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# Business Intelligence: Evolution And Future Trends

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# Business Intelligence: Evolution and Future Trends

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## Biographical Sketch

Dalal Suliman Bataweel attended Taif University in The Kingdom of Saudi Arabia from 2007 to 2010, graduating with a degree in Management Information Systems from the College of Administrative and Financial Sciences. She came to the United States to continue her higher education in Computer Systems Technology. She attended English classes to improve her communication skills and to become more knowledgeable in her studies. In 2013, Ms. Bataweel began pursuing a Master of Science degree in Information Technology at North Carolina Agricultural and Technical State University. She will receive her Master of Science in Information Technology in May, 2015.

# Dedication

To my husband, who left everything behind to accompany me.

To the people who are close to me, though thousands of miles away.

To the people who are taking care of me from afar.

To the people for whom I did all this work*: my family*.

# Acknowledgments

I would like to offer my full thanks and appreciation to the professors who taught me things I would not have learned otherwise that will help me in my career and my future. All the work, discussions, workshops, and everything else we did together helped to shape the Management Information Systems Professional in me. You cannot imagine the impact that you have had on my educational journey, Dr. Ibraheem Kateeb, Dr. Naser El- Bathy, and Dr. Evelyn Sowells. “Thank you” does not seem enough. I hope I will make all of you proud of me.

Thank you so much from the bottom of my heart.

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## Abstract

Business Intelligence systems play a critical role in the business development process. They help make critical decisions based on meaningful information culled from a huge, complicated database system. Business intelligence also plays a key role in business growth and profitability by capturing real-time information and data pieces for market forecasting.

As electronics media advance, companies are looking for the best data integration processes to integrate important information through electronic and computer devices to their business intelligence systems. The real challenge that organizations are facing is how to get real information in real time. In the past, organizations have adopted different solutions to integrate data into their business intelligence tools. Therefore, in terms of data and information integration, business intelligence has made significant improvements within the past three decades to meet ad hoc requirements of business intelligence users.

Over the past two decades, there has been great progress in consuming and automating data in business intelligence, and there are trends and influences that are true inflection points in the industry. Periodically, trends in the industry have significantly changed important aspects of business intelligence applications: what they do, how they do it, or how they are used, either individually or collectively. This thesis discusses the evolution of business intelligence throughout different periods of time, and future trends in business intelligence.

# CHAPTER 1

## Introduction

Among most organizations, business intelligence plays a very important role in producing useful information and making better decisions. Business intelligence is a term used to represent tools and systems that are useful in allowing corporations to make informed decisions. Through these systems, a company can gather, store, analyze, and provide access to data that will be used in decision-making. Basically, business intelligence allows for easier interpretation of data, and business intelligence applications cut across a wide range from strategic to operational. Strategic business intelligence can be on an occasional basis, while operational business intelligence is essential to the normal running of the organization. Some of the functions of business intelligence technologies are predictive analytics, query and reporting, online analytical processing (OLAP), benchmarking, statistical analysis, forecasting data, and process mining [10].

Businesses have resorted to working on information technology because of the current international movement toward dependence on information technology. Focus is on the use of provisioning solutions that ensure organizations are supplied with fully automated ways to synchronize the creation and management of users' accounts and the network-based accounts. These are the needs of an organization. Business intelligence products must provide a wide range of analytical capabilities in order to get relevant information to ensure that companies stay on the right track. These products must be integrated with each other and be consistent with other solutions to get faster solutions through the decisions that are made [27].

Through the course of time, businesses have transitioned to be contending characterized by continuous progressive change; thus, business intelligence should adjust in a way to help

make quick decisions. A study of the demands of the current business market recommends that business intelligence be categorized in the following ways: strategic, tactical, operational, and real-time [29].

## 1.1 Characteristics of Business Intelligence

Business intelligence has several key characteristics mentioned in [27] that are summarized below.

### 1.1.1 Fast processing of data

Data accessed by business intelligence is processed at high speeds, going through the stages step by step without compromising on capacity.

### 1.1.2 Intelligent mutual related analysis

Business intelligence relies on factual models that are mathematical in nature, focusing on the area of specialty of the organization and providing decisions that are definitely reliable.

### 1.1.3 Analysis that targets several aspects

Business intelligence focuses on analyzing every aspect that affects the organization, tools of the trade, and the actual item of trade, so it utilizes a diversity of data in decision-making.

### 1.1.4 Escalating analytical results

The data obtained is collected in a progressive manner in order for the analysis to be sequential through the current situation of the business all the way to suggesting solutions.

## 1.2 Key Technologies of Business Intelligence

The key technologies of business intelligence have been discussed in [34]. Below are the main points.

### 1.2.1 Data warehouse

This is where copies of electronic data to be analyzed are stored for an organization. A data warehouse consolidates data (usually including historical transaction data) from several sources in a relational database intended for query and analysis.

### 1.2.2 Online analytical processing (OLAP)

OLAP is the technology that is behind many Business Intelligence applications in which answers are provided quickly. The purpose of Business Intelligence is to support better decision-making in businesses, and OLAP comes in as a powerful technology for the discovery of data. The foundation of any OLAP system is a cube-like structure called a hypercube. It has facts that are numerical in nature and that are categorical in dimensions. The specific data and design of the cube are obtained from tables where measures are obtained from records in the fact table and its dimensions from the specific dimension tables.

### 1.2.3 Data mining

Data mining is a process in which information that is necessary is isolated from a huge amount of data. In relation to business intelligence, large amounts of transacted data are analyzed through valid reasoning to get patterns that can be used to support business decision-making.

### 1.2.4 Release and express technology

Business intelligence provides application services through the web due to the fact that web applications have become popular. This has led to the expansion of dispatching information that is accessed visually.

# CHAPTER 2

# Literature Review

## 2.1 Definition of Business Intelligence

Business intelligence is strategic planning and management efforts that apply techniques and tools for transformation of raw data into information that is sufficient for use in business analysis and decision-making processes [20]. Business intelligence applies the use of technological thinking and formulations that can be applied on unstructured data to deliver sufficient information on a given issue of concern, such as business trends.

Business intelligence is concerned with using all of the available data in the form of raw collection to derive useful information for analysis in the current business world. Gathering, storage, and access of information allow for proper decision-making in the normal operations of business. It is a modern concept that each business applies in the modern world as a way of achieving strategic management concerns in ongoing business fields. The use of different software is essential in the application of business-processed data from their operations. Business intelligence supports most activities that exist at decision-making levels from the operational to the strategic sectors. Microsoft Excel spreadsheet programs and different database programs can apply in ensuring success in the use of data applicable to most organizations. In current business environments, more applications are developed to help in the analysis of the raw data that businesses possess. There exists business intelligence software that is applied in extracting of all the relevant data applicable in information processing.

Business intelligence helps in better decision-making by using information about people, events, data from processes, and various methodologies and technologies. The main building blocks of business intelligence are the data warehouses and data marts. The sources of data stem

from relational databases. These data sources help provide current as well as historical data. Business analysts use these data for analysis and report generation. The management and respective departments of an organization can utilize these reports in preparing better strategic planning and in gaining competitive advantages by understanding trends [18].

### 2.2 What is Real-Time Business Intelligence?

Real-time business intelligence refers to the concept of implementing a business intelligence system for a business in such a way that the business intelligence can process operational data in real time. The definition and type of 'real-time operational data' may vary depending on the business.

The use of "real-time" may refer to any of these:

- To obtain zero latency from a process
- The target process or system, or the end user of that process
- The process should consider historic data as well as the data from the current time frame [2].

Real-time business intelligence can provide all the functionalities of a general business intelligence system, but can also extend the functionalities for real-time data with zero latency time. It accelerates the business process significantly by providing real-time feedback to the systems. Real-time delivery of information, data modeling in real time, data analysis in real time, etc. can be facilitated by real-time business intelligence.

### 2.3 Cloud Computing in Business Intelligence

With the emergence and advancement of open source software, cloud computing and different kinds of special databases suitable for data analysis have added different dimensions in business

processes. It has also opened up many new possibilities. Businesses do not need to procure costly hardware or software for processing the explosive amount of data required for business intelligence. Cloud technology helps the business intelligence of an organization in the following ways:

- Helps in optimizing responses through sandboxing demands due to market changes
- Helps in reducing the cost and computational overheads in implementing and running data warehouses or in buying costly software
- New data center infrastructure or 'proof of concept' application for business intelligence has been possible without any procurement
- Cloud technologies can help in 'moving' the whole business intelligence infrastructure into the cloud, rather than an on-premise solution [18]

**2.4 Aspects of Business Intelligence**

These aspects refer to the features of a business intelligence solution or software that can apply in developing sufficient information from raw data to derive essential information applicable to business analysis. They refer to what efficient business intelligence should constitute in the normal operations and strategic process of a business. This section would provide the aspects of business intelligence in the companies and other corporate sectors. The aspects can be grouped as security level aspects, must-have applications, and high-level aspects [20].

## 2.5 The Must-Have Applications in Business Intelligence

### 2.5.1 Executive dashboards

This aspect of business intelligence is considered one of the most important in strategic planning. Business intelligence advocates for the existence of personalized dashboards for most company executives. The increased access to real-time data in companies is a feature that is promoted by the development of executive dashboards. Dashboards provide access to summarized and regular information that can increase professional competence. Business intelligence solutions must also increase the relevant information that may be applied by corporate leaders in making real-time decisions [20]. The information in business intelligence dashboards also provides organized data that can be easily filtered by the people involved in executive decision-making processes. The dashboards are also meant to reduce the level of errors that could impair successfully making business decisions.

### 2.5.2 Location intelligence

Location intelligence also provides relevant data sources that may be useful in regionalizing the primary data of a business. This aspect is essential in accurately mapping out the operations of the business in diversified fields. Location intelligence increases the access in a geographical format of information that may be relevant to a particular region. Understanding business operations from different perspectives increases the use of the business intelligence process as part of the application of techniques and tools in normal business operations. This aspect of business intelligence concerns data arrangement and organization in a given format that expedites successful information use.

### 2.5.3 Ranking reports

This aspect is essential to increasing professional use of techniques and tools relevant in analytical processes. This feature places ranks of relevant materials in the forms of data created in the normal operations of a business. Diversity in the arrangement of information in creating the techniques and tools applicable in business analysis is an essential part of this aspect. The report ranking method applies in executing the information and data given in the operational and strategic parts of the business in an order of importance [20]. This feature also allows the business to identify the most useful and least useful data that affect operations and strategic patterns of the business intelligence process.

### 2.5.4 Metadata layer

This aspect is probably considered the most essential in business intelligence. It makes communication and interaction easier in the current operating environment. The essentiality of business information involves the impact it has due to its communication. Business intelligence solutions are free from coding and Structured Query Language (SQL) complications. Such aspects may make it difficult for the business intelligence language to be communicated appropriately to users. The introduction of metadata layer as a feature of business intelligence has been a relevant approach in successfully integrating and comprehending data and database complexities. This aspect is applicable as part of communication and language comprehension through the elimination of all possible features of language complexities. Since the business intelligence approach applies the use of tools and techniques, simplicity in language communication may be a necessary feature.

### 2.5.5 Interactive reports

Interactive reporting is another aspect of business intelligence that can increase access to the conversion of data into knowledge applicable in decision-making processes. This aspect involves the provision of information in one place. The information under this circumstance is considered wide range. The higher level to lower level view of information is essential in increasing the interactive nature of the reports given in business intelligence.

## 2.6 Security-Level Features

The security level features of business intelligence are important in increasing its effectiveness. These factors ensure that the operation and strategic data of the business are under strong security controls. These controls ensure that information that is processed from the operation and strategic levels is secure and adequately observed. Three kinds of security-level features are described below.

