INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 1)
Available online at: www.ijariit.com

Service Oriented Architecture paradigm for Business Intelligence: A survey

Akash Ajay Borse
akashborse9@gmail.com
Sandip University, Nashik, Maharashtra

Siddhant Verma
sid0308v@gmail.com

Dr. Sasidhar Babu
sasidhar.suvanam@sandipuniversity.edu.in
Sandip University, Nashik, Maharashtra

Gardas Naresh Kumar
guru.jasper@gmail.com
Centre for Development of Advanced Computing, Pune, Maharashtra

ABSTRACT

Service Oriented Architecture (SOA) is an arrangement of building blocks of any application in such a way that all dependent/independent components will be able to access/provide service to and from other components. The main objective of SOA is to sustain the availability of required services for components and provide a flexible environment for better efficiency. It is also capable of measuring the maturity of an organizational application by means of continuous assessment of activities. SOA in Business Intelligence (BI) has potential benefit to enhance the analysis capabilities over huge datasets, as enormous amounts of data are being generated by every organization whether industrial or domestic. This survey provides research on how SOA can improve the heavy processing of these data much efficiently and also gives the limitations of the traditional approach.

Keywords— *Service Oriented Architecture, Maturity, Business Intelligence, Event-driven*

1. INTRODUCTION

Service Oriented Architecture (SOA) is having its own potential capabilities and benefits; it has become a trending topic in the business management world in terms of business processes, business intelligence and many more areas. The basic principles of SOA are independent of vendors, products and technologies. In IT world, SOA is defined as "A style of software design where services are provided to other components by application components, through a communication protocol over a network". Business Intelligence (BI) on the other hand is another area of Data Science which deals with processing of huge amounts of historical or present factual datasets to produce the useful patterns and insights for further analysis purpose. As tremendous amounts of data are being generated in day-to-day life by corporate industries and also other data sources, organizations are looking for faster and yet effective solutions to gain insights from these huge amounts of data for their business growth. Applying SOA design paradigm in Business Intelligence (BI) can deliver a better solution to resolve the issues faced by organizations in BI. Today, many companies have adopted and incorporated SOA for their internal use in Business Intelligence and many more companies are moving towards adopting this SOA approach in BI. This paper in further sections elaborates the traditional BI issues faced by organizations, the available solutions and the related work with description.

2. DISCUSSION

2.1 Business Intelligence (BI)

Business Intelligence is enhancing of business capabilities with the use of a set of BI tools, processes and methodologies that provides useful insights against historical or present factual data. It has the potential of running various data mining algorithms to find out helpful patterns existing in that data. As the current data growth today is enormous in size and is being grown rapidly, organizations are looking for much faster but yet efficient BI solutions that can deal with such huge data, which is also known as "Big Data".

2.2 Service Oriented Architecture (SOA)

Service Oriented Architecture (SOA) is an organization of components of software which can be dependent or independent of each other and can communicate with the help of services. Each component relies on services for interaction with other components requests. Service itself is self-contained and light-weight. SOA paradigm is one of the most flexible way for business process integration, business transactions and collaboration tools. It also provides process-level isolation to create event-driven and on-demand services, information and processes which can be invoked and utilized as per business requirement. Most of the industries today are moving towards adopting and incorporating Service Oriented Architectural Paradigm in their business architecture.

Business Intelligence has a huge impact on business process management with the goal of business growth. There is a growing demand for BI tools which are more mission-critical and more suitable for the particular or overall business area(s). The traditional BI process involves many stages of Data Collection,

ETL (Extract-Transform-Load) Process, Data Warehousing, Data Analysis, and Data Visualization.

Following diagram depicts the overall process flow of Business Intelligence with the explanation of each stage involved in the Business Intelligence (BI) process.

