Service Oriented Architecture for Business Intelligence Systems

case study of Saman Bank of Iran

Maryam Marefati
Department of Computer engineering,
Arak Branch, Islamic Azad University
Arak, Iran
mmarefati@gmail.com

Seyyed Mohsen Hashemi
Dean of the Software Engineering and Artificial Intelligence Department
Science and Research Branch, Islamic Azad University
Tehran, Iran
hashemi@srbiau.ac.ir

***Abstract*—Business intelligence (BI) tools include the technologies and processes converting data into information and information into knowledge in order to improve decision making in the organizations. Today we can confidently claim that the use of business intelligence solutions can increase the competitiveness of an organization and to distinguish it from other organizations. This solution enables organizations to use that information to exploit the competitive advantages of being a leader and have a better understanding of customer needs and demands, and allows communication with them.**

Service oriented architecture (SOA) is a good choice for implementation of BI solutions in the organizations. In this paper we consider BI system as a critical system in organization success and explain its role and its elements at first section. In section two we describe service oriented architecture as a good methodology for BI system and in the last section we explain JSON as a data transfer language in our SOA and consider its implementation in Saman bank of Iran.

Keywords- Business Intelligence; Service Oriented Architecture ; JSON

I. INTRODUCTION

Nowadays, information in various sizes and types gets managers into trouble to aware about inner and outer events of an organization. Physical and temporal constraints afford this information to be used generally and in exactly by managers. Such data collection can be caused to any person depends on his conditions, situations and organization post to have different perceptions of available data.

There are always different information resources, but the quality of existing information, collecting, organizing, reporting the work analysis, or in other words "give definition to the data" is a different subject. There isn't any appropriate pattern without the concept and the real meaning of these data. The word knowledge finds meaning of create wealth and competitive market strategy more than ever. Nowadays, importance of information and knowledge in business as an important factor is visible to everyone. Organizations and persons, who access right information at the right time, have more chances to succeed in the field of globalization and crucial competition.

This self-awareness in economical era will be remembered as business intelligence. In other word "smart business" is a business that has relatively "a realistic and comprehensive analysis" of its terms and conditions. So business intelligence has rarely encountered with those of the barriers caused by lack of obvious and real picture of business scope, and their conditions.

Business intelligence term was presented in 1989 by Gartner group and introduced some concepts and models in order to improve decision making process in business. Business Intelligence is a set of tools, technologies and process in order to transform data into information and information to required knowledge for improving decision making in an organization. Storing data in data warehouse, collecting and consolidating of data, reporting and data mining help us have business intelligence. Business Intelligence (BI) is the solution [1], being necessitated to capture, understand, and harness their data to support decision making in order to improve business operations.

Nowadays, we can confidently claim that the use of business intelligence solutions can increase the competitiveness of organization and distinguish it from other organizations. This solution enables the organization to use available information to exploit the competitive advantages of being progressive and have a better understanding of customer needs and demands to allow better communication with them. This solution also cause that organization can control positive and negative changes and monitor them.

Business intelligence is considered not only as a product or a system but also as an architecture and new approach that contains a set of analytic applications which helps decision making for business processing on basis of operating and analytic database.

Business intelligence is a way to increase profits of organization by using intelligence and accurate decision. In general, the goals of BI are:

1. To determine the orientation of organization that makes them to concentrate on overall goals without any waste of time and money.
2. Depth analysis of market
3. Forecasting of market
4. To increase the level of customer satisfaction
5. To identify the persistent customers
6. classifying customers and having diversity in encountering each group
7. To increase the performance of organization in internal activities and clarification of the key procedures
8. To facilitate decision making
9. Early detection of risk before bringing them to serious risks.

Given the above goals, we can say that need for business intelligence was felt in high level of management at first. [2]

Business intelligence contains a set of technology to evaluate status and quality of works in great organizations. The BI activities within span of commercial organization, goals, strategies and tactics find their meaning in internal or external activities scope, adversaries, customers, tools …These tools can be used to determine whether the organization is going in predefined direction of goals or not? Information and data are processed by entering the systems and converted to knowledge. Then analyzing knowledge and analytical results are obtained. From analytical results can find an insight about organization by which managers make the necessary decisions and actions to improve organizational performance.
With this business view ,the information can respond this question ”what happened in system?” and with processing the data can answer this question “ why did this event happen?” .finally with decision which was adopted by manager, we can predict “what will happen?” . BI process can be presented such as data>information>knowledge>executable program.

