

# Implementing a Business Intelligence System for Small and Medium-sized Enterprises

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## Abstract

Over the years, Business Intelligence (BI) systems have become critically important to organizations due to the increasing fast-paced competition, the vast amount of daily generated data and the complexity of how to manage collected data. Business intelligence systems empower organizations to gain insights and to understand a clearer view of their vast data, business and customers, which help to make better decisions and hence produce better results and increase profit. BI refers to a collection of an organization's resources such as tools, technologies, applications, systems and databases which enable organizations to manage insights of their business data, activities and performance in order to make better decision. However the majority of existing BI systems, target and support large organizations, and the small and medium-sized organizations (SMEs) are mostly overlooked due to lack of substantial finance. The paper elaborates the considerations for implementing BI systems for SMEs. Some new trends such as cloud BI solutions, open BI sources solutions are reviewed. The paper finally provides for the implementation of Business Intelligence system for a SME, the purpose and constraints of the system are detailed.

**Keywords:** Business Intelligence (BI), Small and Medium-sized Enterprise (SME), Decision Support Systems, Business IT Alignment

## **1.0 Introduction**

Today, businesses collect enormous amounts of data from their daily activities [1]. It is increasingly essential to leverage and make sense of the large collected data in order to exploit new opportunities as well as to create competitive advantage and a foundation for decision-making process [2].

New challenges of increasing changes and complexity of business demands are emerging for the enterprise systems [2]. This forces enterprises to operate in new ways [2]. Gaining business insights includes the process of integration of data from internal and external data sources, utilizing analysis tools and techniques to make sense of the data, converting the gained insight into actions, and making decisions [3, 4].

The key strategy for creating effective decisions and competitive advantage lies in understanding the data that will shape the marketplace [2]. Finding ways of composing and making sense of large data flowing within and across the enterprise is becoming a key business success factor [2, 5]. For organizations, technology is a key enabler, and by creating and implementing technology-enabled business systems, like Business Intelligence (BI) leads to success and helps to strive in this competitive market [6, 7].

Insights of business data, performance and customers are increasingly important to decision makers and managements. BI systems are designed and built for enabling and managing insights [1]. Furthermore, uncovered insights and knowledge from data can be turned into competitive edge and profitable actions [2, 8]. As a result, BI is treated as one of the most valuable assets to organisations [9]. In the following subsections, we are going to review BI systems, typical architecture of BI systems, and implementation challenges of BI systems.

### **1.1 Business Intelligence Systems**

The concept of Business Intelligence System was firstly introduced by Luhn [10]. It is widely recognized and popularized in recent years due to the significant impact that it can make on businesses [11]. The global markets, technology innovations, competition, and high volume of data (big data) generated by business activities constrain the organizations [1]. BI systems are essential to operating today's businesses [2].

BI has different definitions to different fields of experts [9]. From the view of CRM experts, BI is about integration of operational front-office applications with operational back-office applications. From the view of data warehouse experts, BI is just a new term but providing decision support applications on a new technology platform. From the view of data mining statisticians, BI characterizes the advanced data mining algorithms, such as neural induction techniques.

Papers [2, 12] explain that BI is an enterprise architecture which includes the integrated collection of operations as well as decision support applications and databases that gives the business users easy access to their business information and aids them in the decision-making processes. Furthermore, Turban *et. al.* agree that BI is a collection of decision support technologies which enable the users such as executives, managers, analysts to make effective decisions [1].

## 1.2 Typical Architecture of BI Systems

The business intelligence system typically comprises of components, such as Data Sources, Data Integration, Data Warehouse, Data mining and Applications (Visualization) [2]. Figure 1 shows typical architecture of BI systems. Different components of a BI system perform different functions.

