# Making the Most of Big Data

Manager's Guide to Business Intelligence Success

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# Who is this text for?

Business Intelligence (BI) initiatives represent a challenging area within the Information Technology discipline. They require effective management skills and knowledge of systems development methodologies; effective alignment of business strategy and IT capabilities. To mitigate the risks associated with BI developments and ensure achievement of strategic business objectives a number of approaches to BI initiatives have been proposed and proven successful over the years. This text outlines the principles of Business Intelligence projects, basics of architecture and associated development methodologies which gained popularity and are effectively employed by organisations. Managers and decision makers in areas relevant to IT and those new to Big Data initiatives will find this text useful as an essential introduction to proven Business Intelligence practices. The text concludes with practical recommendations which should be considered before embarking on a business intelligence development.

**Scope**

The book will help managers identify critical factors that contribute to the success of business intelligence initiatives. The top five factors are top management support, alignment between business & business intelligence strategy, flexible technical framework, effective information & BI governance and change management.

Interviews with business intelligence experts and practitioners help gain understanding of contribution these factors have to the success of business intelligence initiatives.

This book endeavours to answer the following questions:

- What issues and problems faced by organisations during the BI Initiatives?
- Indentify and analyse the critical success factors of BI initiatives
- How can problems be reduced in implementing complex BI solutions for the organisations?

What must be considered, from the organizational as well as the technical perspective, to effectively integrate the technology and people in the organization who use it?

# 1 Introduction

In today's globalised economy, particularly under the pressure of economic challenges, the uncertainty that organisations face when making decisions has a significant impact on financial stability and business growth of organisations. Firms rely on its information processing capabilities to deal effectively with this uncertainty (Daft & Lengel, 1986). Increased global competition, the need for increasing profits and demanding customers, all require organisations to take better decisions as fast as possible (Vitt, Luckevich, & Misner, 2002). Hence the ability to effectively take advantage of the growing amount of information, continuously accumulated by firms, has become an extremely critical factor for the success of any organisation (Barlow & Burke, 1999). Preparing and acquiring relevant business information takes time, while the urging need of real-time information, which is ready for decision making, creates what is referred to as the **information gap**. Business analysts spend significant amounts of time gathering data, preparing reports and hardly enough time is devoted to analysis. Business analysts become human data warehouses due to the inadequate state of data in many organisations. The Data Warehousing Institute estimates that business analysts spend an average of two days every week gathering and formatting data instead of analysing it, costing organisations an average of $780,000 per year (Eckerson, 2009). Business Intelligence (BI) is implemented in order to bridge this information gap.

# 2 Business Intelligence: What is it about?

The Data Warehousing Institute[1], provider of education and training in the areas of data warehousing and BI industry defines Business Intelligence as: "*The processes, technologies, and tools needed to turn data into information, information into knowledge, and knowledge into plans that drive profitable business action*".

Business intelligence has been described as *"active, model-based, and prospective approach to discover and explain hidden decision-relevant aspects in large amount of business data to better inform business decision process*" (KMBI, 2005).

Defining Business Intelligence has not been a straightforward task, given the multifaceted nature of data processing techniques involved and managerial output expected. "*Business information and business analyses within the context of key business processes that lead to decisions and actions and that result in improved business performance*" (Williams & Williams, 2007). BI is "*both a process and a product. The process is composed of methods that organisations use to develop useful information, or intelligence, that can help organisations survive and thrive in the global economy. The product is information that will allow organisations to predict the behaviour of their competitors, suppliers, customers, technologies, acquisitions, markets, products and services and the general business environment*" with a degree of certainty (Vedder, et al., 1999). "*Business intelligence is neither a product nor a system; it is an architecture and a collection of integrated operational as well as decision-support applications and databases that provide the business community easy access to business data*" (Moss & Atre, 2003). *"Business Intelligence environment is a quality information in well-designed data stores, coupled with business-friendly software tools that provide knowledge workers timely access, effective analysis and intuitive presentation of the right information, enabling them to take the right actions or make the right decisions*" (Popovic, et al., 2012).

The aim of business intelligence solution is to collect data from heterogeneous sources, maintain, and organise knowledge. Analytical tools present this information to users in order to support decision making process within the organisation. The objective is to improve the quality and timeliness of inputs to the decision process.

BI systems have the potential to maximize the use of information by improving company's capacity to structure a large volume of information and make it accessible, thereby creating competitive advantage, what Davenport calls "competing on analytics" (Davenport, 2005). Business intelligence refers to computer based techniques used in identifying, digging-out, and analysing business data such as sales revenue by product, customer and or by its costs and incomes.

Business Intelligence encompasses data warehousing, business analytic tools and content/knowledge management. BI systems comprise of specialised tools for data analysis, query, and reporting such as Online Analytical processing system (OLAP) and dashboards that support organisational decision making which in turn enhances the performance of a range of business processes. General functions of BI technologies are reporting, online analytical processing (OLAP), analytics, business performance management, benchmarking, text mining, data mining and predictive analysis:

**Online Analytical Processing (OLAP)** includes software enabling multi dimensional views of enterprise information which is consolidated and processed from raw data with a possibility of current and historical analysis.

**Analytics** helps make predictions and forecasting of trends and relies heavily on statistical and quantitative analysis to enable decision making concerned with future predictions of business performance.

**Business Performance Management** tools concerned with setting appropriate metrics and monitoring organisational performance against these identifiers.

**Benchmarking tools** provide organisational and performance metrics which help compare enterprise performance with benchmark data, to industry average, for example.

**Text Mining** software helps analyse non structured data, such as written material in natural language, in order to draw conclusions for decision making.

**Data Mining** involves large scale data analysis based such techniques as cluster analysis, anomaly and dependency discovery, in order to establish previously unknown patterns in business performance or making predictions of future trends.