***Application-Level Security:*** These options are relevant in ensuring that there is an adequate control of per-user role and basis involved in the use of business intelligence applications [20]. The menu options for different users are centrally based on the roles involved. Application-level security includes the mining system that involves the roles as consideration.

***Row-Level Security:*** This is considered a critical aspect of interactive reporting in business intelligence. It is essential in controlling data access in one application. This strategy assists in the delivery of raw data access in most areas of business intelligence and interactive reporting. Different users in an organization often have different needs in the formation of data in the contexts of their business departments. Developing varied applications for the different users may lead to high costs and complications in the ways the business intelligence and interactive

reporting works. The development of multi-tenant security levels has solved this problem in an efficient manner in business operations and strategic processes.

***Self-Service Functions:*** Information technology departments and their applications influenced the capabilities of previous decades of business intelligence systems. Currently, aspects of the business intelligence system have changed to where there are some developments in which users can easily control their activities towards the applications in the business intelligence system. Business intelligence approaches helped to do that as well.

## 2.7 Why People Use Business Intelligence

Several reasons have necessitated the use of business intelligence in the current business environment. The business software and applications have been applied as corporate parts of the business intelligence system. These reasons are associated with the complications in the business system and stiff competition experienced by most industries. Below are some of the reasons that compel people to use a business intelligence system.

### 2.7.1 The need to seek improvements in decision-making

In the business world, decision-making has become an essential part of the current business process. The increased need to make sustainable decision-making by comparing business variables has also become a key necessitating issue in the normal operations of strategic planning [19]. Such needs have implied that people seek alternative methods for the motivation behind decision-making. The business intelligence approach has arisen as one of the potential ways of increasing sound decision-making. People resorted to the use of business intelligence as a way of deriving concrete information from raw business data. The use of software and other techniques has presented a good opportunity to the needs of people in current organizations.

### 2.7.2 Competition and the need to seek efficiency

Intensified competition and efficiency issues have become some of the critical aspects of business scheduling and strategic planning. The need to increase access to positive economic performance through profit levels has become a fundamental part of businesses. Executives and operational sectors of a company may resort to seeking alternative means to ensure efficiency and cost reductions. In the previous decision-making processes, best practices were centrally based on a rule of thumb and other essential characteristics such as knowledge and experience [35]. Such arrangements have limited capability to address efficiency and other quality decision-making scenarios. People use business intelligence as part of solving the inefficiency problems portrayed by the need to seek efficiency and cost-reduction practices in decision-making processes. Such developments and increases in the needs of corporate sectors have necessitated the use of business intelligence as a means to address inefficiency issues in companies.

## 2.8 Trends in the Best Practices of Business Intelligence Systems

As a means for achieving competitive advantage for most businesses, best practices has become an unavoidable reality. Businesses have become competitively strong and are adapting to current trends in order to survive in their environments. One of the trends in business operations that has been formulated includes the existence of computer knowledge as a way of increasing efficiency wellness. The trends in corporate operation demand real-time approaches alongside competency in decision-making [22]. Such factors have made it impossible for human knowledge to accomplish the complicated processes. The inadequacy of human potentiality and ability has led to the best practices that have applied technological involvement. In order to ensure the survival of their businesses, people have resorted to applying business intelligence as a trend and growth opportunity for expansion and sustainability in the future. People also seek

business intelligence as a way of compensating for their inadequacies in the critical analysis of business methods and structure.

## 2.9 Benefits of Business Intelligence

Since business intelligence is a sophisticated computer-related process, its application has produced several benefits to the normal operations of companies. The increased use of business intelligence in normal operating environments of companies has been an advantage to their decision-making and strategic planning processes. Some essential benefits of business intelligence are discussed below.

### 2.9.1 Reduced labor cost-benefit

Businesses used to use manual methods of report generation to support decision-making for business processes. The development of business intelligence has facilitated a technological use of computerized systems to generate reports and other information from business processes. This has reduced labor requirements in business analysis processes. The reduction in the labor requirement for business analysis through the integration of business intelligence has reduced the overhead fixed costs of the business processes. Reduced costs in business operations are an advantage to the profit levels of a business adopting a business intelligence system.

### 2.9.2 Information bottleneck reduction advantages

Information processing is inevitable in business actions. Dependence on people in the information technology departments in the past decades has led to the development of information bottlenecks in which delivery to the end user may be limited. The use of information technology departments in information retrieval limited the access of business reports in a variety of ways. The development of business intelligence has provided several advantages,

including simultaneous access to information in the business system [23]. The personalization of the processes has also increased the ability to deliver information as appropriately as possible. The customization of the views of the data given through the business intelligence system has also become an advantage in ensuring information access flexibility. The increased platforms based on the usability of data given through the business intelligence system have initiated positive plans for information processing and hence proper decision-making.

### 2.9.3 Timely decision-making benefits

In businesses, making decisions may require a given amount of information in order to execute different judgments. The responsiveness of a business and shortening of the time between ideas and actions is a relevant competitive edge. Business intelligence has influenced the changes in decision-making, hence providing benefits. The combination of different aspects of data into a common pool has improved the ability of companies to make real-time decisions. Ad hoc and analytical reporting capabilities are also efficient in increasing the benefits related to business decision-making processes. Data aggregation techniques as provided by business intelligence have also been a fast-forward means of improving decision-making.

### 2.9.4 Data relevance benefits

Most companies have expended considerable time and resources in data collection and seeking validity in data usages. There is a potentially large waste of resources in such companies, since there is a possibility of irrelevant data aggregation. Such possibilities have also increased the overall inefficiencies in most businesses. The existence of business intelligence has challenged that potentially wasteful pattern, providing benefits to business analysis processes. Business intelligence accumulated the key performance indices of a company, providing the

criteria to filter information based on data relevance. The business intelligence system is also known for data collaboration, in which it makes data interactive in business analysis. Such instances would portray the extent of resource efficiency and lead to lowered costs in business decision-making processes [33]. Other benefits may include improved alignment of organization strategies with objectives, due to the existence of fast, real-time data. Business intelligence considers the Key Performance Indices (KPI) in data aggregation. Such circumstances imply that business intelligence keeps the business objectives on track while providing information for business analysis. The new insights of business intelligence have also helped in opportunity identification in most businesses.

**2.10 Keys to Business Intelligence Success**

Accomplishment with business intelligence is not programmed. Organizations are more inclined to be productive at the point when certain encouraging conditions exist. Senior administration has to have confidence in business intelligence and drive the utilization of business intelligence. For business intelligence to be helpful on a venture premise, it must be determined from the top. They should have a dream for business intelligence, give the important assets, and demand the utilization of data-based choice-making. The utilization of data and investigation stands out from choice-making based on instinct or "hunches." Not everyone can roll out this improvement effectively, and new individuals may need to be placed to help it get established. There needs to be coordination between a business and business intelligence techniques. At the point when there is coordination, business intelligence can be a capable empowering agent of business methods, including new plans of action that realize authoritative change. There is successful business intelligence influence: individuals, councils, and procedures must be set up to oversee and support business intelligence. Influence addresses numerous

issues, the most important including arrangement, financing, venture prioritization, venture administration, and data quality [13].

With time, business intelligence has improved; however, the key factors in building an effective business intelligence system remain the same. Previously, data gathering from heterogeneous sources and transforming those data into meaningful formats prior to analysis was required. After collection, data are stored into some data mart or data warehouse. Then those data are aggregated or clustered based on various metrics suitable for further analysis. However, the data management part is the most expensive and computationally complex part of business intelligence, and this is the most important part.

# CHAPTER 3

## The Evolution of Business Intelligence

Historically, most business intelligence and data warehousing tasks were handled by information technology departments, and the focus was always to figure out how to automate the delivery of meaningful information to the user community. Developers took the long approach and wrote lengthy queries and programs to automate data reporting tasks. However, those programs and queries were not smart enough to help businesses make educated and intelligent decisions. There has been some proprietary software such as Access Database for reporting and Crystal Reports for scheduling reporting tasks, but due to the lack of user-friendly features, these tools could not hold a solid ground in the industry. The basic common point of view of a business intelligence system is to support decision-making processes, because all software programs involve a hierarchy of tasks that must be completed within the specified time period.

In the mainframe era, the earliest commercial uses of computers were aimed at automating decision processes such as analyzing sales, updating accounts payable, calculating payroll, and recording credit card charges and payments. Since those early days in the 1950s and 1960s, the use of computers to support decision-making has become increasingly sophisticated by almost completely taking over complex decisions and supporting people who make complex decisions.

The evolution of business intelligence is much like any other evolution in the modern age. It is driven by demand and by the human need for knowledge. For several decades, businesses and their team members dealt with silo systems and segregated data that had to be manually compiled and analyzed and, with the lead time required for analysts and information technology professionals to create reports, this data was not only incomplete, but old.

The difference between growing as a strategic and tactical company, as opposed to a disengaged and stunted business, is having the right information at the right time for the right people. Business intelligence develops organizations by leading to better, faster, more relevant decisions, and providing business visions to its employees. Business intelligence popularity stems from the fact that CIOs and information technology leaders are progressively identifying the value of vision when making important decisions.

The 20th and 21st centuries are known as the information technology age, where everything depends on the availability of information and discovery of modern technology. For businesses, technological inventions such as the World Wide Web and the Internet have presented a wide and open platform to businesses managed all over the world. Since improving any successful business strategy demands information and sufficient knowledge about market status, the inventions of new technology and theories like business intelligence made it clear and simple to reach and manage all kinds of information.

Before the advent of the information age, it was very difficult to access any information in the absence of computing methods, so business decisions were primarily based on intuition. But in today's modern globalized world, the application of business intelligence technology is becoming popular day by day in almost all kinds of businesses. As every small or large organization requires information to promote their business by forecasting future trends, information is now the primary tool for businesses to understand market trends and understand their own market position relative to competitors. Business intelligence is a broad term associated with different modern technologies that deals with changing market trends, customer behavior, demand and supply chains, and several other aspects of business to improve a company's performance.

The origins and subsequent evolution of what is now called business intelligence are not as modern as the development of networking technologies. Indeed, its elements are almost as old as the history of humankind. Data has always had to be gathered for several purposes. In early civilizations, information regarding taxes, armies, population, and several other concerns needed to be managed, collected, and stored. The first example of written language is in fact data storage: Sumerian stone tablets that helped track the shipment of wheat. The Romans were also particularly fond of government of any kind and record-keeping, especially after the discovery of better methods of papermaking. The challenge of storing more information in less space continues to the present day. With the extension of computing power, came the advancement of information storage capacity. Magnetic tapes, capable of mass storage, turned to disk drives, the technology still being used today. Programmers had to develop very strong and complicated database management systems to be able to control continuously growing collected data. The answer to dramatically growing demands of data storage was relational database technology, which was like splitting the data into elements to store as separate pieces.

Below is a list of each stage of business intelligence improvement, with the important parts of business intelligence that organizations were using to obtain the best results.

## 3.1 Stages of Evolution of Business Intelligence

### 3.1.1 The 1980's – printed green bar reports

During the late 1970s and early 1980s, the concept of Decision Support Systems (DSS) evolved from two previous types of computer support for decision making. One was a Management Information System (MIS), which provided:

1. Scheduled reports for well-defined information needs

2. Demand reports for ad hoc information requests

3. The ability to query a database for specific data

The second contributing system was Operations Research/Management Science (OR/MS), which used mathematical models to analyze and understand specific problems. The real definition of DSS, which has evolved since the 1970s and is still valid today, was given by Ralph and Eric Carlson in "Building Effective Decision Support Systems": "Computer-based Systems that help decision makers confront ill-structured problems through direct interaction with data and analysis models." [6]

In the 1980's, the task for business intelligence was to print green bar reports from dot matrix printers. Users had huge stacks of papers on their desks. Management could look through sales reports (inventory reports) that were 50 to 60 pages long. Figure 1 shows how a typical page of a green bar report looked. (The actual data is not important here.) The data was printed as a table, with no graphics available.