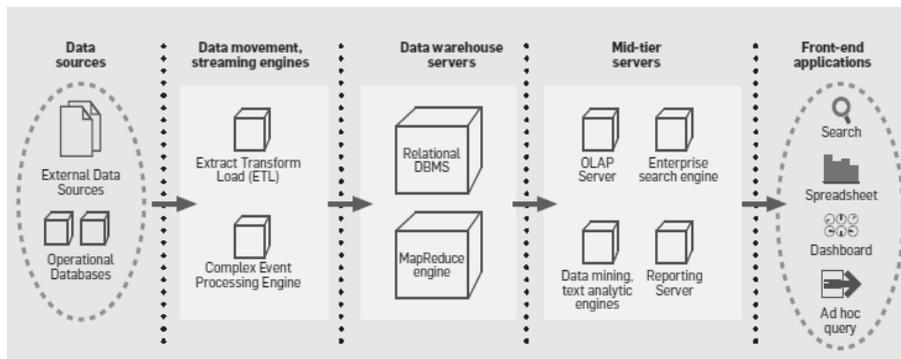


Figure 1: Typical Architecture of BI Systems [2]

Data movement is an essential function for a BI system. The ETL (Extraction, Transformation and Load) process is usually implemented. ETL is concerned with integrating data from various sources, processing the data with the transformations required, and loading the data into a database [2, 13]. Extraction simply deals with obtaining data from one or more destinations [13]. Transformation involves converting the extracted data into various rules, functions or formats required by the structure and design of the data warehouse [13]. Load concerns with inputting the transformed data into a data warehouse or a target database [13].

The extraction process can be challenging because data can be stored in diverse sources (relational databases, flat files) with different structures [2]. In addition, data might be required to source from applications or web mining [13]. This means that data may be required to access from the same server or different server location, hence it may require different rules and policies of access. Accessing flat files or web data can be completely different from a database or a documentDB such as MangoDB [2].

Data warehouse is essential to operating any BI systems because it stores and provides historical and most up-to-date data required. Data warehouse can be built multi-dimensionally and designed in either bottom-up or top-down approach [13].

According to [13], there are two distinctive characteristics between a data warehouse and a traditional database; OLAP is used to support data warehouses and OLTP is used for running traditional databases. **OLAP (Online Analytic Processing)** is a data warehouse database but specifically designed for reports and analysis. It is usually built multi-dimensionally to support business's needs [13]. It focuses on performance so that data access can be fast and response time can be reduced [1]. Thus it requires powerful and high performance CPU and memory as well as huge storage capacity [2, 8].

In contrast, traditional databases, also known as **OLTP (Online Transaction Processing)**, are optimized for transactional and day to day data processing, and preserve data integrity [13], without data analysis for supporting multi-dimensional business needs.

Front-end applications provide data view and manipulation available to the user [2]. Dashboard is often used due to effective usability [14] Different types of reports such as decision-support systems are often designed and built to meet specific business needs [1]. Furthermore, the user can get deeper insights using Analytic application whereas interaction and further investigation can be carried out [17].

BI applications are essential to operating the businesses as well as to get insights [2]. BI Applications can range from traditional reports to recent popular analytics, and predictive tools such as IBM Watson Analytics, Microsoft Azure Stream Analytics, Qlik and Tableau. Those applications can be used across different fields, from government to banking, from education to insurance.

One major benefit BI can offer to the business is that it enables them to manage insights of their business's data [1]. Effective managing insights of businesses and performances enable organization to be competitive and to create business values [17].

### **1.3 Challenges of Business Intelligence System Implementation**

BI can provide valuable and actionable insights, ultimately helping decision makers. With the growth of the Internet, pervasive computing and their applications, numbers of challenges, such as big data and data integration from different resources, are faced for implementing BI systems.

Inevitably, the key challenge for BI is the vast amount of data collected by organizations. The vast available data makes it difficult for the organizations to effectively accumulate and process for potential benefits and competitive edge [1].

Secondly, integrating data from different sources, applications and systems is challenging for both Large and Small companies due to the vast amount of data available [1]. Furthermore, data can be stored in different platforms and file formats at varied servers across different locations. Rivalry among businesses is fearsome in this changing unpredictable market. Hence, insights of the business and its customers are increasingly important and it can be a major factor differentiating from the competitors [17]. However, it is a daunting task to make sense of the collected large data [1].