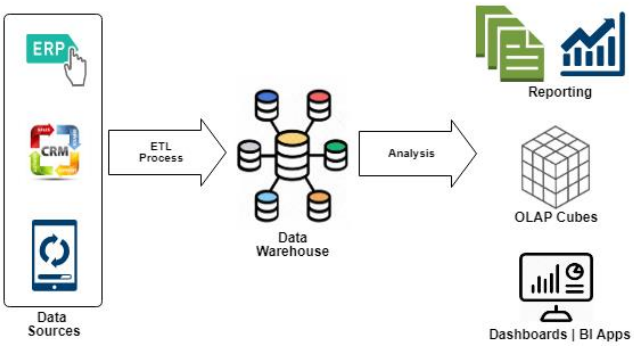

Fig. 1: Business Intelligence Process Flow

(1) Data Collection: This is the first stage of Data Warehousing in which data is collected from various internal and external sources like CRM (Customer Relationship Management), ERP (Enterprise Resource Planning), SAP (Systems Applications and Products), SCM (Supply Chain Management), and many more. This data can be in different forms like structured, unstructured and semi-structured.

(2) ETL Process: ETL that is Extract-Transform-Load process is applied over collected datasets for cleansing, transforming and loading this data into data warehouse.

(3) Data Warehousing: Data Warehouse is a large repository of collected data from various internal and external data sources. Data Warehousing is a process of loading or storing of the data into data warehouse.

(4) Data Analysis: Data Analysis is the process of selecting a cube of data from data warehouse and applying various algorithms for identifying useful patterns in that data for gaining insights for business growth.

(5) Data Visualization: Data Visualization is an art and process of representing the raw data or available data into various understandable and/or interactive forms like charts, graphs and shapes. And these visualizations are collectively represented as Dashboards.

2.2.1 Role of SOA in Business Intelligence: Business Intelligence is having its own potential benefits in the business world. It is capable of providing many insights regarding what is currently happening, what has happened earlier and also what is going to happen within an organization based on historical and present fact-based data. BI allows identifying the trends based on facts and patterns of where an organization is and where it is going to be.

The process of BI starts with ETL process in data warehousing which involves:
(1) Extraction of data from internal and external data sources.
(2) Transforming data as per business need.
(3) Loading or Storing of this transformed data into data warehouse.

It is observed that Service Oriented Architecture (SOA) standards can provide the flexibility to organizations which is needed to leverage their existing IT infrastructure without having to deal with the issues associated with proprietary application servers. An SOA based BI solution can run on any web server and can comply with existing firewall and routers. A single Web API (Application Programming Interface) can ensure that the solution can be integrated easily with other applications and can be extended further as per business needs.

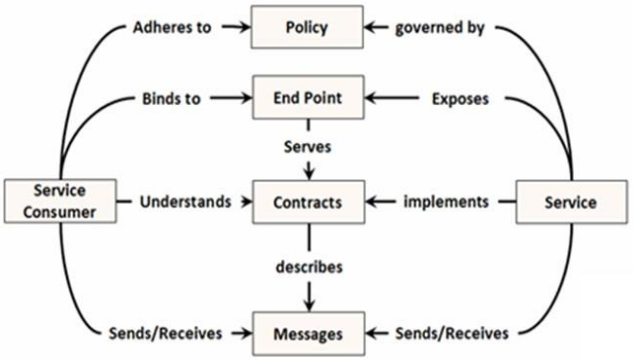

Fig. 2: SOA Components and their relations (Arnon, 2006)

The above figure elaborates the components and their relations. Let's describe these components in brief:

(1) Service: Its the main pillar of SOA. It is composed of small code with specified business logic. It itself is a facility which is supplied on demand. A service should comply at least all the functionalities that are promised by contracts or its operation it exposes.

(2) Contract: A contract is a collection of all the messages supported by the service. It is a set of messages that a service prefers to provide.

(3) End Point: An EndPoint is an address location/ URL/ a specific place where the service resides and is utilized. An individual contract can be exposed at a specific endpoint.

(4) Message: A message in SOA is a communication medium for the services. It can be in forms of SOAP messages, HTTP messages and even SMTP messages. The messages are having both header and the body. Headers are more generic and are compatible with frameworks and infrastructure components and are easy to consequently couple with components. It allows components to route the messages effectively and also handles the security better.