**Predictive Analysis** deals with data analysis, turn it into actionable insights and help anticipate business change with effective forecasting.

Specialised IT infrastructure such as data warehouses, data marts, and extract transform & load (ETL) tools are necessary for BI systems deployment and their effective use. Business intelligence systems are widely adopted in organisations to provide enhanced analytical capabilities on the data stored in the Enterprise Resource Planning (ERP) and other systems. ERP systems are commercial software packages with seamless integration of all the information flowing through an organisation – Financial and accounting information, human resource information, supply chain information and customer information (Davenport, 1998). ERP systems provide a single vision of data throughout the enterprise and focus on management of financial, product, human capital, procurement and other transactional data. BI initiatives in conjunction with ERP systems increase dramatically the value derived from enterprise data.

While many organisations have an information strategy in operation, effective business intelligence strategy is only as good as the process of accumulating and processing of corporate information. Intelligence can be categorised in a hierarchy which is useful in order to understand its formation and application. The traditional intelligence hierarchy is shown in figure 1, which comprises of data, information, knowledge, expertise and, ultimately, wisdom levels of intelligence.

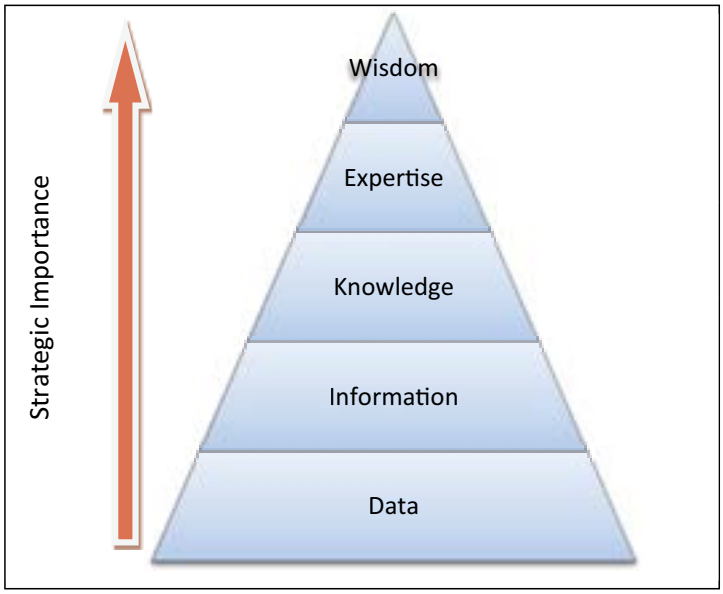


**Figure 1:** Traditional Intelligence Hierarchy (Liebowitz, 2006)

Data is associated with discrete elements – raw facts and figures; once the data is patterned in some form and is contextualised, it becomes information. Information combined with insights and experience becomes knowledge. Knowledge in a specialised area becomes expertise. Expertise morphs into the ultimate state of wisdom after many years of experience and lessons learned (Liebowitz, 2006). For small businesses, processing data is a manageable task. However, for organisations that collect and process data from millions of customer interactions per day, identifying trends in customer behaviour, accurately forecasting sales targets appear more challenging.

Use of data depends on the contexts of each use as it pertains to the exploitation of information. At a high level it can be categorised into operational data use and strategic data use. Both are valuable for any business, without operational use the business could not survive but it is up to the information consumer to derive the value from a strategic perspective. Some of the strategic uses of information through BI applications include:

**Customer Analytics,** which aims to maximise the value of each customer and enhance customer's experience;

**Human Capital Productivity Analytics,** provides insight into how to streamline and optimise human resources within the organisation;

**Business Productivity Analytics**, refers to the process of differentiating between forecasted and actual figures for inputs/outputs conversion ratio of the enterprise;

**Sales Channel Analytics,** aims to optimise effectiveness of various sales channels, provides valuable insight into the metrics of sales and conversion rates;

**Supply Chain Analytics** offers the ability to sense and respond to business changes in order to optimise an organisation's supply chain planning and execution capabilities, alleviating the limitations of the historical supply chain models and algorithms.

**Behaviour Analytics** helps predict trends and identify patterns in specific kinds of behaviours.

Organisations accumulate, process and store data continuously and rely on their information processing capabilities for staying ahead of competitors. According to the PricewaterhouseCoopers Global Data Management Survey of 2001, the companies that manage their data as strategic resource and invest in its quality are far ahead of their competitors in profitability and superior reputation. A proper Business Intelligence system implemented for an organisation could lead to benefits such as increased profitability, decreased cost, improved customer relationship management and decreased risk (Loshin, 2003). Within the context of business processes, BI enables business analysis using business information that lead to decisions and actions and that result in improved business performance. BI investments are wasted unless they are connected to specific business goals (Williams & Williams, 2007).

As competitive value of the BI systems and analytics solutions are being recognised in the industry, many organisations are initiating BI to improve their competitiveness.

# 3 Importance of BI Initiatives

An increasing number of organisations are making BI and analytics functionality more broadly available to all decision makers inside and outside the organisation. BI has great promise and even a limited investment could yield compelling returns. During the next 10 years the explosion of information is the biggest opportunity for BI (Gartner, 2012). Research by Loudhouse in 2012 shows that management reporting is an area that is lacking behind though their functional areas are tightly integrated using ERP or other systems. While systems may have been integrated in their construction it is clear that the full benefits of the integration are not being felt across most business. 11% of respondents reported that they had real time information and analytics access across the business, however 64% reported their reporting is entirely or mostly manual through spreadsheets. In spreadsheet based reporting the information cannot move freely across a business, it is trapped within a specific functions or teams (Loudhouse, 2012). These two studies indicate that BI has vast opportunities for growth, organisations have realised high value and benefits that can be achieved from BI. However, many BI implementations have been delayed or scrapped altogether as the actual implementations fall short of their expectations due to various factors.