Furthermore, traditional and predefined reports can cause cumbersome business process as well as a slow down on making decisions [20]. The overall implementation and deployment of BI is costly as well as time-consuming, in either adopting the existing vendors or developing own solution [1], which has been always problematic.

In summary, BI systems are crucial for organisations in all sizes. Large organisations are able to build enterprise systems to possess the resources to manage, create diverse and advanced operational systems [15, 21]. The adoption of BI systems for SMEs is still unreachable because of the cost of building BI systems. We have thus looked at how to provide an affordable BI solution for small and medium-size enterprises. In this paper, we elaborate the considerations for implementing BI systems for SMEs. Some new trends such as cloud BI solutions, open BI sources solutions are briefly reviewed. The paper finally provides for an implementation of a business intelligence system for a specific SME, the purpose and constraints of the system are detailed.

The rest of this paper is organized as follows: Section 2 discusses BI system development method. Section 3 reviews new trends for adopting BI systems for SMEs. A case study of an insurance company is presented in Section 4, which also provides insights of a BI solution for SMEs. Conclusions and future work are discussed at the end.

## **2.0 BI System Development Method**

Implementing BI systems just like implementing other enterprise systems generally includes the following phases [16]: requirement and analysis, design, implementation, deployment as well as review and enhancement phases, as shown in Figure 2.

At the requirement and analysis phase, requirements of adopting a BI system need to be clearly defined in order to justify the cost and benefits of the adoption [16]. A set of key performance indicators (KPIs) are maintained by business users, and hence they should be included in the requirement analysis [16, 13]. This phase produces an abstract design of relevant items, components and data sources with the appropriate structures of intended storage, required by the BI solution [16].

Upon the outcome of the requirements and analysis phase, appropriate BI technologies need to be selected. To maximize the success and delivery of requirements and expectations, prototyping is used in analysing the functional deliverables [16]. This process also includes technical architecture, data models such as dimensional models, and application design based on the requirements [13].

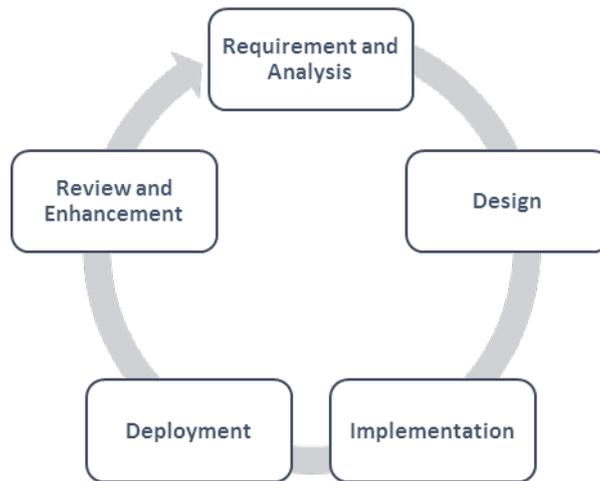


Figure 2: BI Life Cycle (Adapted from [16])

The full implementation of the identified BI should be carried out at the implementation phase. This process includes the development and testing of the defined components, features, and sourcing and storing the relevant data from internal and external data sources (ETL) [16]. The key benefit of BI lies in identifying and gaining hidden insights from the data, and turning the gained insights into actionable opportunities [2, 3, 13].

Once the implementation phase is completed, the solution is deployed, and is available to the users. User training and support are critically important to the success of the solution [16]. This requires an interactive approach, with adjustments to meet the user's needs [16].

New challenges for businesses are constantly emerging due to the new demands of customers, increasing competitive market and rivalry, and the large data generated by businesses [2, 8]. Improvement and enhancement are important for maintaining the users' satisfaction, and for meeting new demands of the business. The goal of the review and enhancement phase is iteratively reviewing and enhancing the BI application which enables to meet the needs of the business and users. This can be done by analysing new requirements of application and component, measuring the success of application, extending the application across the enterprise, and increasing cross-functional information sharing [16].

### 3.0 Aspect of BI Technology

The Internet has fundamentally changed how people consume software. Cloud computing has enabled users to use computing resources in a pay-per-use manner and perceiving these resources as unlimited [18]. Open source software provides free and modifiable software.