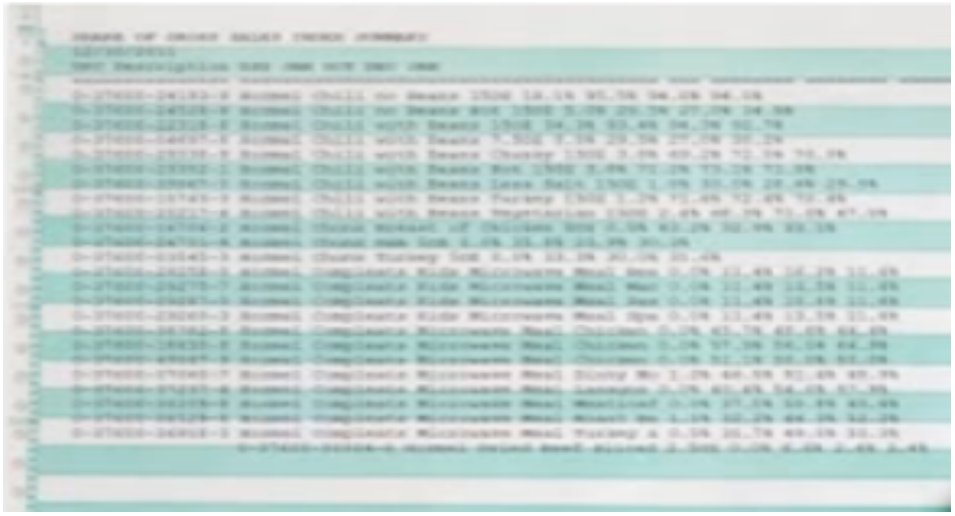

*Figure 1.* Printed Green Bar Reports [10]

### 3.1.2 The 1990's – the OLAP/ROLAP breakthrough

In the 1990's, business intelligence transitioned to OLAP (Online Analysis Processing) and ROLAP (Relational Online Analytical Processing). In OLAP/ROLAP systems, the data warehousing and cubes concepts were introduced; users had the capability to use those cubes to manage departmental data in separate cubes. Users could also run queries directly to relational databases, which were the ROLAP model (Figure 2).

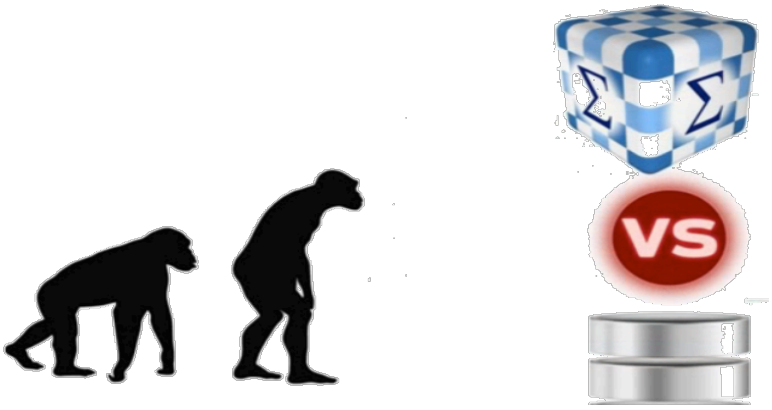


*Figure 2.* OLAP/ROLAP Breakthrough [10]

### 3.1.3 Early 2000's – the rise of the Web

In the early 2000's, Web-based business intelligence was introduced for the first time. Users could finally have access to real-time consumption of information. Users could run reports through a Web-based application and make charts and graphs to give a graphical look to reports. Also, users have been able to aggregate data to summarize complex reports in fewer pages. This was the era when real prediction-based analysis started. The reports produced through Web-based systems are still being used tremendously among organizations (Figure 3).

### 3.1.4 Late 2000's – the age of dashboards

In the late 2000's, dashboards were finally built. Users moved away from grids and graphs of 50-page reports and finally got into the consumable dashboards that business users can use to view data at a glance and see what is going on in the business (Figure 4).

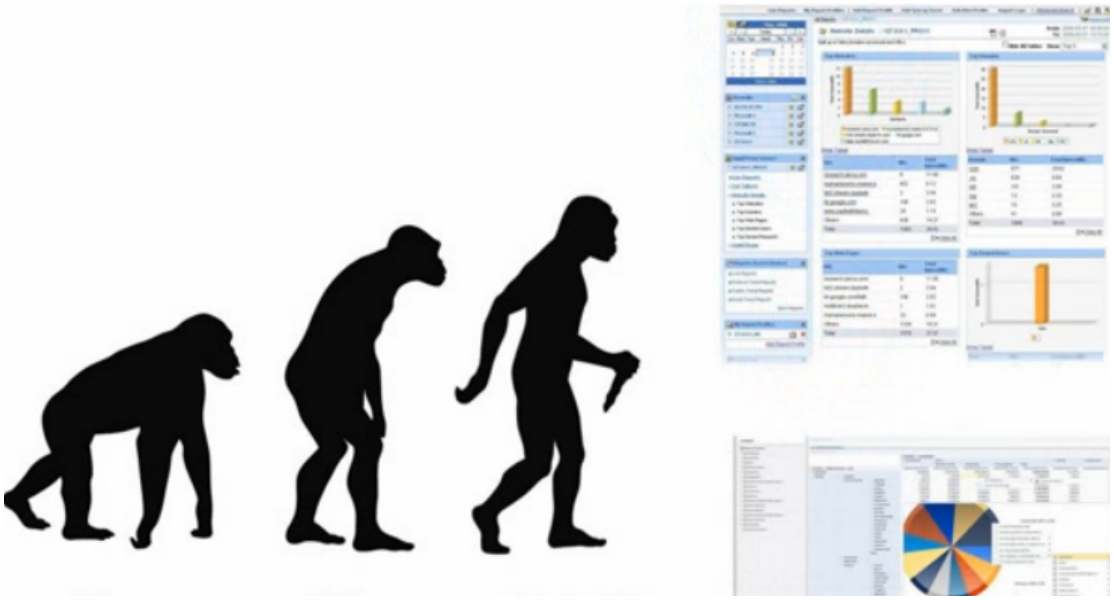

*Figure 3.* The Rise of the Web [10]


*Figure 4.* Age of Dashboards [10]

### 3.1.5 Early 2010's – portable and swift

Finally, in the 2010's, the trend is in portable and swift business intelligence, which is also called mobile business intelligence. Portable and swift business intelligence basically is taking all the business intelligence that has been created in the past and integrating it into mobile devices for consumption and also enabling visual data discovery for casual business users (Figure 5).

*Figure 5.* The Age of Portability [10]

## 3.2 Business Intelligence Today

Users who have a business intelligence system in their organization were polled where they stand in business intelligence today (Figure 6). Business intelligence has tremendously evolved among users to make intelligent decisions in different organizations. Figure 6 displays the steps that business intelligence has been through, from the 1980s through the 2010s. The most effective step used by organizations, and found very useful, is the Dashboard period. This

period, the 2000s-2010s, has seen very effective progress. So, the time of dashboards is one of the important stages in business intelligence for improving business.

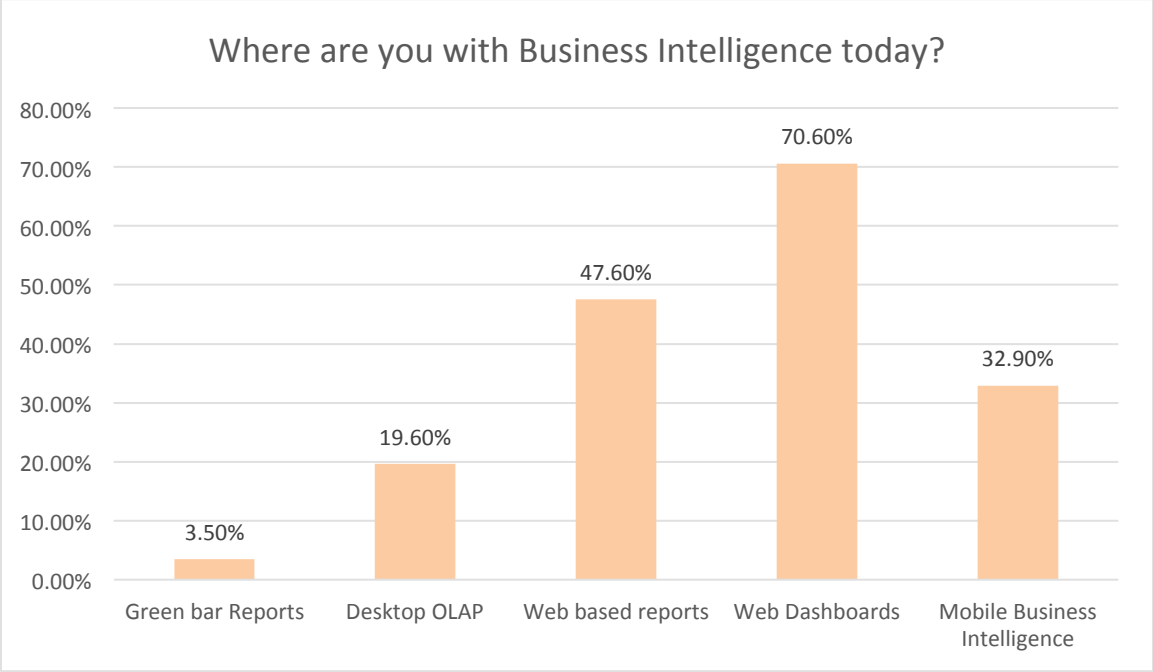


*Figure 6.* Business Intelligence Today

### 3.3 Need for Intelligent Information

There has always been a need for a tool that can be used by business users to automate reporting, schedule tasks, and to use to make strategic decisions based on short-term and long-term data and trend analysis. The business need for data was not only for informational purposes; users were looking for intelligent solutions to the following problems:

How to get easy and consistent access to financial data?

How to make a product easily accessible to customers?

How should a marketing team act when a new product is launched

or an old product is updated?

How quickly can the business take action?

How to get the right information to the right people at the right time?

The ability to get the right information at the right time and to provide that information to the right people is the main focus of organizations. Organizations that have successfully collected, managed, and delivered the right information from the huge amount of transactional data are the leaders of their respective businesses. The ability to act faster and more effectively than the competition can be a huge advantage in today's marketplace, and that means the organization is successfully managing customer relationships for the long run.

As organizations look to answer the above questions with limited two-dimensional tools such as spreadsheets, such complexity cannot be managed. Figure 7 is a tool that can be used by business users to show how information can integrate into a business intelligence system and deal with the main four factors: customer, organization, partners, and data. Figure 7 shows that the previous system was dealing in a different ordering. Now it is focusing on how organization and data work separately, and customers with partners. At the same time, customers have the chance to work with organizations and data with partners together. Figure 7 shows how the system now is faster and more flexible. So, this tool makes it easier for organizations to have the intelligence and information integrated by the right people at the right time.