(5) Policy: Policy in SOA represents the well-governed conditions specified for availability for service consumers. Policies can be updated in run-time that is embraced by the business logic. The policy incorporates dynamic properties like SLA (Service Level Agreement), Security and Auditing.

(6) Service Consumer: A service consumer can be any entity like software component or any other piece of code that interacts with service by exchanging messages with the service. Consumers can be either client application or any other neighbouring services with the requirement that they bind to a defined specified SOA contract.

According to Pat Helland[7] in "Data on the Outside versus Data on the Inside"[7], the service's internal data should not be exposed outside of service, i.e. it should have limited scope to itself for a particular operation and should not be revealed to other existing services, this provides service-level isolation; hence supports component-level fault tolerance. In SOA, each service is autonomous in nature and are independent of each other. Each of the services is composed of a piece of code and certain data that is exclusive to that service. A service can communicate with

other services exclusively through messages and their operations are kept private to themselves. Each component in SOA relies on independent services which are interconnected with messaging. Based on well-defined business rules, the services interact with each other as per the specified operations over components.

Service Oriented Architectures (SOA) are widely becoming the key initiatives for most of the business organizations. They are having a massive impact on how the Business Intelligence (BI) environments or platforms are designed, developed, deployed and utilized across an organization. It leverages more reusable and powerful application components with the associated services with specified operations and governed business logic. These services are distributed and/or shared across application components to make the overall business system more flexible and easy for integration with other new components like software solutions, databases, and other technology resources which can furthermore easily interact and interconnect with each other.

2.2.2 SOA Approach Vs. Traditional BI Approach

Table 1: SOA vs. BI approach

SOA Approach	Traditional BI Approach
It is Enterprise-Oriented	It is Subject-Oriented
Acts as Middleware	Follows Extract-Transform-Loading (ETL) process and Presentation of data
It is Transactional	It is Non-Volatile
It relies on web services and message-level processing of data	It relies on Very Large Databases (VLDBs) which can be in Terabytes (TBs)
Provides a Real-Time environment	It is a Scheduled process

2.3 Limitations of traditional Business Intelligence Systems

Data collection and Data Warehousing are the primary stages in every Business Intelligence (BI) solutions. It is observed that Data Warehousing is the time-consuming process, and these BI systems are having some common limitations compared to present Service Oriented Architectures (SOA) which are as follows:

(1) Piling of Historical Data: The main objective of a BI system is to collect and retain all historical data for future use i.e. to help experts to deal with the extracted patterns and helpful facts from data for analysis.

(2) Cost: A standard Business Intelligence solution can be a little too much costly for small as well as for medium size/ scale enterprises or organization. Hence, implementing and maintaining such a solution can be quite expensive for even basic operations.

(3) Complexity: When implementing a BI solution it could be difficult to arrange and implement data, which may lead to difficulty in accessing and processing of data.

(4) Time-Consuming Implementations: Though today industries are fast enough to plan and implement necessary tools and technologies, it is quite a long period of implementing a BI solution as it includes data warehousing, which can take more time as data in growing much rapidly.

2.4 Advantages of using SOA in Business Intelligence

The deployment of a service-oriented architecture in a business organization can endeavour many potential benefits like one of the key features of SOA which is "Reusability" can efficaciously reduce the IT overhead costs, simplify and expedite the application development and further administration. SOA provides the more robust and efficient architectures for data access and data movement.

Moreover, "Event-Driven" is another major feature of SOA that allows real-time information visibility, dynamic on-demand data transfer actions as certain condition occurs or criteria meet or some critical issue arises.

Furthermore, SOA is having its own potential benefits which are as follows:

(1) Service oriented: It provides improved information flow and has the ability to expose internal functionality and organizational flexibility.

(2) Service Re-usability: This feature lowers the development, management and administration cost of an organization.

(3) Message/Information monitoring: Results in Business Intelligence (BI), Performance/ Maturity Management or Benchmarking, and Risk Analysis.

(4) Information transformation: It allows data transformation for different independent modules or application components.

(5) Module-driven implementation: It allows for faster development and implementation of new functionalities.