II. BASIC ELEMENTS OF BI

In BI, intelligence is often defined as discovery and explanation of hidden and decision-relevant contexts in large amounts of business and financial data [3].Business intelligence focus on knowledge discovery from various internal and external data repositories for making better decision. Data mining techniques are important for knowledge discovery from database. In recent years, business intelligence systems play a vital role in helping organization to match better of business goals. (Such as increase in customer satisfaction, market penetration, profitability and efficiency).

Michalewicz et al. (2007) expressed the general goal of most BI systems was accessing data from a variety of sources; transform these data into information, and then into knowledge; and provide an easy-to-use graphical interface to display knowledge. BI systems are responsible for collecting and digesting data, and presenting knowledge in a friendly way.

As we consider a business intelligence solution we must first examine the principles and elements of it. The basic elements of business intelligence solution can be summed as follow:

- **Extract, Transform and Load (ETL):** If you work on business intelligence solution maybe need to store data in data warehouse or data mart. At first it seems very simple, you must collect data from various systems and load them into data warehouse. You may force to map some columns. It’s very simple because data was stored in relational database. But in real word this isn’t very simple because data stores in different places of organization with different format. Some of them maybe store in relational database or flat files. Obtaining data from these sources is very complicated and may take weeks.

  Data warehouse is a system for collection, sorting and process large volumes of data with analytic tools in order to provide complicated and meaningful information for decision makers. This information was collected, stored and evaluated in database to maintain competition in business. [4] Data warehouse is related to ETL process.

- **Data Warehouse:** “The amount of heterogeneous data that is available to organizations has made information management a seriously complicated task, yet crucial since this data can be a valuable asset for business intelligence”. [5] “Nevertheless, it is believed that only about 20% information can be extracted from data warehouses concerning numeric data only, the other 80% information is hidden in non-numeric data or even in documents. Therefore, many researchers now advocate that it is time to conduct research work on document warehousing to capture complete business intelligence.”[6] Data mart is a subset of data warehouse related to single business process or a single business group. Data marts are systems that gather all the data required by a specific company department, such as marketing or logistics, for the purpose of performing business intelligence analyses and executing decision support applications specific to the function itself. Therefore, a data

mart can be considered as a functional or departmental data warehouse of a smaller size and a more specific type than the overall company data warehouse. [7]

- **OLAP:** "On-line analytical processing (OLAP) systems based on a dimensional view of data have found widespread use in business applications. These systems provide good performance and ease-of-use". [8] Using multidimensional data base model lead to reduce execution time of query rather than traditional data base model (OLTP). In this model data store in special structure like cube so we can execute query quickly. OLAP helps the user synthesize enterprise information through comparative, personalized viewing, as well as through analysis of historical and projected data in various "what-if" data model scenarios.
- **Data Mining:** Data mining is a tool for acquiring knowledge of the stored data. [9] Data mining, attempt to find rules, patterns and the possible desire to model, among a huge volume of data. This inference is implicitly defined by the following three points:
  - The data mining is beyond the ordinary and conventional search.
  - May be you can't acquire relevant result at the first time and you need to do it for times and with different methods.
  - The more data, the better and more confident result

  OLAP and data mining are complementary, for example OLAP can specify a problem in specific scope and data mining can analysis and model the behavior of effective elements on that scope.

Reporting Software: reporting software as a part of business intelligence is responsible to generate reports and display them to users. This part has interactive with users. In a business intelligence should be able to create various reports such as ad-hoc reporting, drill down reporting and etc. and these reports can be also displayed in different formats. In business intelligence solution this part can be called as dashboard.