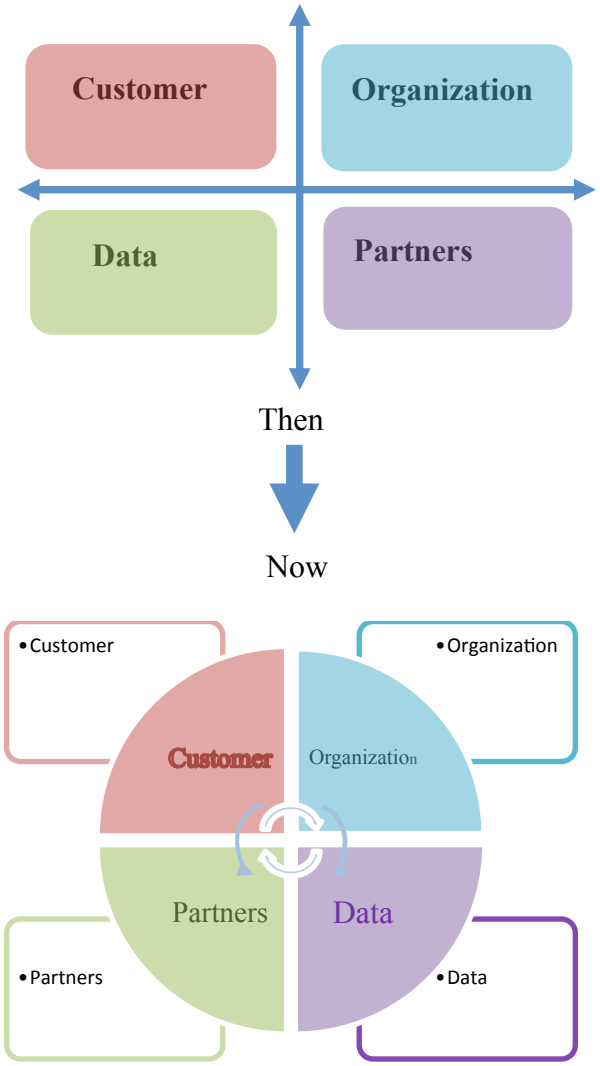


*Figure 7.* Integration of Information

### 3.4 Why Organizations Cannot Compete

There are some solid business reasons why organizations cannot achieve the goals to compete in the market:

- Loss of opportunities due to unpreparedness
- Set goals not achieved regularly
- Frequent change in business objectives
- Inability to scale the business

- Not reacting to events in a timely manner
- Redoing or repeating processes, such as re-keying data manually
- Conflicting customer treatment

Apparently, all of the above reasons are related to each other and can be solved at the organizational level. Organizations have already realized that for strategic competition, it is very important to implement business intelligence. Companies use business intelligence to reveal significant events and identify business aspects in order to adjust quickly to their changing environment [3].

### 3.5 Conclusive Evolutionary Business Approach

In this rapidly changing world, most of the biggest organizations in the world believe that information, and knowledge about information, is power. However, the challenge for organizations is how to grasp the latest technology.

An evolutionary business approach shows sound planning to deliver the solutions that meet the long-term goals of the organization. This does not mean that an organization will have all the latest and greatest technology. It means that an evolutionary business approach delivers information to establish and maintain strategic visions of the organization. It achieves strategic and tactical goals through information used to create sustainable competitive advantage. This can be done through simple or complex solutions (Table 1).

Table 1

*Organization Data Requirements and Technology Solutions*

| Data Requirement | Solution |
|---|---|
| **What Does Data Mean?** | Data mapping according user and schema requirement |

Table 1

*Cont.*

| Data Requirement | Solution |
|---|---|
| **Data Integration** | Information integration Services, Data transformation and query |
| **Business Rules** | Rules attachment to Measure Data |
| **Data Warehousing,**<br>**Data Mart** | Consolidation, Aggregation of queries |
| **Entity Data,**<br>**Track Records,**<br>**General Ledger** | Metadata storage |
| **Information Management** | Analysis repository, Information Management and Discovery services |

Organizations need to proactively realize the advantage of enhancing their business intelligence approach. Those who plan their evolution in a systematic manner typically lead over those that get forced into change. As an organization moves along the evolutionary process, it expands its capability for delivering increased business value via information. Understanding how to evolve into an intelligent enterprise means the organization has to comprehend the procedure.

Organizations need to recognize where they are and why they are there, and then understand how to move to the next level. They need to agree on the level of achievable evolution, establish priorities for improvement, and then implement pragmatic action plans for improving their information maturity to align with organizational goals and objectives. Businesses have made a huge investment in technology in the past few decades. The spending has decreased, and businesses are looking to leverage their technology investments. Although

information technology spending has decreased in this economy, overall business intelligence spending has increased.

Figure 7 shows that business intelligence now is working better with more flexibility. This is one of the reasons why business intelligence has progressed within the past few years. That progress has led to increases in business intelligence spending to take advantage of the improvements from the last several years in business intelligence.

Technological advancement makes it easy to obtain vast amounts of data in a shorter time, and computing resources make it easy to analyze data for long-term strategic decision-making. However, if we look at the history of business intelligence, we can find that it is totally a recent concept developed to facilitate business decision-making. In 1989, Howard Dresner, a research scholar at Gartner Group (an information technology research and advisory firm in Connecticut), popularized the term "business intelligence" with a set of methods and concepts to improve business decision-making by using data resources.

Combining common business intelligence concepts with data warehouse technologies, well-developed enterprise application tools, and on line analytical processing (OLAP) assists in faster collection, analysis, and data research. Hence, business intelligence technology assists in extracting information from the available data and using it as knowledge in developing innovative business strategies. Growing competition in the market is forcing small to large organizations to adopt business intelligence to understand economic trends and have in-depth knowledge about the operation of their businesses.

To summarize the contrast between present and past business intelligence, earlier business intelligence was a very simple tool that allowed better circulation of information. Throughout the years, that particular system for people who worked (and are still working) in

companies was improved until presently, we have quite good support to manage companies. Business intelligence now provides more complicated tools and insight that allows managers to rely on it to help them run a company. The next chapter will discuss current business intelligence.

# CHAPTER 4

## Business Intelligence Today

Like other business technology platforms, business intelligence has shown great progress and the possibility of vitality in operations and strategic management. There have been advancements in business intelligence in the current business environments. Current business intelligence has been redefined in its purpose and in the objectives that it wishes to achieve within the operations of the companies and other normal business operations. The rise of innovation in the technology sector has been the central source of changes in the application of tools and techniques for the analysis of business. Below are analyses of some of the features and development of business intelligence in the current environment.

Currently, business intelligence systems have become able to process real-time operational data. The operational data for a business can be available from an Enterprise Resource System (ERS), a Customer Relationship Management (CRM) system, a Supply Chain Management (SCM) system, or different databases across the organization. 'Operational business intelligence' adds much other functionality to common business intelligence practices. Using operational business intelligence, organizations can manage performance, business processes, and role-based scoreboards and dashboards. Examples of the decision-making that can be done with operational business intelligence are doing a market evaluation over multiple geographic areas and making a personalized product recommendation list for a customer.

Data quality is an issue inherent to the concept of business intelligence. Other related issues are the consistency and reliability of data. These issues arise while creating or maintaining data. Intelligent reporting unitizes existing data for effective data analysis and decision-making [18].

### 4.1 Business Intelligence Technological Advancements Today

In the current world, technological changes have influenced both objectives and success factors, as evidenced by shifts in business goals. Data analytics is part of business ongoing advantages. The use of different applications in business analysis can form one of the essential moves in the formation of business intelligence success. Currently, business intelligence has taken a different direction due to technological advancements and changes [28]. Below are some of the issues that necessitate technological advancements under business intelligence in current working environments.

### 4.2 Increased Data Volume

Business analysis involves the integration of data in order to enhance quality decision-making. The increased operations of the business such as mergers, expansions, international trade development, and globalization have resulted in an increased need for technological improvement under the concept of business intelligence. The factors mentioned have increased the sizes of business variables as part of its normal operations. Such increases and advancement have led to the development of high computing power in the use of business intelligence. The increased demands for higher computation power have compromised the current capabilities of the business intelligence systems and software. Due to such developments, there is rising development of applications that have high computing power under the innovation of business intelligence [3]. The business intelligence in the current world has been challenged on the grounds of inadequacy in computation power and data aggregation as part of the current ongoing business challenges. The critical databases have been given powerful computation in order to ensure that there is an increased development when dealing with the business intelligence systems and software.

### 4.3 Advanced Information Delivery

The advancement of information delivery occurs when enterprises institute strategies of delivering quality information in a manner that is more comprehensible to their users. The increased technological advancements in the current business environments have led to improved information delivery techniques such as the use of Google maps in business. Summarized charts and diagram flows have increased the events of sustainable information delivery in such a way that business intelligence has gained a new perspective. The addition of such aspects to business intelligence has led to development in the levels of business strategies as part of the ongoing competitive advantage methods. Digitalized platforms such as mobiles and tablets have led to ease of data delivery in the business intelligence sector. Such delivery tools can apply in increasing the technological innovations of the business intelligence software and systems. The current business intelligence is known for easy data delivery and flexibility in data access [31]. The embedment of different support applications as part of the business intelligence system helps to increase the levels of reliability that individuals experience with the business intelligence system. The increased basis of business intelligence information delivery has caused a paradigm shift in the entire process of information delivery in the commons aspects of data analysis. Companies have long recognized data collection and analysis to be significant activities for long-term strategic planning. Before the beginning of the Information Age, utmost decision-making was based on guess-work or trial-and-error methods. Businesses exploring to obtain a sustainable advantage over their opposition instantly turned to information management systems for accurate data analysis. These systems and techniques have evolved to what is now known by the general term business intelligence.

Business intelligence leads to in-depth analysis of company data for better decision-making. The technology and methods that make this analysis possible take heavy collections of information and change them into established, readily-accessible, human-readable collections of data. With an effective business intelligence tool, companies can easily track their own operations, activity patterns, and trends of their customers and their industry. These factors help companies work toward distinct goals with confidence.

### 4.4 The Shift of the Intentions of the Business Intelligence System to Operational Efficiency Today

There has been a shift in the ways in which the objectives of business intelligence have changed in the current view of business environments. The current view does not focus entirely on the real-time data and decision-making, but also focuses on issues pertaining to operational efficiency. According to the current intentions of business intelligence in business, the previous ones provided data that would last only for a short while in the business. After the use of data, the next question was "What next, now that we have made the decision?" The current objectives of business intelligence intend to ensure overall efficiency in the operations of the business. The efficiency levels in business operations have been diversified according to the ways in which the integration of business operations and computer technology should appear. The operational efficiency factors are characterized by consistency in the levels of operations experienced by most businesses in the current environments. The shift of intentions has also modified the aspects of business intelligence towards achievement of sustainability in the operations of the business process. Some of the affected areas include the monitoring of inventory in business sectors [12]. The increased requirements for the business to deliver inventory information in the time for effective inventory management. Tools such as business monitoring activity tools have been

integrated with the business intelligence to ensure that there is adequate development in the ways in which business intelligence adapts to changing strategies today.

### 4.5 The Objectives of Business Intelligence Today

There are some changes in the current world that can be associated with the development of business intelligence in current situations. Apart from the delivery of on-time real data for decision-making, a paradigm shift can be recognized in the current operating environments in which the objectives of the business intelligence system have changed significantly. There are notable differences between the previous objectives of business intelligence and the current situations as dictated by the external and internal processes of a business. Raw data is assembled and handled into information, and afterward information must be sifted and masterminded into significant patterns. The information drawn from that data analysis serves to structure the business intelligence of the company. Over commercial enterprises, business intelligence needs change crosswise. The utilitarian range and specific methods under examination assume a vast part in a sort of data assembled, and the scope of learning sought. Common practical territories include sales and marketing, human resources, operations, and finance. Sales and marketing departments track products, customers, demographics, promotions, sales force, order type, and other related fields. Human resources regularly look to measure employee, organizational, and departmental issues. Gathering pace, warehouse stock, producer and supplier cost, and movement benefit are the areas of operations administration. Data on themes, for example, cash principles, account data, and industry patterns are all handled closely by finance departments. In the field of business intelligence, staff authority levels likewise become an integral factor. Those in lower hierarchical levels are more inclined to concentrate on measures of short-term, correctable execution, while more senior

workers may measure abnormal state drifts rather than absolutes. Obviously, both of these sorts of measures are essential to gaging an organization's relative achievement. Great business intelligence means adjusted data. Too much data or excessively little data is not valuable. Organizations can concentrate on the most essential enhancements by setting sensible cutoff points on the data accumulated, arranging their efforts around an extensive methodology, and utilizing business intelligence frameworks.