2.5 SOA based BI Platforms

There are various BI tools available in the market today for both small scales as well as large scale organizations. IBM's Cognos Analytics and Microsoft's Power BI are two of them which provides the promising Business Intelligence features that can meet user demands and both works on Service Oriented Architecture (SOA) based Business Intelligence (BI) platform, also known as Service Oriented Business Intelligence (SoBI) platform. Each of the BI solutions comes with their own potential benefits and the drawbacks or we can say the limitations that can be in terms of cost, features, domain knowledge or even overall setup/ implementation time.

"New Intelligence" is a company which is one of the leading IBM solutions providers for Business Intelligence, Performance Management and Data Warehousing. According to them, when a company or an organization decides to incorporate Business Intelligence in their organization, they will choose a particular BI solution with the consideration of their IT consultants and not specifically there end-users. But ultimately end-users will also benefit from the chosen BI platform in terms of overall performance and experience.

Following are the top Business Intelligence platforms listed by Gartner in 2018:

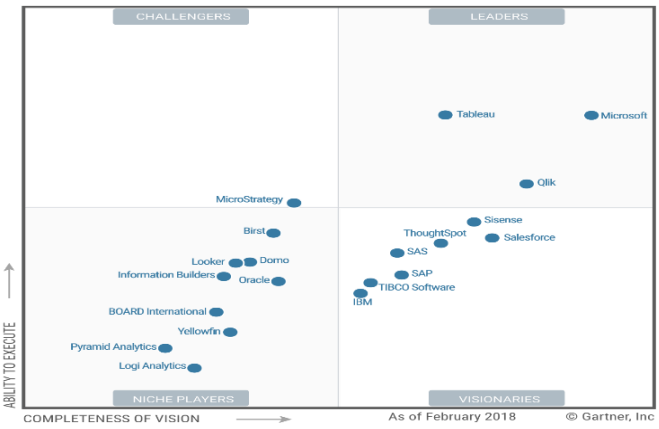

Fig. 3: Magic Quadrant for Analytics and Business Intelligence Platforms (Gartner)

3. RELATED WORK

There are various case studies which have been studied and implemented over Service Oriented Architecture (SOA), especially in Business Intelligence domain. SOA has been an evolving sector since the term SOA was coined in the year of 1998 as Service-Based Architectures (SBAs). Since then SOA has been evolving in terms of approaches, designing and implementations. Some of the studies and implementations are described further in this section.

Mohsen Mohammadi[1] and Muriati Mukhtar[1] has reviewed the basic concepts of Service Oriented Architecture (SOA), its approaches and comparison with other traditional approaches, and has described how the service communication takes place in SOA. Authors also state that how SOA can be incorporated in Business Process within an organization.

Mohsen Moghaddam[2] and other authors[2] has done research to identify the technical and technological gap on business architectures and provides the recommendations for developing new reference models or architectures for Next-Gen (Generation) enterprises. Authors provide the study based on Industry 4.0 paradigms and architectures like IIRA, RAMI4.0, their characterization, limitations and mainly the evolution towards Modular Service Oriented Architectures.

Liya Wu[3] and other authors[3] has described the Service Oriented Architecture for Business Intelligence domain which results in the seamless integration of technologies in a comprehensible BI environment. Authors provide the comparison of their Service-Oriented approach with other traditional BI architectures. Also, authors have implemented the prototype of their proposed solution which is SOA-ITPA (Service Oriented Architecture for IT Performance Analytic) and has elaborated some use-cases like adding data, delivering web application for multiple BI tools, and closed-loop as feedback for predicted information.

Ramos Somya[4] and other authors[4] has implemented a reference model for Service-Oriented Business Intelligence (SoBI) and claims that if SoBI model is applied instead of traditional BI models, the ETL (Extract-Transform-Load) process which much more time-consuming process especially when data integration can be simplified with the help of web services. Authors have used academic and financial data from Satya Wacana Christian University (SWCU) for their case-study implementation.

