supported by other database vendors.

H. Using BI Accelerator

Read performance of BI queries is greatly improved by the query drill down. Navigation requirements of the customer are complex and unpredictable. We are creating aggregates, but it is impractical to create an aggregate for every possible navigation scenario.

TABLE V. BI ACCELERATOR BENEFITS.

BI Accelerator Benefits			
No	**Benefits**	**Advantages**	
1	Very fast query response time	Performance Improvement by factor 10-100	Increased end user satisfaction
2	Stable query response time	Independent DB optimizer, aggregates	
3	High Scalability	One BIA instance can run on multiple blade servers	Significant reduction in cost of ownership
4	Low maintenance	No aggregates maintenance, minimized rollup/change run	

Tools like BI Accelerator (BIA) [13] with combination of special hardware are now providing business advantages to improve performance

I. SAP HANA

SAP HANA is a new solution and provides resolution for major BI problems [16].

TABLE VI. SAP HANA SOLUTIONS.

SAP HANA Solutions			
S No	**Problems**	**HANA Solutions**	**Additional Notes**
1	Speed (Proof Points)	3600x faster analysis, 460B data analyzed in less than a second.	21% average increase in revenue.
2	Flexibility	Real-time access to transactional data	Real-time data replication engine, Calculation Engine
3	Scalability	Ground breaking In-memory Innovations, Live cache, BW Accelerator	Solution with software and parallel procession of multi core CPU
4	Data Volume	41.9 GB of data in traditional DB comes in 6.6GB by data compression in HANA	
5	Query Run-time comparison	Query1: 2000 sec (6.1sec in HANA) Query2 1320 sec (5.1sec in HANA) Query3:1050 sec (3.2 sec in HANA)	
6	Classic Enterprise Data	To have corporate BI integrated with multiple ERP systems including SAP and non-SAP	

	warehouse	systems with new applications on HANA
7	Rapid delivery results	Fast Implementation methodology (Start, Deploy, Run)

J. Hadoop Big Data and SAP HANA

Big data raises many challenges. There are three main challenges which are common and are called as "Three Vs"

- Velocity
- Volume
- Variety

Hadoop low-cost commodity servers are able to handle data in petabyte and in Exabyte range, which is much higher than 100 TB ranges of data. SAP HANA and other RDBMS can typically handle less than this range. On the other hand, Producing Analytic solutions from Hadoop are much slower than SAP HANA.

We can achieve very fast analytic solutions from really big data by using combination of capabilities provided by SAP HANA and Hadoop.

SAP HANA provides excellent OLAP, OLTP innovative capabilities with very fast data access and administration tools whereas Hadoop provides very slow data access and can support any data or file structure on the disk. It provides distributed and scalable architecture and does not provide OLTP and slow OLAP and few administration tools as compare to SAP HANA.

SAP is now providing full integrated support for Hadoop with SAP HANA platform, SAP Business Object & SAP Data Services to achieve complete sophisticated OLAP and OLTP technology solutions with both structured and unstructured data.

K. Cloud And Mobilily

Secured BI clouds are opening new opportunities for organizations that are able to get quality services at a low cost where users are also able to use different applications and web services and are using cloud data to make it available on mobile for business intelligence.

Now organizations are taking steps to bring all Business Objects, Web Intelligence reports and dashboards to make them available to mobile users with real-time data for operational use and business decision making.

L. Nosql in Future

Demand for NOSQL [24] is increasing along with the demand of Big Data [25] as combination of big data and NOSQL technology will set a new trend in 2014 in the form of high demand technology. Need for this technology is rising to improve performance for real-time analytics from large data sources, where traditional SQL is becoming a bottleneck for speed [30].

M. BW Capabilities

It is a good change coming in BI market for the implementation of Data warehouses on products like SAP HANA [16]. Companies were facing big hurdle in the way of BW adoption. It is now a breakthrough and companies would be able to think for BW capabilities [16] during 2014 to achieve the goals in an effective way and fast track. However, the need for BW platforms would still be required.

N. Embedded BI and SAP Netweaver CE

Now, people expect analytic information to be embedded in business processes. Embedded BI allows developer and business experts to embed BI components in applications and composites and to allow business users jump to reports, dashboards and BI tools within the business context and to make the information actionable.