### 4.6 The Change from Labor Cost Savings to Reduction of Total Operating Costs

After the development of business intelligence in previous years, there have been changes in the cost focus placed on the business intelligence system. Initially, business intelligence was based on labor cost reduction through the reduction of the labor needed in generating of reports in the companies and other business entities. Today, the trend has changed drastically to focus on the overall total costs of the companies and other entities in response to the need to increase the overall relationship between company efficiency, profitability, and efficiency purposes [13]. “Overall total costs” focuses on the overall operation costs that the company experiences in their distinct environments. The objective would include the costs that are not even related to the data generation steps. In general, the scope of cost reduction in accordance with the mission of business intelligence has changed to capture the overall efficiency factors involved in the environment of a given industry.

A substantial profit from business intelligence is the time and effort spared by avoiding physical delivery of standard reports for the association. Occasionally, that is the biggest profit from business intelligence. It is so unmistakable that it is regularly part of the equation when a choice must be made about actualizing business intelligence. In the event that these savings alone could support the business intelligence framework, then it is the most effortless approach

to legitimize it. Most organizations without business intelligence use far-reaching measures of assets, assembling heaps of standard reports that are designated “all”. To ensure that everyone has each data report they require, various sorts of reports are sent to employees, normally on an exceptionally definite level. Taken together, this implies that the potential restorative and astute activities that these data could have prompted are missed, either because of being past the point of no return or because the workers neglected or were out of time to discover the applicable patterns in the hordes of data.

At the point when representatives attempt to discover head and tail of the data, they frequently find that the numbers are not similar between diverse reports and end up dissecting the distinctions, looking at the trees instead of the forest. Also, since trust in the day is lost, no one dares to settle on a choice focused around the numbers.

### 4.7 The Change in the Need for Information Delivery

In previous periods, the need for information provided by the business intelligence was centrally managed in accordance with the needs of the business in strategic planning and operation smoothing. The current needs of information have changed much in such a way that the information must ensure a successful integration of all the business stakeholders within the points of interest. The increased changes in information delivery demands have also revolutionized the applications used in information delivery. Additional tools and applications have been applied in order to ensure that there is quality delivery of information in the business contexts. The stakeholders who may want to use the information have also changed with the changes of business composition. The increased access to real-time information has been extended to the shareholders and the stock exchange authorities. This factor has been owed to the fact that there has been increased business information that is necessary for making appropriate

investment decisions. Since the number of stakeholders has changed, an overall strategy has been created in order to ensure that there is an adequate increase in the tools applied in the information delivery process [20]. The increased changes have also been due to the development of other support technology such as tablets, which are used in managing information delivery across all shareholders. This fact has also created the development of applications that are self-managed among users as a way of increasing information access and validity in the company sectors.

The decision-making process in any organization can be developed by the intelligence system. If the company decided to implement the intelligence approach, it must first define the goals for this new strategy. Then, the company must evaluate whether or not the decision-making will improve, and in which areas. However, there are many commercial tools providing intelligence support such as data warehouse, Knowledge Discovery in Database (KDD), score coding, data visualization, data mining, and Online Analytical Processing (OLAP). These tools initiate from the raw data and extend to the informed decision. Furthermore, some of these products provide logical results when combined. For instance, a data warehouse used to monitor a store's inventory can display the old sales trends in the company or even the external customers' opinions. In this way, the intelligence system expands the information to improve the decision-making and understanding the conditions. Therefore, the intelligence support software will be the next step in the research.

Decision Centric or Analyzer software will help companies that have insufficient information technology or have data available in different sources. These two applications are manufactured by Decision Technology, Inc. By using either of these two tools, the user can analyze data, generate reports, and transfer files to other software such as Word, Excel, and Acrobat. Decision Centric with its Enterprise Information Integration **(**EII) engine is designed to

support the intelligence system for small and medium size organizations. As a result, most companies delay the deployment of the data warehouse or extend it to other data warehouses. In addition, this application has an advanced reporting tool. Generally, the business intelligence is a dominant approach in every level of company's transactions and in every enterprise. With these technical advancements, the companies need to make good decisions in each moment, because any company that can devise a perfect strategy in this high level competition will succeed over their competitors. The business intelligence software always guarantees that companies will know the current information they need to be on the right track.

### 4.8 The Change in the View of Business Intelligence as a Competitive Advantage

As companies advance in their operations, the need to integrate computer technology has become an essential aspect. Business intelligence is a part of computer technology in which companies may wish to analyze their data in an order of accuracy. The need to process information in different fields has affected the competitive edge of most companies. Today, businesses apply business intelligence as part of generating competitive advantage within the industry. For example, the increasing trends in the ways in which companies show and deliver their data through the business intelligence applications have been aimed to provide critical information that may be needed in the stock and company markets. The view of information systems as a competitive advantage has made use of business intelligence in order to gain the upper hand in the operations of business strategies [17]. Competitive advantages that are contributed by business intelligence have also been shifted drastically due to the major changes in the potential outcome of business information processing. Managers who can maintain a clear view of what and why their customers are buying will be able to increase sales cycles, cross sell, and maximize pricing. Analytical applications can help decision-makers determine the highest

margin products in order to be able to show the right products and increase gross profit. Those applications happened by serving up highly granular data on costs of goods sold. Operating costs were also important. When cost centers and lines of business managers can learn about operating costs as a result of an analytical deployment, they can better minimize expenditures that produce low returns. Business intelligence tools could also be known as productivity benefits. Those tools can remove manual processes for building reports and also accelerate analytical processes for making decisions.

Organizations often rely on complicated spreadsheets that are understood by only a few to make critical decisions, whereas business intelligence tools can make data analysis much easier and foolproof. In other words, it is the most effective way to support decision-making processes and support data flow in small, medium, and large organizations. In fact, business intelligence can serve all organization levels and across industry, but not all employees are involved in decision-making processes in an organization. Another benefit is that business intelligence doesn't require internal skills to set or use tools. Furthermore, organizations that use business intelligence tools will better achieve their goals and thus receive a better return on their investment. Integrated organization analytics applications and tools with three or more data sources tended to achieve higher returns. So organizations that can integrate three or more data sources become more efficient and effective in making decisions than other organizations that integrate only one or two data sources. Moreover,, using business intelligence applications helps to understand customer needs and wants, so that an organization can build strong customer relationships with their products or services. Business intelligence allows to focus in core competence and capability of organization. In other words, business intelligence gives a clear

analysis of the marketplace, market changes, competitor responses, and regulatory requirements to help the development of new and potentially innovative products.

### 4.9 The Business Intelligence Competition in Companies Today

Different levels of information delivery have been established, in which different companies have changed their tactics used in business intelligence. Information delivery is not similar in all companies having the technological applications. In the current business environments, companies have shown different capabilities to use the processing power of information. The changes in the processing power of information have led to giving out ranks in which some applications of some companies may not be easily realizable within the working environments. Microsoft is considered the best business intelligence company, followed by Tableau Software, Qliktech, and Logi Analytics [28].

Companies that announced their need for a big data strategy, which involves a complex data set application, thought it seemed like a knowledgeable and smart investment. They are beginning to wonder why they are collecting data in the first place. They are realizing that they have established technology to help the business case, and they are now concentrating on the business case. They did not want their companies to be left behind while their competitors increased their technology on the "bleeding edge," and overlooking the big data promise looked like it could be deadly. However, the best methods around big data continue to evolve, one being simply to combine it to a company strategy. More possibly, you may begin to hear the expression "big data" less in 2015.

Most companies create a lot of information flow about different areas, however, in this century, technology and computers have helped organize that information in data to be saved. It helps to measure whether the information that been saved can be found when is needed for an

excellent performance. This confirms that big data has been the best fit for needle-in-the-haystack analytics, as a different way from which everyone can benefit. It would be impractical to say that half of the business intelligence vendors list will be available a year from now as exist today. However, 2015 will be the start of a landslide as the business intelligence arrangements and vendors begin to admit that they cannot succeed with incremental developments. The first casualties will be the QlikView and Tableau wannabes, with consolidation as successful business intelligence companies acquire some good concepts and technology. We have seen this concentration before with Brio, Business Objects, Cognos, etc. The only difference is that these are cloud-based tools that allows users to change their apps as easily as possible. Loyalty and stickiness are very important — and churn will drive a lot of exits. The explosion in "things" will create a steady wave of valuable new sources with fluctuating data formats for powerful analytics. Information technology is still struggling to keep up with the massive information that can be delivered from a mobile worker. With the arrival of information technology, that wave of information will be increased with each asset over an organization from the stress sensor on the wellhead to the video surveillance at the gas station pump. Business decisions will be improved in an organization that has a strategy for quickly growing information and normalizing data across their ecosystem.

Overall, business intelligence has been revolutionized tremendously in the present. The perspectives with which people view business intelligence have also changed in that they view it as a competitive advantage for most companies. The cost reduction aspects have also changed, in that overall cost reduction strategies have been considered as the central cause for the establishment of business intelligence. The changes in information delivery have also changed, in that the companies view stakeholders as an essential party to the generated reports. These

changes have been accomplished by the vast changes in technological innovations that have changed the applications and tools used for information integration and presentation.

# CHAPTER 5

## The Future of Business Intelligence

### 5.1 Key Trends in the Business Intelligence Market

Most of us are familiar with the Gartner Hype Cycle (Figure 8), which is the methodology used to tell where you are in the life cycle of a product. As shown in Figure 8, there are great expectations for any technology when it starts with a Technology Trigger phase. There is a trough because it turns out to be harder than people thought it would be, and slowly technology gets into a productivity area that is called the Plateau of Productivity. Today, in business intelligence, we are in the productivity area where business intelligence has passed the entire inflation peak and disappointment trough, but there are still trends and influences that are true inflection points in the business intelligence industry [10].

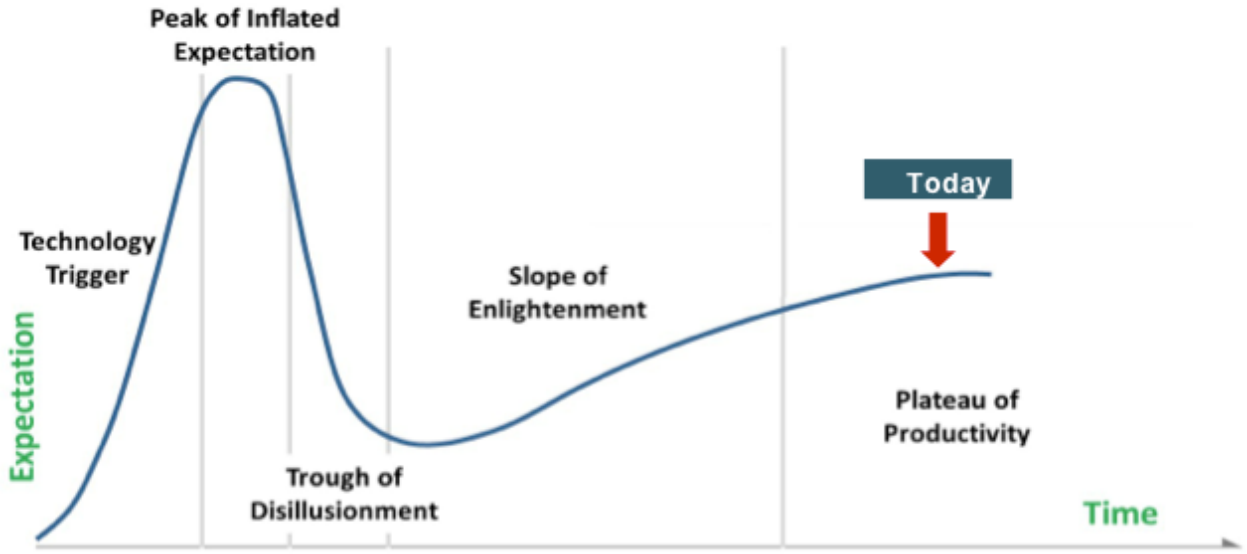


*Figure 8.* Gartner Hype Cycle Chart [11]

In Figure 8, we see that business intelligence today is in the area where it has passed the disappointments and the disillusionment of its performance, so business intelligence is now a

product. The area of the Plateau of Productivity tells the producers of any product that the time of bad thoughts of this product has passed.