#### 3.1 Cloud computing

Cloud computing is increasingly popular, offering alternative solution to in-house IT solution. Cloud computing enable the ability to access large amounts of data and computational resources through a variety of web interfaces [19]. It is software as a service via the internet. The services are delivered from data centres and accessible from anywhere.

Small enterprises and start-ups that do not have the legacy of IT systems are the major consumers of Cloud [22]. One major benefit to cloud computing is that it is relatively cheap because it does not require to buy any hardware or equipment to adopt it [22]. Thus, it is more affordable and implementable for SMEs. Moreover, a variety of built-in functionalities and features such as Web Analytics are available.

However, it is a big responsibility for companies adopting cloud services provided by an external vendor because companies have to hand over all their customer data and hence lose the primary control of their own data. Moreover, the very complex legalism in data protection, privacy and security are ever becoming complicated.

Despite the fact that, there are agreements on various service levels which are signed off between the company and the cloud service provider, the potential risk of problems with backup and recovery plan, and instant access to your own data from a separate party can only be higher than managing self-process and procedures.

Advantage	Disadvantage
<ul style="list-style-type: none"><li>• No IT infrastructure needed to implement</li><li>• Cheaper as no technology equipments are required to buy and implement</li><li>• Can be accessed anywhere via the internet</li><li>• No deployment needed</li><li>• Support and maintenance plan available</li><li>• Various features available</li></ul>	<ul style="list-style-type: none"><li>• All data are stored outside the organization reaches</li><li>• Loss of ownership over data</li><li>• Security risk due to no ownership of your own data</li><li>• Can be issue for large organizations with legacy systems</li><li>• Costly due to licensing, increasing storage, support and maintenance</li><li>• Complexity of data protection, privacy</li></ul>

Table 1: Some Advantage and Disadvantage of Cloud Computing

### 3.2 Open Source

The term open source software is defined by the Open Source Organization as “software that can be freely used, changed, and shared (in modified or unmodified form) by anyone”. An individual or organization can use open software by modifying the original sources or features to meet their needs free of charge. However it must be under the licenses which comply with the Open Source Definition.

One major distinctive advantage to the Open Source Approach is the opportunity available to organizations in which they can implement it in accordance with their goals, rather than a proprietary software vendor [8].

Advantage	Disadvantage
<ul style="list-style-type: none"><li>• Free to edit or modify</li><li>• Open source community provides a certain level of support and help</li><li>• Free to deploy some of commercial BIs such as Jasper, Panto, etc with a limited version</li></ul>	<ul style="list-style-type: none"><li>• Required IT expertise if change or improvements are required</li><li>• Configuration may take time as organization’s existing systems and needs</li></ul>

Table 2: Some Advantage and Disadvantage of Open Source

### 3.3 SQL Server BI

SQL Server is a database, product of Microsoft and is mainly used in database management system. However, SQL Server not only provides the ability to store data but offers a variety of services such as Integration, Analytics and Reporting [23].

One major benefit of SQL Server solution is that it provides all services such as database (data warehouse), integration (ETL, SSIS), Analytics and reporting which are fundamentally required in building a BI solution. The current latest version of SQL Server 2016 offers features such as predictive and analytic capability. In addition, it can be integrated with office applications such as Excel [23]. On the other hand, a level of knowledge and expertise in the technology itself is required in order to implement.

Overall, SQL Server is ideal for SMEs because it provides all tools and features required to build BI. It eliminates the need for buying extra tools and hence it makes it more affordable, and manageable in a realistic way.

### 4.0 Case Study

The following is a case study of evaluation of BI in the independent insurance group Z. The BI method mentioned in section 2 is not fully implemented in this paper. The focus is rather concerned with the evaluation of current BI implementation at Insurance Group Z.

Insurance Group Z is an insurer of household gadgets and appliances based in UK. It is formed of two partner companies: A and B. Company A primarily insures household appliances whereas Company B covers both gadgets and appliances with affordable and competitive prices. Group Z currently has insured over 68,000 customers. Both company A and B currently have two types of insurance policies, i.e. single product insurance policy and multi-product insurance policy. Both types of the insurance policies currently cover accidental, electronic and mechanical damages, loss and theft cover for over 50 products of appliances and gadgets. The current maximum number of covered product on a policy is 18 products.