Gartner's research says 70% to 80% of corporate business intelligence projects fail due to a poor communication between IT and business, the failure to ask right questions or think about the real needs of the business (Goodwin, 2010). The success of BI implementation is questionable; about 60 to 70% of BI applications fail due to the technology, organisation culture and infrastructure issues (Lupu et al., 2007). Given the failure rate of the BI projects, the overall purpose of this book is to provide an overview and assess the critical success factors for the Business Intelligence initiatives in the industry.

# 4 Evolution of Business Intelligence

The area of Business Intelligence has made significant advances over the last 30 years, since the emergence of the first versions of analytical software packages appeared on the market and the concept of Decision Support Systems (DSS) had taken shape. Decision Support Systems are responsible for the delivery of business information and business analysis to support organisations (Williams & Williams, 2007). They provide capabilities of exception reporting, stop-light reporting, standard repository, data analysis and rule based analysis. DSSs markedly vary in price and sophistication and are application specific; hence they have not been evaluated systematically (Petrini & Pozzebon, 2009).

The 1980s saw the release office spreadsheet software, which is a popular analytical tool until today. In the early 1990s the Executive Information Systems (EIS) came into market and grew quickly in popularity. They promised to provide easy access to internal and external information for decision making needs of top management, placing "key information on the desktops of executives" (Rasmussen, Goldy, & Solli, 2002). User friendly interfaces and powerful analytical abilities of executive information systems made the information easily accessible and available. EIS systems were expensive and inflexible (Williams & Williams, 2007).

Both DSS (Carlsson & Turban, 2002) and EIS (Turban & Walls, 1995) systems captured the interests of information systems researchers, but in practice their popularity continually decreased. The need for manual work to convert and load data from data sources into EIS systems and the narrow scope of DSS systems are the reasons for their downfall in popularity.

In the 1990s the emergence of Data Warehousing technologies (DW) (Kimball, 2000) enabled harnessing vast amounts of data generated by transactional IT systems. Transaction intensive businesses such as financial services, insurance and telecommunications were the early adopters to DW to make sense of data about millions of customer transactions. Along with the data warehouse, ETL tools (extraction, transformation and loading) and powerful end-user analytical software with OLAP (online analytical processing) (Body et al., 2002) capabilities paved the way for the emergence of business intelligence systems. DW is a key enabler of business intelligence, it becomes feasible and economical as a result of rapidly declining data storage and processing costs, special-purpose data integration tools, innovations in the way that data can be organised in databases and innovations in the way the data can be converted to information and presented to information consumers within a business (Williams & Williams, 2007). Figure 2 shows the transformation of information systems over the last three decades(Olszak & Ziemba, 2004).

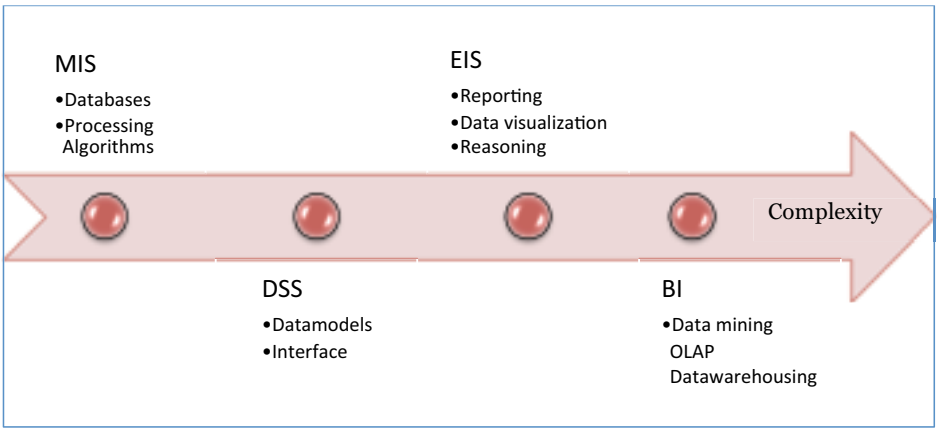


**Figure 2:** Development of Management Information Systems

The impact of the internet further improved the usability and availability of information from business intelligence tools. Current analytical products are web based, via internet and intranet users can investigate and analyse data from home, while travelling or from any other location (Carlsson & Turban, 2002). Today, terms DSS and EIS are no longer used in the industry, and BI is the accepted term for analytical and strategic information systems including number of applications classified into analysis (data mining and OLAP), monitoring (dashboards, scorecards and alert systems) and reporting.

# 5 Managerial and Technical Perspectives on Business Intelligence

Two perspectives are known in the BI, namely technical or managerial approaches. BI from the managerial perspective is a process by which data gathered from inside and outside the company is integrated in order to generate information relevant to the decision making process (Kalakota & Robinson, 2001). BI's role here is to create informational environment in which operational data gathered from transactional systems and external sources can be analysed to reveal "strategic" business dimensions (Petrini & Pozzebon, 2009). BI from technical approach perspective is a set of tools that gather data from inside and outside an organisation and integrate it to generate relevant information for the decision making process (Watson, Goodhue, & Wixon, 2002). From technical perspective, the focus is on technologies that enable recording, manipulation, analysis and recovery of information.

Though there are differences between these perspectives on BI, they share the basis – gathering, analysis and distribution of information – to support strategic decision making process such as decisions related to company's vision, mission, goals and objectives. Technological innovations in the area of storing and retrieving data are helping business intelligence being adopted in more originations and it is set to grow in the coming decades. Although the volume of information available in data warehouses is increasing and functionalities are gaining sophistication, this does not automatically mean that firms and individuals are able to derive value from them (Burn & Loch, 2001).