However, Figure 9 shows the question about the future. After dealing with the Technology Trigger, Trough of Disillusionment, and Slope of Enlightenment, today's business is talking about the future of business intelligence. The expectations involve two directions: either increase the performance of the product (business intelligence), or decrease the performance of the product in the organizations that are working with it.

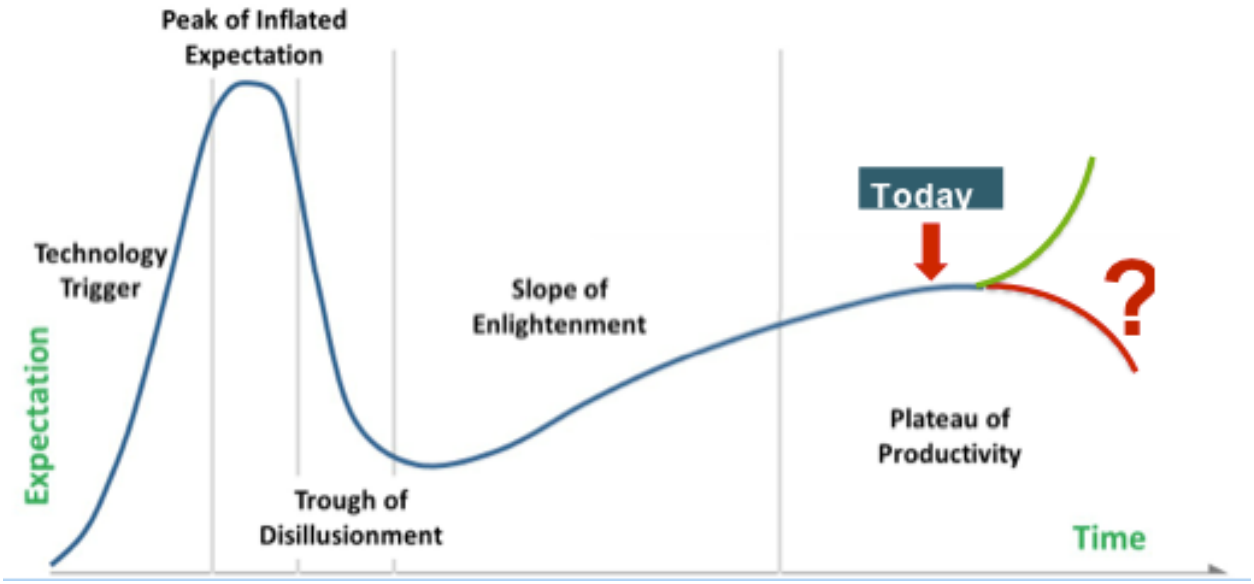


*Figure 9.* What is the Next Step? [11]

Every two or three years there are trends in the business intelligence industry that significantly changes the behavior on how people consume in access of business intelligence applications [9]. Figure 10 shows when different users in different industries started to be involved in business intelligence applications.

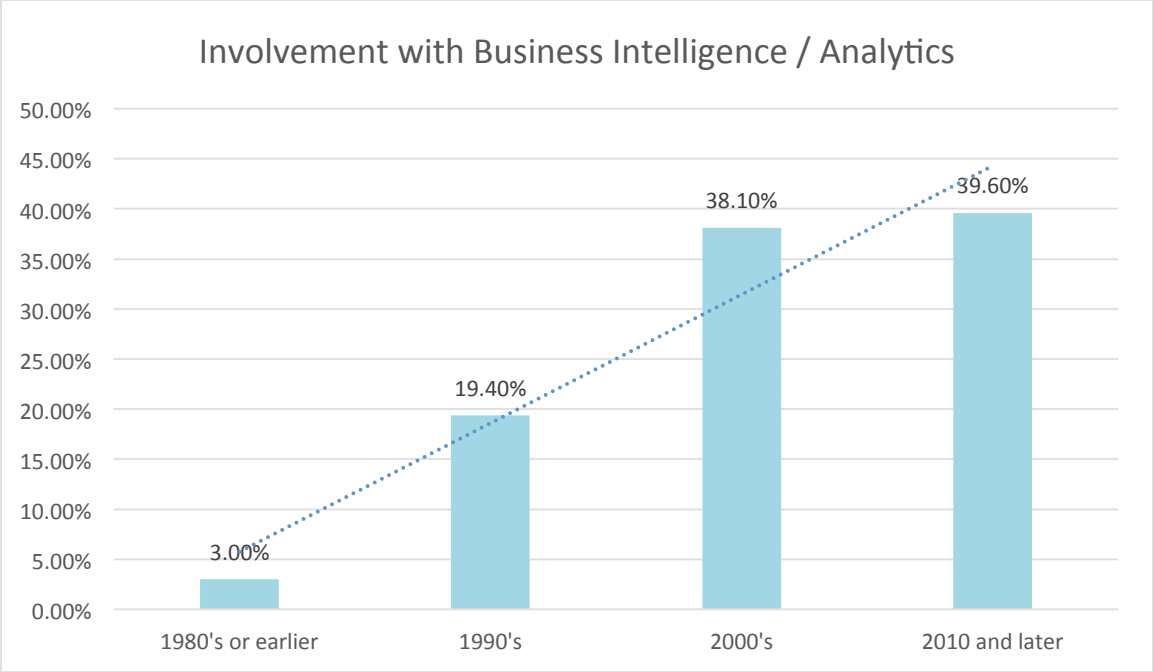


*Figure 10.* Analytics

According to [9], here are four trends that Gartner Group saw in 2011, and their predicted effect on business intelligence use of applications from 2011 to 2014:

1. 33% of business intelligence functionality will be consumed via handheld devices by 2013.
2. 30% of analytic applications will use in-memory functions to add scale and computational speed by 2014.
3. 40% of spending on business analytics will go to system integrators, not software vendors, by 2014.
4. 15% of business intelligence deployments will combine business intelligence, collaboration, and social software into decision-making environments by 2013.

### 5.2 The Development of the Cloud Business Intelligence Model in the Market

Business intelligence is being diversified each day; inventions such as the cloud business intelligence models are the most prevalent among customers. Cloud business intelligence has been identified as an analytical tool that is progressively developing in the business sector. Most businesses are keenly observing the trends in the use of business intelligence methods. The targeted customers may not be actively replacing their current business intelligence tools and software, but at least there are some trends showing the adoption of the new cloud business intelligence model. The development of this new concept has been made possible by different promoting factors, which may be composed in terms of calculations to ensure economic effectiveness. With the existence of this new model, several limitations may be identified as impediments to system adoption. The cloud business intelligence model is an essential tool that can be considered as part of essential business computer technology initiated by different producers in the field of concern in the present.

### 5.3 Factors Favoring the Adoption of a Cloud Business Intelligence Model

There are promoting factors that have influenced the existence of the cloud business intelligence model. These drivers are centrally based on the operational areas of the business. These operations focus on strengths, elasticity, and time factors of cloud business intelligence.

- The potential strength of the business intelligence model is another central promoting factor associated with the model implementation. For example, once a business may focus on the capability of the new model, it becomes more attractive due to its abilities such as possibility of outsourcing, which encourages its adoption among customers.
- The levels of flexibility in its use are also a significant driver to the adoption of the new model. The computation powers offered by the cloud business intelligence model can suit

any level of operations. This promoting factor makes the model an all-round tool for computations of all categories.

- There is a reduction in time required to get the cloud business intelligence model into action. This approach implies that there can be an easy integration of the cloud business intelligence model with the existing organization system without the existence of time wastage. This reduces the potential losses associated with implementation duration.

### 5.4 Dashboards 1.0

Today, users are experiencing applications over the web and mobile devices. These applications can combine data, multimedia, and transactions all in one application that people consume. They are really not aware if it is an analytics or a transactional application. For example, in Figure 11 below, a REDFIN application on the iPad displaying where multiple sources of data are being displayed on a one page dashboard.

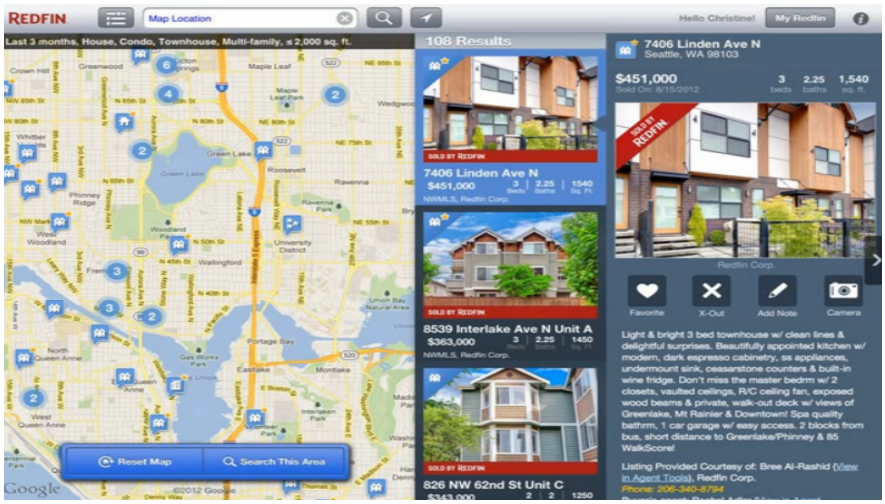


*Figure 11.* REDFIN [11]

### 5.5 Current Business Intelligence Applications

The typical dashboard or web dashboard that is produced by a business intelligence team today consists of graphs, some charts, and several lists of drill down capabilities (Figure 12). There is quite a difference from a user perspective. The user adoption rate is higher because there is a big difference between the class of applications that users are enjoying on their mobile devices and on the web today, and the class of applications organizations are pushing out to the users in terms of analytics.

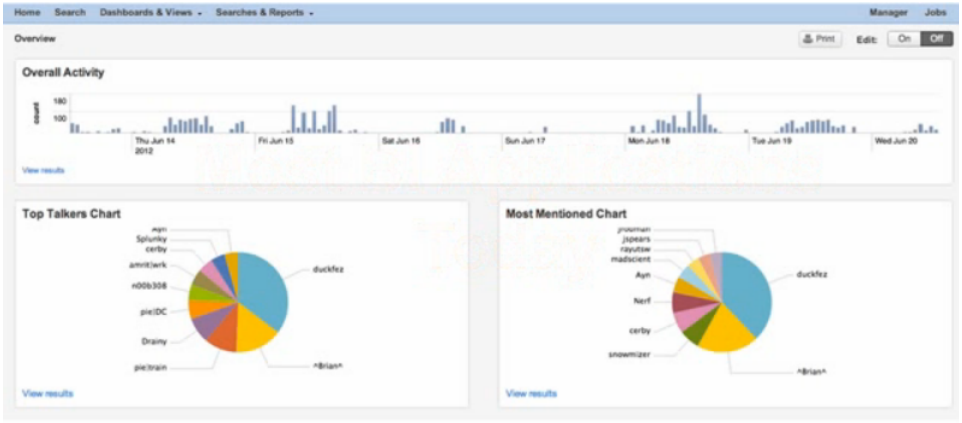


*Figure 12.* Current Business Intelligence Applications [11]

Dashboard 1.0 in the 1990's and 2000's was simply a data consolidation instead of having 20 different reports in the folder. Users took those 20 reports and put them in a single dashboard on grids and graphs (Figure 13). Dashboard 1.0 was very useful at the time because users did not need to run several different reports to get the information on one page. But those reports worked independently, because there was no connection between them; there was no work flow and no guided navigation between those reports.