Lightweight SAP composition environment provides integrated/embedded BI capabilities on top of common BI services layer.

SAP Net weaver Visual Composer [15] provides integrated key matrices from several heterogeneous systems into one user interface and one report without extensive and costly data modeling. It supports very quick Xcelsius dashboards style reporting [15], lightweight analytics and visualization.

O. Social Media Analytics

Social media analytics use advanced natural language processing engine to read, analyze, and normalize data by extracting customer's perceptions from terabytes of social media data in real-time and conclude not only sentiments but deeper insights for opinions and emotions.

Natural Language Processing (NLP) engine read each sentence and identify noun, verbs and adjectives and categorize them according to the required target opinion, emotions & behaviors. Later, NLP engine finally helps you understand what your customers feel about your product or service.

By SAP social media analytics you can get access to pre-analyzed data from social intelligence warehouses. Every hour these sources are updated with new entries and analyzed information. We can get real-time access from Twitter's complete data stream with more than 250 million tweets per day for our customized analysis.

By using the analysis tool, you can define filters, searches and produce drilldowns for analysis of customized categories like different products, topics, interest, feelings, and demographics. One can also export data and graphics into reports and presentations to examine individual comments for more detailed analysis.

P. Strategic Analytical Platform

To have a strategic analytical platform, you need to ensure that the solution we are planning should be able to access, integrate and process data for desired outputs taking from Cloud Data, Big Data, to local data and corporate data warehouse for all structured and unstructured data.

Q. Drives the New Data Warehouse

Data warehousing architectural design needs modifications in this current era towards more advanced state of art technology concepts like SOA, Big Data, social media analytics, mobility, Cloud, NOSQL and data visualization for more advanced BI solutions with advanced analytical and

transaction processing capabilities with improved ways of implementations.

IV. BI PROJECTS

BI Leaders are considering the rapid change in BI trends and technology and are working on to overcome related challenges during initiating completely new BI projects, BI migration and integration projects. In addition, below are few areas to do tradeoff in order to bring effective BI systems and better project management.

- Produce all BI business cases
- Determine global integrated architecture
- Defining global implementation scope
- Prioritizing enterprise global scope
- Balancing top-down and bottom-up approach
- Follow and consider all aspects in six global dimensions
- To adjust 3-dimensions (Scope, time, cost)
- Project progress measurement procedure
- Document control & approval procedure
- Draw milestones for project linked with progress
- Monitor and control progress and risks
- Quality monitoring
- Produce global staffing plan
- Project Budgeting (How much and for how long)
- User acceptance group and UAT Plan
- Follow standards & steps during each phase including blueprinting, realization, Cutover and Go Live

V. BI IMPLEMENTATIONS

Most of implementations of any BI Technology are not successful and are becoming problem for companies in the completion of BI projects. Some of important things to consider for successful BI implementation are mentioned below

- Strategic Vision to succeed
- To draw short and long term BI strategies for short and long term benefits
- Platform/Technology and tools Selection
- Skilled staff and sub-optimal staff utilization
- Business analysis or standardization
- Business sponsors engagement
- Integration with Multiple Source Systems
- Organizational Collaboration (Disciplines, Departments, Business Units, Strategic Divisions, Global Locations)
- Cross Organizational Collaboration (Partners, Contractors, Subcontractors, Vendors, Customers, External Parties and Market conditions)
- Cross organizational collaborative culture
- Privacy Breaches and IT Security concerns
- Limit productivity VS Security Lapses
- Manage Islands of Information Systems
- Disparate data sources not designed to work together
- Elimination of Multiple Storage Towers
- Consistent Touch Points for all end users/Stakeholders
- Real-time data access to Stakeholders
- End user trainings
- Outsource model, Vendor & SLA management

VI. CONCLUSION

There is a need to maximize returns on BI investments and to overcome difficulties. Problems and new trends mentioned in this article and finding solutions by combination of advanced tools, techniques and methods would help readers in BI projects and implementations.

BI vendors are struggling and doing continuous effort to bring technical capabilities and to provide complete out of the box solution with set of tools and techniques.

In 2014, due to rapid change in BI maturity, BI teams are facing tough time to have infrastructure with less skilled resources. Consolidation and convergence is going on, market is coming up with wide range of new technologies. Still the ground is immature and in a state of rapid evolution.

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