Current BI technologies integrate a large set of diversified resources such as packages, tools and platforms. Various BI products are being released to cater to different needs, such as search for and use of information, report extractors, dashboard applications and sophisticated mining applications. Advances in knowledge of the technical view of BI are greater than on the managerial side (Petrini & Pozzebon, 2009).

# 6 Development Process in BI Initiatives

Over the years multiple software development methodologies have emerged in order to mitigate the notoriously high failure rate amongst software projects. Software development approaches range from documentation-heavy Software Development Lifecycle (SDLC) proposed by ISACA to a spectrum of Agile methods favouring communication, flexibility of requirements and user involvement in software projects. Large software vendors, e.g. Microsoft, SAP, have developed their own project management frameworks. For ERP implementation Microsoft, for example, clearly defines each role in the development process in its Microsoft Dynamics Sure Step methodology. Activities performed throughout the initiative are assigned to specific roles. An array of document templates is also used can be used at different phases of an implementation project. In the Sure Step methodology implementation goes through the following phases: diagnostics, analysis, design, development, deployment and operation. In most software projects these phases have some commonality. Typically, BI initiatives go through the several stages as shown in the figure 3; the process consists of analysis, designing, development, deployment, evolution (Gangadharan & Swami, 2004).

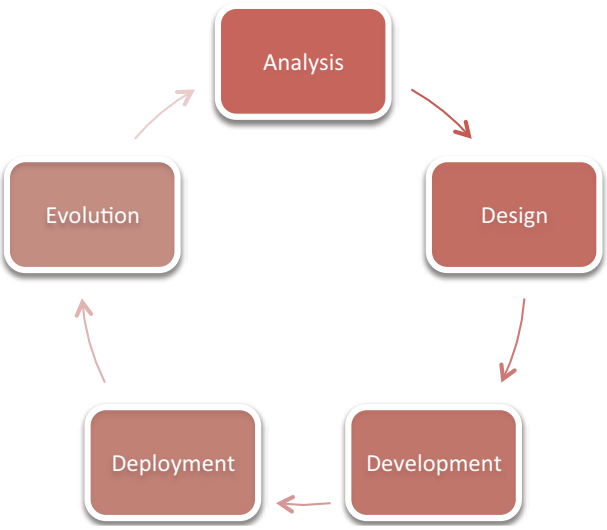


**Figure 3:** BI Methodology

### Analysis

To realise a BI initiative, first the organisation has to determine a general vision of the initiative for organisation. The system envisaged has to relate to company's business objectives. This phase involves specifying information needs of organisation, simultaneously paying attention to key IT decision makers and specialists. Ranking of informational needs carried out based on prioritisation allows for highlighting while realising business strategies (Chaudhary, 2004). Analysis phase produces a high level design of various components of the BI initiative and sources of relevant information (Gangadharan & Swami, 2004).

### Design

Appropriate selection of BI technologies is a key step in this phase, which is a difficult task due to various internal and external parameters. Companies offer a wide range of BI tools and products beginning from simple reporting technologies to sophisticated BI platforms. When choosing the BI tool it is necessary to consider functionality, complexity of the BI solution and its compatibility with existing systems. Also it is necessary to remember that organisation's information requirement will evolve, so the BI tools selection should meet the future expectations. Some organisations follow a prototyping methodology to help the business users to visualise the outcome of a BI initiative.

### Development

In the development phase it is necessary to identify the source of data it may be internal sources and external sources. Analyse the reliability of the sources and a form of transformation that the sources have to undergo so that they could be subject to further analyses. Realisation of this phase calls for significant input provided by decision makers, operational workers, IT departments, departments of knowledge management and strategic customers (Olszak & Ziemba, 2007). Also, depending on the data cleansing and data transformation requirements, an ETL (Extraction, Transformation & Load) tool may be required at this stage.

**Deployment**

During this phase the BI solution is released to end-users once the system is tested and validated for accuracy of information. End-user training and support is critical to the success of any BI initiative, this training should be interactive and any adjustments made should meet the user needs. Also predefined reports are developed and ground work is laid for any future advanced analytics.

**Evolution**

Exploration and discovery of new informational needs is critical for the whole cycle of building any BI system (Olszak & Ziemba, 2007). Implemented BI environment provides new insights on the role of information and competencies in an organisation and on business relations and interdependencies. It is normal that new informational needs arise during this phase, it is required having procedures to analyse and realise the new informational needs. BI process is of iterative nature, and requires carrying out more and more analyses of informational needs, re-evaluating of already existing solutions and their modifications, optimisations and adjustment (Olszak & Ziemba, 2007).

The iterative nature of the process is shown through interconnections of phases in a BI development. Early prototyping and continuous user acceptance tests ensure that the delivered BI solution meets user requirements and business objectives.

# 7 Business Intelligence Architecture

A BI solution comprises different components and technologies as shown in figure 4. depending on the benefits expected from a BI solution. Information delivery can be through the web or spreadsheet based. According to organisation's requirements tools and technologies are selected for the BI initiatives. These components form the basis of any business intelligence architecture

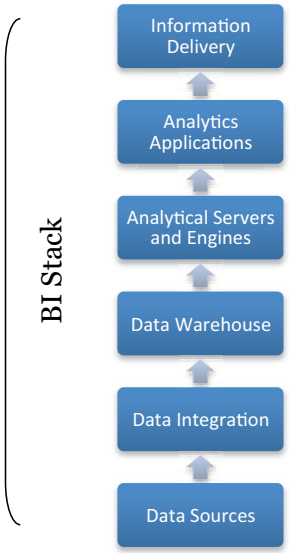


**Figure 4:** Components of BI solution and Information Flow.

Business intelligence data architecture is business rather than technically oriented. While technical data architecture focuses on hardware, middleware and Database management systems (DBMS), BI data architecture focuses on standards, metadata, business rules and policies (Moss & Atre, 2003). Key infrastructural foundation for enterprise level BI systems is the data warehouse. Data warehouse is a subject oriented, integrated, time-variant and non-volatile collection of data that differ from online transactional processing (OLTP) databases (Inmon, 2005). The hub of BI environment is the data warehouse, which is centralised repository of data that has been compiled from a number of disparate data sources and is in turn used to power analytical processing from which business value is derived (Loshin, 2003).