Company B is solely online-oriented; the website where the customer can set up the policy and can make payment, and the online customer portal where customers can make claims, buy additional items, and download related policy documents. On the other hand, the sales of insurance product for Company A is internal-oriented where the sales and retention teams dial existing and potential customers through the internal campaigns. Prospective customer leads are supplied by external parties on a daily basis or in real time.

Insurance Group Z primarily uses over six SQL Server 2008 R databases storing for customer, policy, claim, payment and marketing data. Each database has APIs consumed by the company's systems such as CRM, Sales, Claims, Reports, etc. In addition, MySQL database is used for campaign dialler and call recording. However, these databases are not designed or optimized for BI, reports or related ad hoc queries. Thus this makes it difficult for business users to gain insights of business performance, customers and growth in efficient ways.

## **4.1 BI Application**

### **4.1.1 Management Supported System**

A management focused reporting system is designed and built, enabling the provision of information for business users and the addition of new reports as needed. A reporting database is used for storing raw and fact data as required. The primary purpose is for fast implementation and cost-saving due to no data warehouse.

### **4.1.2 Vicedial**

Vicedial (Open Source Dialler) is used for the majority of the sales campaigns. It has various reports including real time capabilities, which allow the analysis of the performance of each campaign, sales agents, monitoring, disposition, etc.

### **4.1.3 QlikView**

QlikView enables the Data Analyst to analyse data in different ways which cannot be easily and quickly implemented in the business. Key information of sales data with suppliers is analysed and learned. For example, analysis of sales data enables

the Analyst to see what kind of data from a specific provider is generating more sales than another provider.

#### **4.1.4 RStudio with R**

R programming with Apriori and RStudio is used for analyzing claim data and patterns. This gains better understanding of customer claim data, claim patterns, and enables the provision of valuable insights to the insurance group Z, supporting the decision-making process. Findings are converted into interactive web pages which can be easily accessible by business users.

The results of BI implementation enable decision makers to examine ways of optimising the business, creating new opportunities, and to respond quickly and more effectively to demands.

In addition, managements and business users have access to information of profit and cost drivers that directly impacts the business.

Handling the following business operations efficiently by the implemented BI solution increased revenue by 30%:

- Lead Data Trend Analysis - planning and determining new lead strategies
- Campaign Dialler and Agent Analysis
- Estimating and forecasting sales
- Claim Analysis – Claim data, claimed customers and products
- Monitoring and compliance to internal and external rules

One key component which will significantly advance the insurance group Z's BI capability is to implement data warehouse. This will enable the replacement of the inadequate reporting database used by the management supported system, and will maximize BI's effectiveness. In addition, exploring the implementation of a cloud based BI solution is extremely promising as it can bring substantial benefits of saving costs and resources. After all, BI is essential and a key enabler to increase business value and growth [7]. And the insurance group Z can leverage and unleash the complete value by implementing BI-enabled business strategy.

## **5.0 Conclusion**

BI is not just an IT system, but a corporate asset which enables organizations to manage insights of their data, businesses, strategies, profits (past, present, and forecast) and performance. Thus it helps to make better decisions.

Business IT Alignment plays an important role in an organization by enabling the business and IT management to work cohesively to support the organization's goals and objectives by implementing technology solutions such as BI-enabled business strategy.

SMEs requires a new approach in order to manage their insights of the businesses by implementing a BI solution, as various reasons discovered in the paper such as vendors targeted large enterprises, the capability of complex resources and finance. Hence some technology solutions were overviewed, and solutions such as cloud based or SQL Server BI solution is most promising to meet SMEs' requirements.

Overall, it is the challenge for organizations, SME or Large, to discover new ideas and processes, define strategy and implement the findings into BI capability as the competition grows, and market and customer demands increase. Most of all, BI is the ultimate asset and tool, which will enable organizations to manage insights of their business and make better decisions.

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