Martin Mikuf[5] and other authors[5] has implemented a case-study to set up web portals and create reports. Authors have used BI tools in Visual Studio from Microsoft and Cognos from IBM. They concluded that how switching to new technologies can affect and enhance a company's reporting process. Authors acquired the real manufacturing data & work from the company.

M. Miskuf[6] and I. Zolotova[6] has implemented a case-study to generate the regular BI reports for a company based on real acquired manufacturing data of the company. Author's main objective was to identify how a company can save their money if they use already owned BI solution for basic reporting. They state that based on used technologies Cognos from IBM seems to be bit more complex solution for this purpose according to its ETL process when collecting data from sensors.

4. CONCLUSION

SOA is a trending and an evolving sector for a decade with a large count of the audience. It is capable of various proficient functionalities like re-usability of predefined services for a particular application component in its environment, and many more. If Service Oriented Architecture (SOA) paradigm is integrated or applied or incorporated in a Business Intelligence (BI) sector, it can result in much faster processing of data, efficient data movement and management of the business process.

In this survey done, we have discussed the concepts and terms of Business Intelligence (BI), Service Oriented Architecture (SOA), BI process flow, components of SOA with a brief description of each component. We identified the limitations and research gap between traditional Business Intelligence models and Service Oriented Architectures for BI (SoBI). This research states the study of BI tools, SOA and the case-studies, thus we can conclude that this research study can collectively be helpful for other researchers and the developers for understanding the impact of SOA in BI domain and approaching the best-suited SOA based BI solution.

5. REFERENCES

[1] Mohammadi, M. and Mukhtar, M., 2018, September. Service-Oriented Architecture and Process Modeling. In 2018 International Conference on Information Technologies (InfoTech) (pp. 1-4). IEEE.

[2] Moghaddam, M., Kenley, C.R., Colby, J.M., Berns, M.N.C., Rausch, R., Markham, J., Skeffington, W.M., Garrity, J., Chaturvedi, A.R. and Deshmukh, A.V., 2017, July. Next-generation enterprise architectures: Common vernacular and evolution towards service-orientation. In Industrial Informatics (INDIN), 2017 IEEE 15th International Conference on (pp. 32-37). IEEE.

[3] Wu, L., Barash, G. and Bartolini, C., 2007, June. Service-Oriented architecture for business intelligence. In Service-Oriented Computing and Applications, 2007. SOCA'07. IEEE International Conference on (pp. 279-285). IEEE.

[4] Somya, R., Manongga, D. and Pakereng, M.A.I., 2018, September. Service-Oriented Business Intelligence (SoBI) for Academic and Financial Data Integration in University. In 2018 International Seminar on Application for Technology of Information and Communication (pp. 1-5). IEEE.

[5] Miškuf, M., Zolotová, I. and Nemčík, M., 2016, January. Application of business intelligence solutions from Microsoft and IBM on manufacturing data. In Applied Machine Intelligence and Informatics (SAMI), 2016 IEEE 14th International Symposium on (pp. 41-45). IEEE.

[6] Miškuf, M. and Zolotová, I., 2015, January. Application of business intelligence solutions on manufacturing data. In Applied Machine Intelligence and Informatics (SAMI), 2015 IEEE 13th International Symposium on (pp. 193-197). IEEE.

[7] Helland P. Data on the Outside Versus Data on the Inside. InCIDR 2005 Jan 4 (pp. 144-153).

[8] Zadeh, A.T., Sahran, S. and Mukhtar, M., 2016. Automated Service Identification Methods: A Review. International Journal on Advanced Science, Engineering and Information Technology, 6(6), pp.1053-1059.

[9] Mohammadi, M., 2017. SERVICE ORIENTED ARCHITECTURE: A REVIEW AND EVALUATION OF REFERENCE MODELS. International Journal on Information Technologies & Security, 9(4).

[10] Florea, A.M.I., Diaconita, V. and Bologa, R., 2016. Data integration approaches using ETL. Database Systems Journal, 6(3), pp.19-27.

[11] Shivtare, S. and Shelar, P., 2015. Data warehouse with data integration: problems and solution. In IOSR Journal of Computer Engineering (IOSR-JCE) (pp. 67-71).