Metadata is a catalogue of intellectual capital that surrounds the creation, management, and use of a collection of information (Loshin, 2003). In simple terms it is defined as "data about data" and it is a major component of any BI initiative.

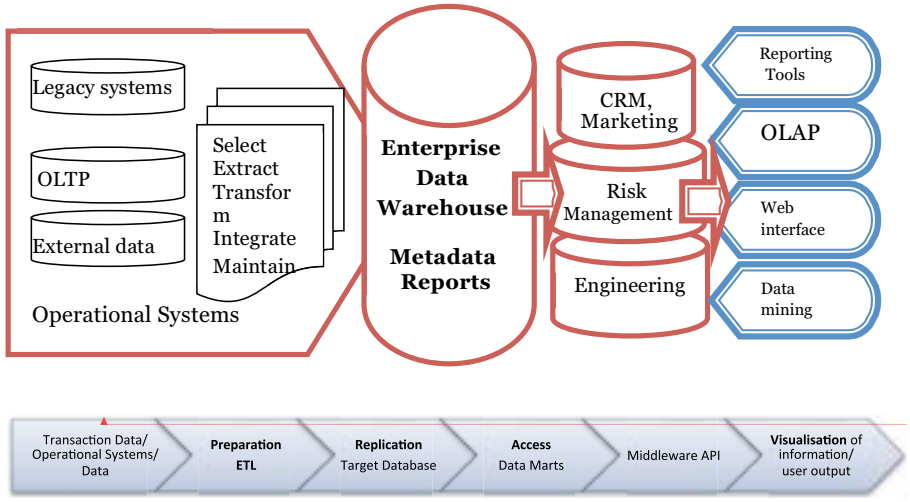


**Figure 5:** BI Architecture

ETL (Extract, Transform, and Load) is the sequence of applications that extract data sets from various sources, bring them to a staging area, apply a set of processes to prepare the data for migration and load them to data warehouse. Normal activities that are carried out during ETL stage are shown in figure 6.

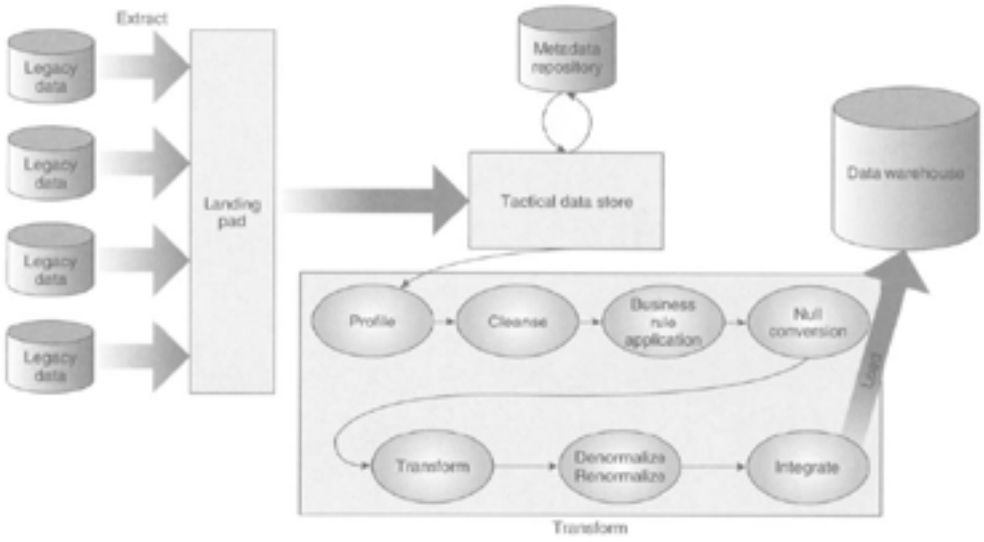


**Figure 6:** ETL Process

Data Marts are subject-oriented data repository and its structure is similar to the data warehouse. It holds data related to specific department or function or group within the organisation to support decision making and BI needs. As data marts are centred on the specific goals and decision support needs of a specific group or department within the organisation, the volume of data is much smaller but the concentration is focused on the department's or group's function (Loshin, 2003).

There are various front end BI products are being released to cater to different needs such as – search for and use of information, report extractors, dashboard applications and sophisticated mining applications.

A complex data structure must be maintained in order to provide an integrated view of the organisation's data and so that users can query across departmental boundaries for dynamic retrieval of relevant decision-support information (Yeoh & Koronios, 2009). BI system architecture is highly complex owing to multiple datasources from different back-end systems and a vast volume of data to be processed.

**Maturity Model**

Organisations face complex challenges in how to use business intelligence effectively. Business intelligence maturity model is important in the process of assessing how well an organisation harnesses BI output. Maturity model describes, explains & evaluates growth life cycles. It aids the organisation to move forward in the right direction to better align information technology with its business efforts. Maturity models are based on the concept that things change overtime and majority of these changes can be predicted and regulated (Rajteric, 2010). Leveraging business intelligence investments and moving up to higher maturity levels can be difficult for the organisations.

Maturity models for business intelligence help organisations understand where they are and how they can improve. They offer a structured way to find answers to these questions (Rajteric, 2010):

- Where in the organisation is core reporting and business analysis done?
- Who is using business reports, analysis and success indicators?
- What drives business intelligence in the organisation?
- What business value does business intelligence bring?