III. ARCHITECTURE OF BUSINESS INTELLIGENCE SYSTEM

Traditionally, architecture of BI systems was focused on bake-end such as data ware housing but nowadays multi-tier architecture is commonly used for them. [10]

"The principal objective of business intelligence can be summed up as follows:

- To provide a "single version of the truth" across an entire organization.
- To provide a simplified system implementation, deployment and administration
- To deliver strategic, tactical and operational knowledge and actionable insight" [10]

BI systems include data warehouse technologies, OLAP, reporting tools, data mining, predictive analysis and so on. In this paper we try to introduce event driven SOA for integration of this techniques in a BI solution.

A. *Service Oreinted Architecture*

In heterogeneous environment which data is stored in different systems and domains, achieving important information and integration of techniques are vital challenges to meet the mentioned goals. Nonintegrated BI system causes redundancy, inconsistency, specialization and increases cost of development and because of data inconsistency providing a single version of the truth is impossible.

We have three basic elements in SOA system:

- Service Provider
- Service Requester
- Discovery Agency

As shown in Fig. 1, SOA involves three different roles: service providers, service requesters and discovery agencies." The service provider runs and exposes the service. Also, the provider has to publish the service description, in order to enable dynamic service discovery and to allow requesters to access the service. Since providers and requesters usually do not know each other in advance, the service descriptions are published via third-party discovery agencies. They categorize the descriptions and deliver them in response to queries issued by service requesters. As soon as the service requester retrieves a service description that meets its requirements, it can use it to interact with the service."[11]

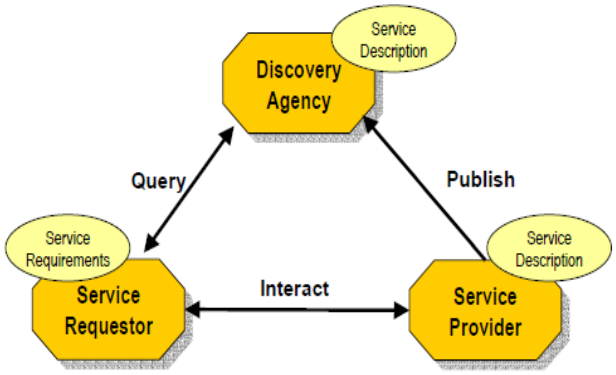

Fig.1 Service Oriented Architecture, cf. [11]

B. *Service Oriented Business Intelligence*

Service oriented business intelligence (SOBI) is a combination of service oriented architecture and business intelligence in order to a success implementation of

integrated BI system. Fig 2 show views of BI and SOA. As shown in fig 2 as point view of BI, SOA is a set of data and on other hand SOA views BI as a set of services. [12]

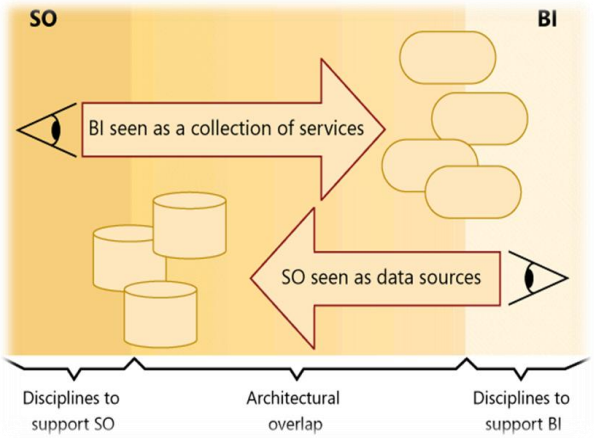

Fig.2 point view of SOBI, cf. [12]

In SOA each available element has to communicate with the other to allow system perform its duties well. This communication is consists of data and instruction transfer. We use standard data transfer language such as XML (Extensible Markup Language) or JSON (JavaScript Object Notation) For data transfer in SOA.

"In fact XML is really a meta-language for describing markup languages. In other words, XML provides a facility to define tags and the structural relationships between them. Since there's no predefined tag set, there can't be any preconceived semantics. All of the semantics of an XML document will either be defined by the applications that process them or by style sheets" [13] .THE main use of XML is invoke remote call and object serialization for data transfer between applications.