*Figure 13*. Dashboards 1.0 [11]

## 5.6 Dashboards 2.0 - The Evolution of an Information-Driven Application

There are six key attributes of Dashboards 2.0 that make it fundamentally different from the first version.

### 5.6.1 Concept of the application

Users do not need to navigate to a folder to view this application. Instead, they go directly to the application itself. This is a self-contained application that contains information from multiple sources. It also has a very high density of information. Examples of this kind of application are large retail organization that can send thousands of applications via email to their store manager every day. Store managers do not really know if they are analytical applications, they just interact with the applications the same way they interact with other web-based and mobile applications.

### 5.6.2 Business process workflow

Dashboard 2.0 is not all about presenting data to business users; it is built around business workflow and user requirements. For example, the sales enablement application is for the sales representative in the field, and the Chief Financial Officers (CFO) application is for the CFO of a company. So everything is built around a guided business workflow instead of having several reports the users do not know how to handle. More importantly, a key aspect is the ability to transact within an application. The whole function of analytics has always been the ability to take some actions on the analytics, and finally business intelligence is at the point where we have the technology today to take those actions. (Figure 14).

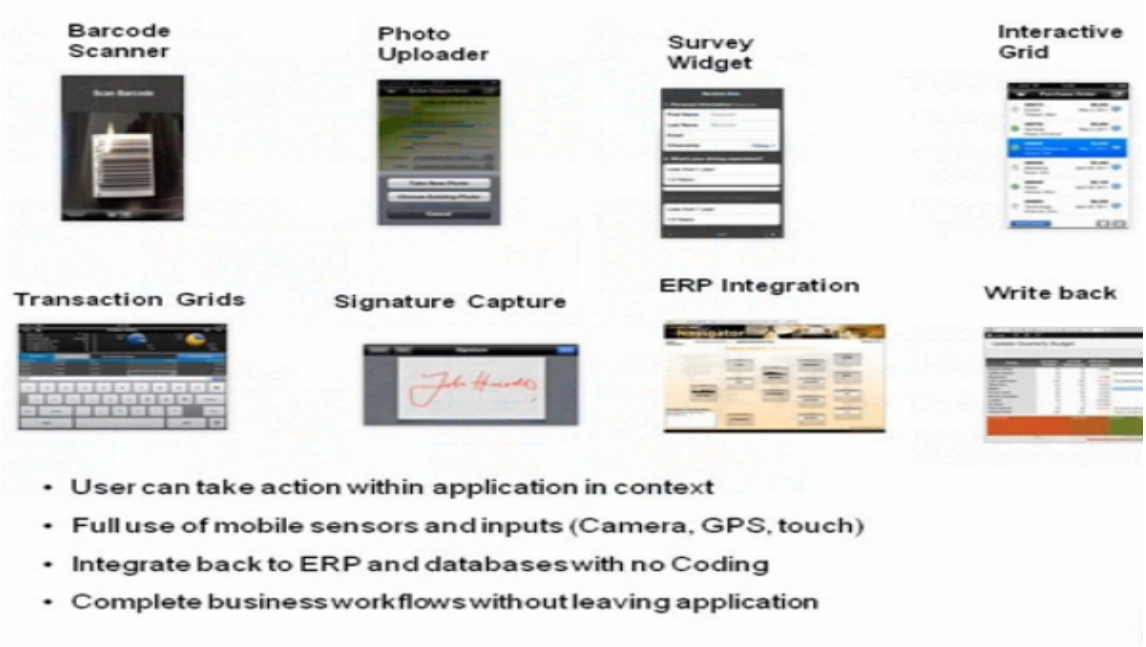


*Figure 14.* Business Process Workflow [11]

### 5.6.3 Mass personalized distribution

Unlike its predecessor, applications are not distributed to just a few users. Instead, thousands of personalized applications with auto role-driven customization are distributed

throughout the organization. These applications have the ability to push high volumes of data with Web-enabled and Mobile applications.

### 5.6.4 Multimedia and other contents

This is the idea of structured and unstructured data. In the past, technology gurus have been smart enough to put the structured data from databases into purposed dashboards. The unstructured data and semi-structured data such as log files, machine sensor data, social media, documents, audio-video, etc. still needed to be integrated into the dashboards (Figure 15).

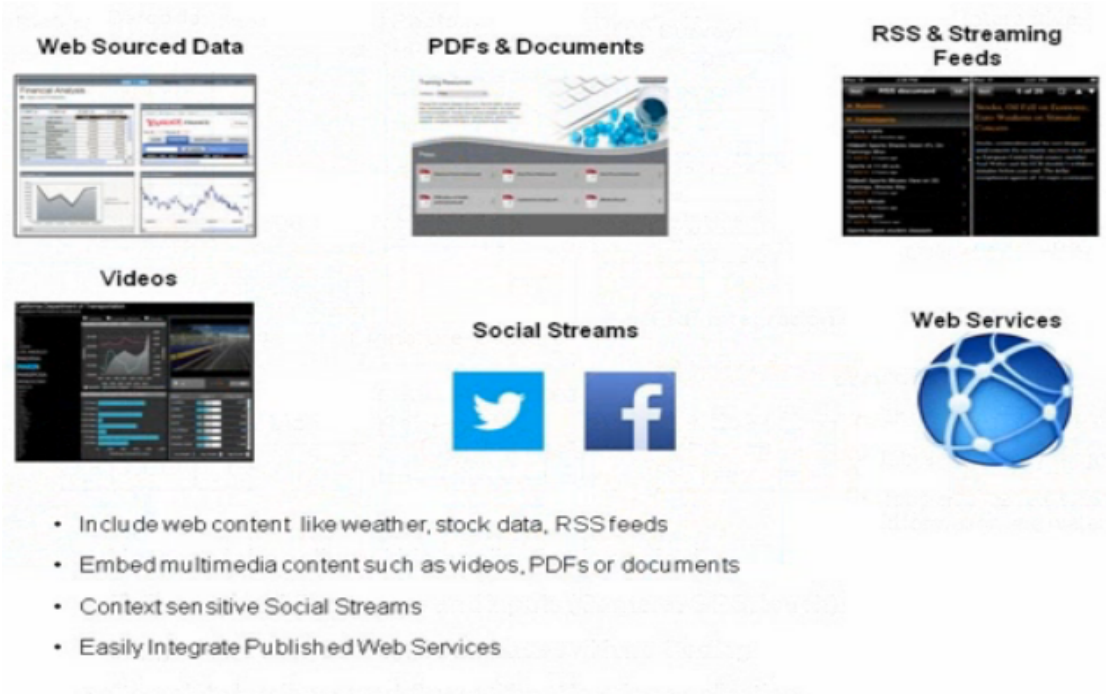


*Figure 15.* Multimedia and Other Contents [11]

### 5.6.5 Real-time insight

This feature ensures that decision makers can spot, analyze, and react to quickly-changing trends and outliers. They can resolve issues as they occur, act on information in real-time in context, and fine-tune strategy with real-time feedback.

### 5.6.6 Cloud model

Cloud-based business intelligence has many characteristics that make business intelligence more efficient. Some important features of the cloud are the speed that reduces the time of the work, more flexibility to go through applications, and the strengths that are associated with the model implementation.

The best Dashboard 2.0 applications combine all of above six attributes into one easy-to-use application. Figure 16 describes each attribute of Dashboard 2.0 separately, and tells what each attribute holds.

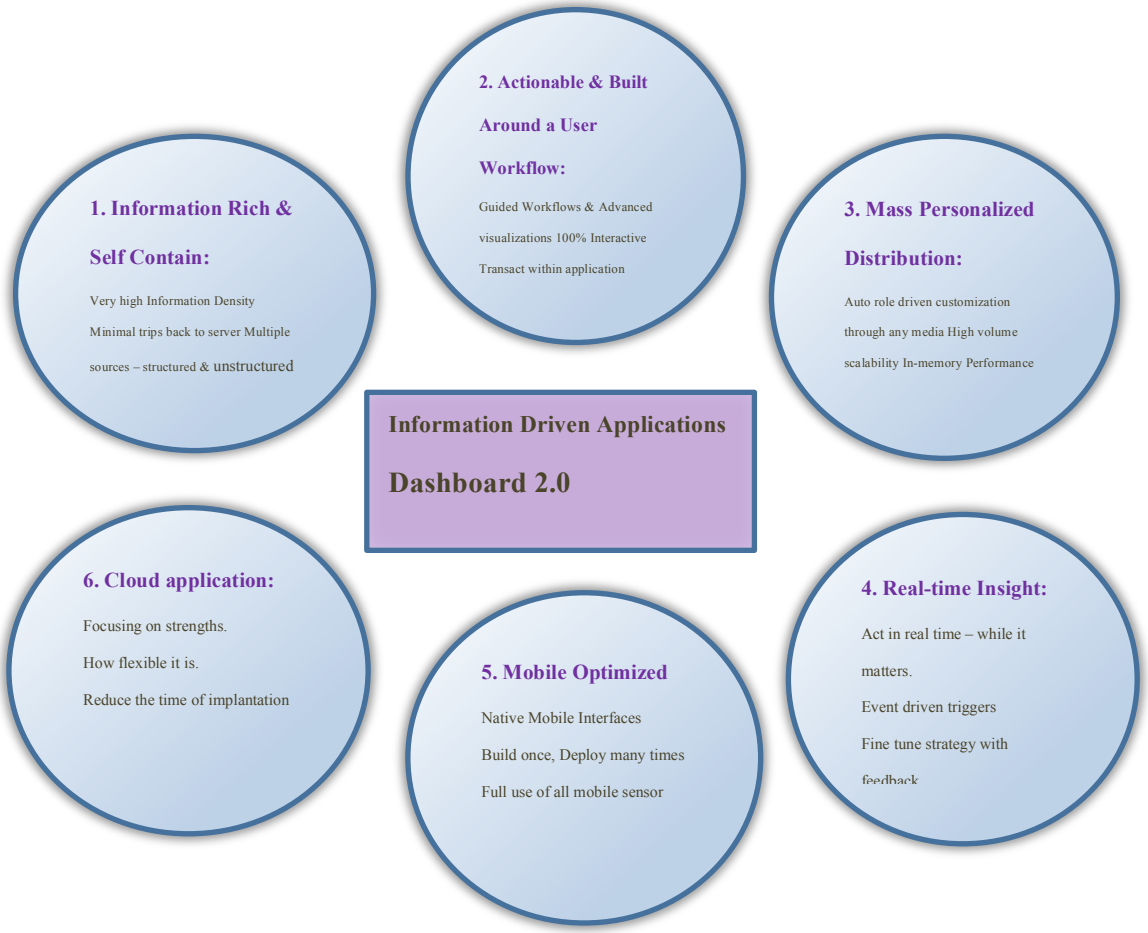


*Figure 16.* Dashboard 2.0

On the other hand, Figure 16 shows all the attributes of Dashboard 2.0 together. It shows that combining all these features will give us the advantages of all the attributes in one application. For instance, when we combine the cloud property with all the other features, the results will be more efficient. Because of the union of these features, the application will improve with new characteristics that were not in the application before. Dashboard is something that improves our technology and makes it easier to use. Figure 17 shows current usage of different dashboards.