The maturity model for business intelligence developed by TDWI (The Data warehousing Institute) is shown below and the maturity stages are described (Eckerson, 2005).

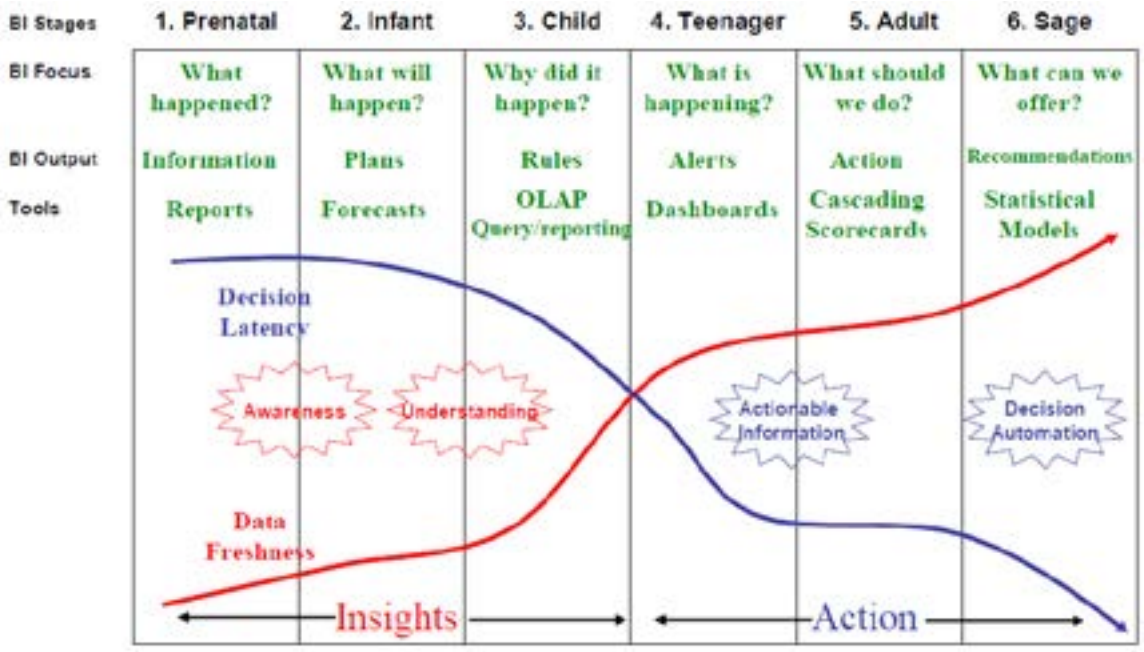


**Figure 7:** Stages of BI Development(Eckerson, 2005).

As a first step business intelligence helps an organisation to focus on what happened in the past with the help of reporting tools. Next stage in the BI is to focus on what will happen with the help of forecasting tools, further step focus on the why it happen with the help of online analytical processing (OLAP) query and reporting. These first three stages are about gaining insights into business information.

Stages 4–6 is are concerned with how actionable information can help keep up competitive ability of the organisation. In the 4th stage the focus is on what is happening currently with the help of dash boarding tools, the 5th stage information helps the organisation to visualise what should done from a strategy or operation perspective.

Stage 6 is the sophisticated BI systems that use statistical models to recommend the course of action.

# 8 Critical Success Factors of BI Initiatives

Over the past few years many organisations initiated Business Intelligence projects but the results of these initiatives are debatable. Despite the wide acceptance of BI systems the amount of academic research related to BI is very limited. This especially relates to the evaluation of critical success factors for BI initiatives. In the Information Systems literature, few articles deal with Business Intelligence or Competitive Intelligence (Negash, 2004). Implementation of BI systems is a complex undertaking requiring considerable resources and it is argued that previous research has fallen short of providing an in-depth analysis of BI success (Yeoh & Koronios, 2009). Extant literature on business intelligence aspects such as mistakes, problems and outcomes, critical success factors and risk management is relatively lean. The success factors covered in literature include top management support, BI & organisation strategic alignment, Information & BI governance, change management, balanced team, infrastructure and organisation culture and the like.

Despite the benefits that can be achieved from successful BI initiatives, there is a significant proportion of failures in BI projects. Companies continue to invest more and more in business intelligence projects but success is significantly lagging behind business goals and expectations (Forrester, 2011). A of study of 7400 IT projects show that 34% are late or over budget, 31% are abandoned, scaled or modified and only 24% are completed on time and in budget (Aloini, Dulmin, & Mininno, 2007). 17% of the project goes so bad that they can threaten the existence of the company (Bloch, Blumberg, & Laartz, 2012). BI, as a category, suffers a failure rate between 70–80% according to Gartner's research (Goodwin, 2010). Continental Airlines have seen investments in BI generate increases in revenue and produce cost savings equivalent to a 1000% return on investment (Anderson-Lehman, Watson, Wixom, & Hoffer, 2004), on the other side many organisations have spent more on BI than their competitors with smaller ROI (Gessner & Volonino, 2005).

An understanding of the critical success factors enables BI stakeholders to optimise their scarce resources and focus their efforts on those significant factors that are most likely to lead to a successful system implementation (Yeoh & Koronios, 2009). Despite the complexity in implementing BI systems there has been little empirical research about critical success factors (CSFs) impacting the BI initiatives (Yeoh & Koronios, 2009).

**Success Measures of BI**

Business Intelligence initiatives typically involve a number of stakeholders and the meaning perception of BI success varies from one stakeholder group to another. For instance, project managers and implementation consultants define success in terms of completing the project on time and within budget, whereas people whose job is to adopt the system and use it to achieve business objectives tend to focus on how smooth was the transition to stable operation, whether business improvements as were achieved as expected and whether advances in the decision support capabilities (Markus & Tanis, 2000). Here when considering critical success factors, we are looking at the entire life cycle of a BI initiative and not limiting to the implementation issues arising during development stage.