"JSON is a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. An object is an unordered set of name/value pairs. An object begins with {(left brace) and ends with} (right brace). Each name is followed by: (colon) and the name/value pairs are separated by, (comma)"[14]. This definition can be summarized in fig 3:

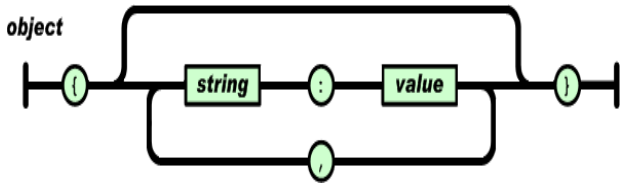

Fig. 3Definition of an object with JSON, cf. [14]

SOA is an architectural concept in all functions and services which can be implemented in distributed system by a procedural language and interfaces. Interfaces depend on hardware platform, operating system and languages that use for implementation of services. One of the most important advantages of SOA is simplicity of developing that means we can use different groups for developing system without knowing how each groups work exactly.

IV. CASE CASE STUDY: A BUSINESS INTELLIGENCE SYSTEM IN BANKING INDUSTRY

Currently, huge electronic data repositories are maintained by banks and other financial institution in the world. Little information has been valuable in the repositories. Extract interested information from these huge data repositories for decision making processes by traditional and manual analysis, is impossible. A number of commercial companies are quick to realize the value of these concepts, which result is creating marketing data mining software that got million dollars revenue.

Business intelligence and data mining applications in the banking industry are:

- Marketing
- Risk Management
- Fraud Detection
- Portfolio Management
- Stock Exchange
- Customer Profiles and Customer Relationship Management (CRM)
- Anti-Money Laundering
- Basel Setup based on business intelligence
- Management Dashboard based on four perspective of balance scorecard and management principles

Banks are member of organization that is directly interacting with customers. Therefore, analysis of customer behavior to increase they loyalty is important. In recent years, increasing access to customer data and improve data analysis capabilities through a variety of intelligent methods to analyze customer behavior is performed.

The key benefits of our Event Drive SOA architecture for Saman Bank are:

- Integrated and consistent “single version of truth” data architecture
- Scalable and flexible ETL processes
- Reusable and extensible services
- Actionable insight BI solutions to send BI analytical results to users and help them to understand the information so the appropriate actions can be taken in BI real time environment

In this section we present a service implemented for SOBI in Saman bank of Iran. We use WCF for implementation of services. "Windows Communication Foundation (WCF) is a framework for building service-oriented applications. Using WCF, you can send data as asynchronous messages from one service endpoint to another."[15] WCF implements many advanced Web services (WS) standards. WCF also provides RSS Syndication Services, WS-Discovery, routing and better support for REST services. In fig. 4 we present

parts of source code for implementation of customer's service.