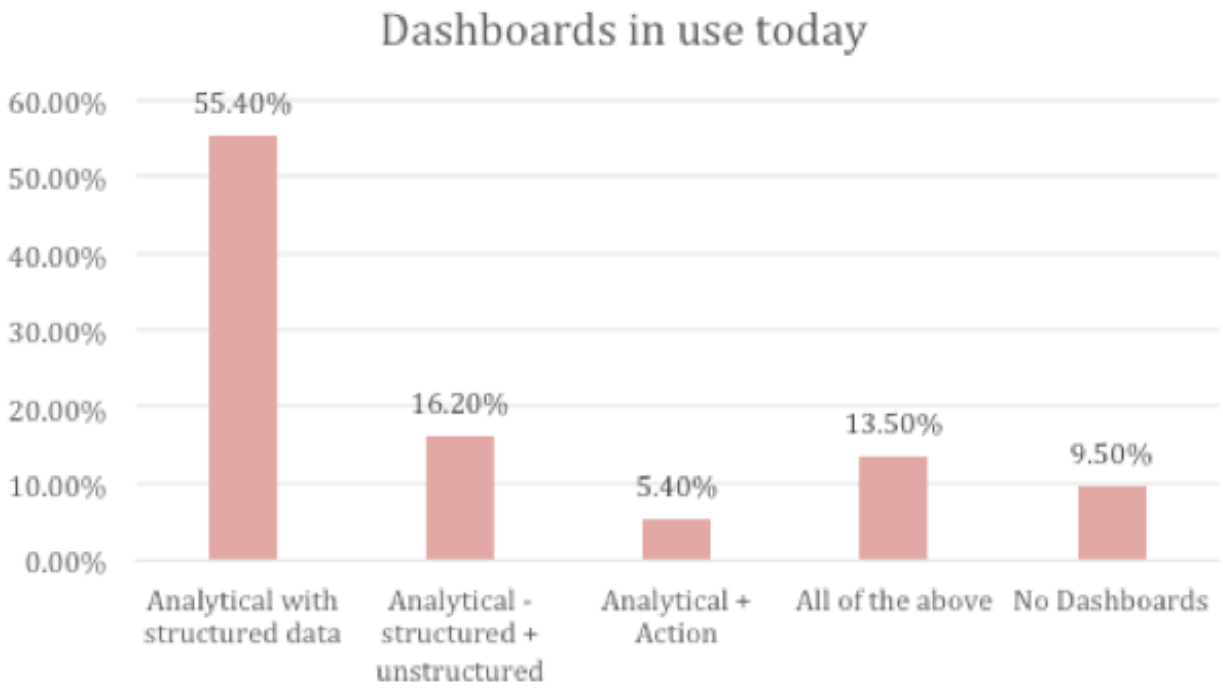


*Figure 17.* Poll of Dashboards in Use Today

In addition to Dashboards, there are more new technologies that have improved in business intelligence. One of these important systems in business intelligence is In-Memory Application.

### 5.7 High Performance In-Memory Applications

Performance management has always been the priority of an organization, and the focus was always on the hardware aspects of systems. However, this is the first time organizations are focusing on the performance of business intelligence systems. For the business intelligence system, the magic bullet of performance is the RAM. The systems built on an in-memory RAM platform are significantly faster than the traditional disk-based systems. The speed difference between in-memory RAM systems versus traditional disk-based systems are the same as if the RAM has a speed of an F-18 fighter jet with max speed of 1,190 mph and disk access speed is like a banana slug with a top speed of 0.007 mph [11]. Therefore, there is a way to get in-memory performance: in-memory combined with multiple parallels. This is the setup that will give a business intelligence system the performance of seconds to run a dashboard application (Figure 18).

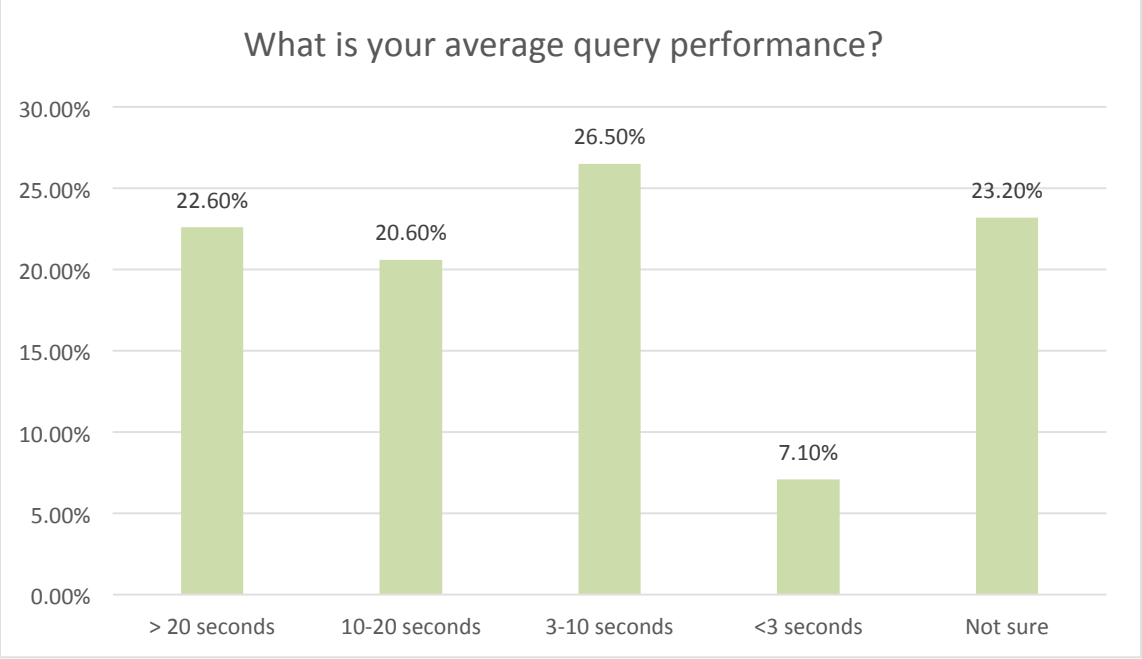


*Figure 18.* Poll on Query Performance

There are four main reasons why in-memory business intelligence is becoming progressively more critical:

1. User expectations
2. Mobile expectations tied to user expectations
3. Dashboard 2.0 concepts
4. Big Data expectations

The combination of these four reasons and the requirement of speed have driven every business intelligence system to in-memory performance.

While in-memory applications are among the most important systems in business intelligence, there is also something very important and required in business intelligence, which is commercial grade.

### 5.8 Commercial Grade Business Intelligence

Commercial grade business intelligence is similar to enterprise grade business intelligence, which brings the class of technology that an organization needs to distribute information widely to users throughout the enterprise. The commercial grade business intelligence concept has been around for almost ten years, with different names such as industrial strength, enterprise scale, etc. There is a new level of technology required when we want to commercialize business intelligence. Below is the stack from Gartner that predicts 30% of businesses will be monetizing data by 2016. Monetize means they will be selling their data to end users (Figure 19).


*Figure 19.* Monetizing Data [11]

When we look at monetizing our data assets, we should be considering the following four aspects of the technologies:

1. easier to build
2. easier to deploy
3. easiest to maintain
4. cloud and virtualization ready

These four aspects are considered easier to use for our monetizing. It is very important for us to use a kind of technology like this, because it has many different aspects that make the work easier.

# CHAPTER 6

# Future Work and Conclusions

## 6.1 Future Work

Business intelligence is concerned with many different things. Two of the concerns in business intelligence are:

- the need for improved decision-making
- increased intensity in the level of business competition, creating the need for efficiency

Successful integration of business intelligence as a core component in the day-to-day operations of the business has many essential benefits such as reduction in labor costs, timely decision-making, and reduced information bottlenecks. Business intelligence as it currently exists is a result of many transformations through the years. With each advancement in time, paradigm shifts have led to the formulation of new objectives of business intelligence.

The objectives of business intelligence should include monitoring the overall efficiency in the operations of the business. Efficiency levels in business operations have been diversified according to the ways in which the integration of business processes and computer technology is reflected. The shift of intentions has also modified the objectives of business intelligence towards achievement of sustainability in the operations of the business process.

## 6.2 Problems Business Intelligence is Facing

A number of open problems must be resolved to sanction the improvements and successful incorporation of business intelligence across various business settings. These

problems suggest a number of research directions that can be pursued to enable the application of business intelligence to improve overall efficiency to the many stakeholders involved.

One such direction would be to evaluate the main aim as to why this revolutionary idea was introduced in business. Changes from essentially focusing on reducing labor costs to measures aimed at reducing a firm's total organizational costs are a key component of business intelligence today. From the onset, business intelligence was developed to save on labor costs through reduction of staff required for generation of business reports in different entities. Currently, the objectives of business intelligence have been transformed to be incorporated in the modern view of business environments. The view should not focus exclusively on real-time data and decision-making, but also on matters pertaining to operational efficiency. According to the current intentions of business intelligence in the business, the previous models provided data that would last for only a short while in the business.

Another direction that can be pursued is the capability and importance of providing information to many users. Previously, the accessibility of information to different parties within an organization was managed from a central location. However, the situation has changed substantially. There is a need to ensure that there is a successful integration of relevant information provided to the different stakeholders within the organization. Changes in legislation have seen the need for the users of different business reports increase dramatically [9]. Thus, the production of business reports must incorporate the need for real-time reports. Trend analysis and the use of accounting ratios as a measure of evaluating business performance should be taken into careful consideration. The information should be readily available to be used in simple web platforms and hand-held devices. Since the quantity of stakeholders has changed, the overall

strategy should ensure that there is an adequate increase in the methods applied in the process of delivering information.

Organizations are looking for ways to achieve their goals. As mentioned above in this paper, organizations are having some difficulties that hinder their ability to achieve their goals. Focusing on the main problems that make business intelligence not work as expected is important to improvement. The tools that we have described make improvements every year.

By completing the idea of improving the tools and systems to make business intelligence better and more effective, we will have many stages of business intelligence improvements that will show us how to continue with the same idea. Technology innovation affects business intelligence by adding a new concept in each stage of life cycles. These improvements help us to understand the system and keep developers on the track of developing new concepts. That will make it easier for us in the future to correct deficiencies and provide what is going to make the system better.

### 6.3 Conclusions

As an organization moves along the evolutionary process, it expands its capability for delivering increased business value via information. Understanding how to evolve into an intelligent enterprise means the organization has to comprehend the procedure. Organizations need to recognize where they are and why, and then understand how to move to the next level. They need to agree on the level of achievable evolution, establish priorities for improvement, and then implement pragmatic action plans for improving their information maturity to align with organizational goals and objectives. Businesses have made a huge investment in technology in the past few decades. The spending has decreased, and businesses are looking to leverage their

technology investments. Information technology spending may have decreased in this economy, but overall spending on business intelligence systems has increased.

The emergence of Dashboard 2.0 business applications, in-memory business intelligence applications, and commercial grade business intelligence for data monetizing are three major trends for the future of business intelligence within the next three to five years.

Cloud computing is a very recent and important technology that is now used by many businesses. Since the Cloud is very important currently, we have included it to demonstrate the improvement in results. The idea of integrating the Cloud in Dashboard 2.0 applications is making Dashboard 2.0 different from what it was before, and improving the Dashboard 2.0 application to have new features that benefit all users of the application.

Finally, as we see, every year has different, improving systems of business intelligence. The tools we are updating here will be improved in future time periods, just as others have gone through them and improved them in every previous time period. Continuing that path is going to provide great progress in business intelligence.

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