Different types of information systems require specific success models and measures (Petter, Delone, & Mclean, 2008). Successful application of Business Intelligence in an organisation uses correct, valid, integrated and timely data, as well as the right tools which transform data into decision-making information (Zeng, Xu, Shi, Wang, & Wu, 2006). Organisations must tackle two important issues in BI architecture: 'the integration of large amount of data from heterogeneous systems' and 'provision of analytical capabilities such as querying, OLAP, reporting and data mining' (see fig. 5). Based on considerations of BI architecture and objectives Popovic et al (2012) proposes the following measures to determine success of business intelligence systems:

- **Data Integration** – integration of data from heterogeneous systems
- **Analytical capabilities** – business users have the tools and knowledge to leverage the data into information
- **Information content quality** – consistency and accuracy of information available in the BI system
- **Information access quality** – the provision of information corresponds to business user needs
- **Use of information in business processes** – exposes the problematic aspects of current business processes and makes stakeholders aware of them
- **Analytical decision making culture** – the decision making process is well established and known to its stakeholders

Wide selection of academic literature include one or more of the above measures to define success of BI initiatives. Additionally to these measures it is important to take into account project management perspective and consider whether a BI project is delivered on-time and on-budget.

**Review of BI Critical Success Factors**

Critical success factors are necessary for evaluating success of BI implementation, the absence of the CSFs would lead to failures of system implementation (Yeoh & Koronios, 2009). Within the Information Systems field, researchers have considered BI from different dimensions, including application of artificial intelligence, benefits of BI, decisions, implementation and strategy (Jourdan, Rainer, & Marshall, 2008). A number of sources report studying BI success and how to make BI initiatives a success. The factors are related to key dimensions: Process performance, Infrastructure performance, organisation factors and technology (Yeoh & Koronios, 2009). Despite significant technical difficulties posed by BI, researchers agree that organisational factors are crucial for a BI initiative to be successful (JafarTarokha & Teymournejada, 2012).

BI systems utilise technical as well as non-technical infrastructure of an organisation. Shared corporate philosophy and goals at all levels of organisation is one of the contributing factors (Chaudhary, 2004). BI systems are often associated with challenges caused by back-end systems and processes being difficult to adapt to BI applications, poor data quality derived from sources and maintenance process that tend to be vague and ill-defined (Fuchs, 2006).

Due to the time-consuming nature of the information needs identification process, as a result of less structured processes in knowledge-intensive activities, BI systems face major challenges in assuring quality of the information content. Moreover, use of BI systems in many circumstances is mandatory. Therefore experts suggest that organisations should adopt a strong analytical culture on BI systems acceptance, use and, consequently, its success (Popovic, Hackney, Coelho, & Jaklic, 2012). Williams & Williams (2007) suggest that many BI projects don't know how business information, business analysis, and structured business decisions could be incorporated into core business processes that impact company's profit and performance. Frequently, the changes required to capture business value of BI are not considered systematically, which leads to unexpected problems.

The following table summarises top 10 critical success factors of BI identified in extant literature.

| No. | Critical Success Factors | Key Sources |
|---|---|---|
| 1 | *Alignment between Business Strategy & BI strategy* | (Watson & Wixom, 2007), (Yeoh & Koronios, 2009), (Williams & Williams, 2007), (Chaudhary, 2004) (JafarTarokha & Teymournejada, 2012), (Anderson-Lehman, Watson, Wixom, & Hoffer, 2004) |
| 2 | *Top Management Support* | (Watson & Wixom, 2007), (Yeoh & Koronios, 2009), (Williams & Williams, 2007), (JafarTarokha & Teymournejada, 2012) |
| 3 | *Effective Information & BI Governance* | (Watson & Wixom, 2007), (Forrester, 2011), (JafarTarokha & Teymournejada, 2012), (Anderson-Lehman, Watson, Wixom, & Hoffer, 2004) |
| 4 | *Flexible technical framework* | (Watson & Wixom, 2007), (Yeoh & Koronios, 2009), (Chaudhary, 2004), (Anderson-Lehman, Watson, Wixom, & Hoffer, 2004) |
| 5 | *Change Management* | (Yeoh & Koronios, 2009), (Williams & Williams, 2007), (Chaudhary, 2004) |
| 6 | Organisation's Analytics Culture | (Watson & Wixom, 2007), (Anderson-Lehman, Watson, Wixom, & Hoffer, 2004) |
| 7 | Balanced Team composition | (Yeoh & Koronios, 2009), (JafarTarokha & Teymournejada, 2012) |
| 8 | Adequate Resources and funding for support efforts | (Anderson-Lehman, Watson, Wixom, & Hoffer, 2004), (Williams & Williams, 2007) |
| 9 | Business Driven and Iterative development approach | (Yeoh & Koronios, 2009) |
| 10 | Availability of necessary tools to users, Training and Support | (Watson & Wixom, 2007) |

**Table 1:** CSFs of BI Initiatives

A comprehensive review of the critical success factors in BI initiatives was conducted by Yeoh and Koronios (2009), which classified success factors into organisational, technology and process perspectives. In some ways BI projects carry similarities to ERP initiatives, therefore considering critical success factors of ERP software integration ( see table 2) is essential as some of these factors would be applicable to BI initiatives as well in addition to the BI success factors.