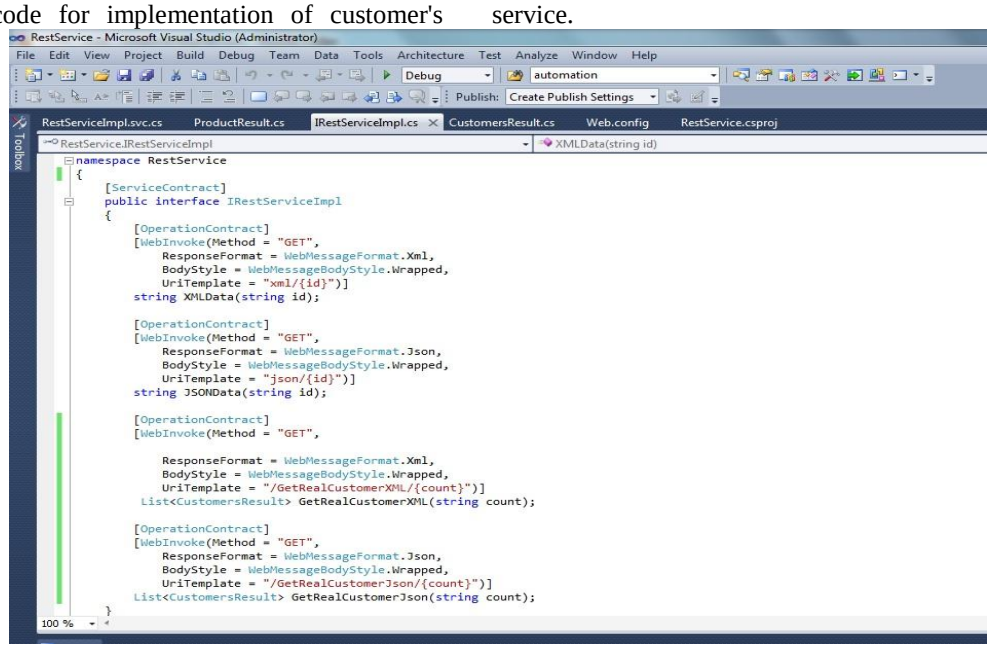

Fig.4 Source code of customer service

We use .net framework 4 for implementation of services so we can use XML or JSON as data transferred language. In order to compare these formats we use customer's data of Saman bank as a data resource and run this service on bank's server. In each stage of running we increase the number of transferred records and then check two parameters time for transfer and volume of data transferred. For computing these two parameters we use fire bug as shown in fig.5. The result of this test summed in table 1.

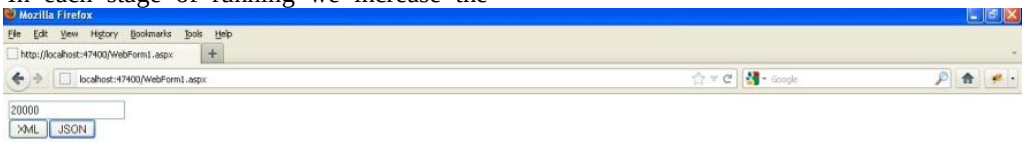

Fig.5 output of customer's service

TABLE 1

Result of customer's service

Number of transferred records	Volume of XML data transferred (KB)	Volume of JSON data transferred (KB)	Time of XML data transferred (ms)	Time of JSON data transferred (ms)
100	41.8	31.3	47	47
1000	417.7	313.3	78	93
2000	835.5	626.9	125	125
5000	2000	1500	515	313
10000	4100	3100	1047	1016
15000	6100	4600	2037	2005
20000	8100	6100	3044	2066

According to the earned results we can claim that use of JSON as a data transfer language in SOBI can reduce volume and time of data transferred.

V. CONCLUSION

Business competition is very intense, so organization and companies should have a better understanding of the business environment and their customers. Organizations that have no understanding of the behavior and needs of their customers are faced to fail. Business intelligence is a tool that understands customer needs and environmental changes that greatly satisfies. Business intelligence will bring many competitive advantages for organizations but, prospering implementation business intelligence solution is much expensive and time consuming.

In this paper we choose SOA as a best choice for implementation of BI system and use JSON as data transfer language. Using SOA can satisfy requirements of modern software architecture and also increase flexibility and lifetime of software, by modifying requirements or organization's method, the related services with them will changed.

In next work we consider event driven architecture (EDA) in order to covering shortcoming of SOA for asynchronous events besides of SOA to increase reliability of system.

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AUTHORS PROFILE

Maryam Marefati is currently a Lecturer with Islamic Azad University, Iran. She holds an M.S. degree in Computer Engineering at Arak Branch, Islamic Azad University. Her research interest is in Business Intelligence Systems especially in banking industry. Marefati has published in some International Journals, conferences.

Seyyed Mohsen Hashemi received the M.S. degree in Computer Science from Amirkabir University of Technology (Tehran Polytechnic University) in 2003, and the PhD degree in Computer Science from the IAU University in 2009. Both of them ware under supervision of Professor Mohammadreza Razzazi. Moreover, he is currently assistant professor and as a faculty member at Science and Research Branch, IAU University, Tehran. His current research interests include Software Intensive Systems, E-X systems (E-Commerce, E-Government, E-Business), and Virtual Banking.