| No. | Critical Success Factors | Key Sources |
|---|---|---|
| 1 | Top Management Support | (Holland & Light, 1999), (Nah, Lau, & Kuang, 2001), (Somers & Nelson, 2001), (Sumner, 1999) |
| 2 | Business Vision (Business Strategy Alignment to ERP strategy) | (Holland & Light, 1999), (Nah, Lau, & Kuang, 2001), (Somers & Nelson, 2001) |
| 3 | Change Management | (Holland & Light, 1999), (Nah, Lau, & Kuang, 2001), (Somers & Nelson, 2001) |
| 4 | Project Champion | (Nah, Lau, & Kuang, 2001), (Somers & Nelson, 2001), (Sumner, 1999) |
| 5 | Project Management | (Nah, Lau, & Kuang, 2001), (Somers & Nelson, 2001), (Markus & Tanis, 2000) |
| 6 | Communication | (Holland & Light, 1999), (Nah, Lau, & Kuang, 2001), (Somers & Nelson, 2001), (Sumner, 1999) |
| 7 | Balanced Team and Competence | (Holland & Light, 1999), (Nah, Lau, & Kuang, 2001), (Somers & Nelson, 2001) |
| 8 | User Training & Education | (Somers & Nelson, 2001), (Sumner, 1999) |
| 9 | Culture | (Nah, Lau, & Kuang, 2001) |
| 10 | Business Process reengineering | (Somers & Nelson, 2001) |
| 11 | Management Structure | (Somers & Nelson, 2001), (Sumner, 1999) |
| 12 | Vendor & Customer relationships | (Somers & Nelson, 2001) |
| 13 | Minimal customization | (Somers & Nelson, 2001) |
| 14 | User Participation | (Gable, Rosemann, & Sedera, 2001) |
| 15 | External expertise | (Somers & Nelson, 2001), (Sumner, 1999) |

**Table 2:** CSFs of ERP Implementation

Comparing CSFs identified in tables 1 and 2, many of the BI CSFs also appear in the ERP CSFs list as well. However the prioritisation of the factors is different, which can attributed to the analytical nature of BI systems compared to transactional nature of ERP systems. Even though the order is different, the top 5 in both the lists contain three of the same factors: **"Top management support", "Alignment between business strategy and System"** and **"Change management"** which shows importance and priority of these factors in both BI and ERP.

### Determination of Top 5 Critical Success Factors

It may be an impossible task for an organisation to concentrate on ALL success factors described in extant literature. Due to limited resources, cost/benefit considerations, etc. it is important to prioritise CSF for BI projects. It makes more sense for organisations to direct their restricted resources towards the success factors that are highly important for the success of BI initiatives. Therefore there is a need to rank critical success factors based on their importance in order to help organisations decide what critical factors they must act upon.

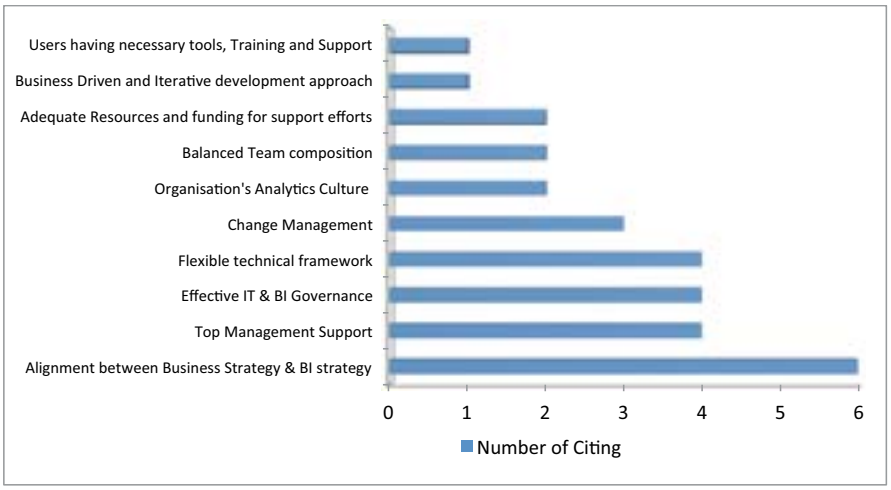


**Figure 8:** BI Critical Success Factors – Citing Frequency in Literature

The top most cited critical success factors, are **"Alignment between business strategy and BI Strategy", "Top management support", "Effective IT & BI Governance", "Flexible technical framework" and "Change management"**.

***Alignment between Business Strategy and BI Strategy***

When there is alignment between business strategy and BI strategy, BI can be a powerful enabler of business strategy including new business models that bring about organisational transformation (Watson & Wixom, 2007). A long term vision, primarily in strategic and organisational terms, is needed to establish a solid business case. The business case must be aligned to company's strategic vision and meet business objectives and needs. Yeoh & Koronios (2009) argue that the overriding reason for failures is not in the technical difficulties, because there are proven solutions. Rather, the most general cause for failure is that the BI initiative does not align with the business vision and therefore fails to meet the core objectives of the business.

A common cause of failure for BI decision support initiatives is that the objectives of these BI initiatives do not align with the strategic business goals of the organisation (JafarTarokha & Teymournejada, 2012).

According to Williams & Williams (2007) one of the most common and critical mistakes is the lack of explicit alignment between BI strategy and the business strategy. BI investments made without a coherent guiding business strategy results in organisations inability to fully leverage BI as a profit-improvement tool. To optimise any BI capabilities business must have a clear understanding of the opportunities that exist to deliver and use information in support of the business strategy.

***Top Management Support***

For BI to deliver benefits at the enterprise basis, it must be driven from the top. Senior management should have a vision for BI, ensure that necessary resources are allocated, and insist on the use of information based decision making (Watson & Wixom, 2007). Committed management support and sponsorship has been widely acknowledged as an important factor for BI system implementation. Consistent support from the top management helps to secure the necessary operating resources such as funding, human resources, and fulfil other resource requirements (Yeoh & Koronios, 2009).

BI system is implemented through an iterative process of development in line with dynamic business requirements (Moss & Atre, 2003), therefore BI initiatives require consistent funding and resource allocation directly from the top management to overcome continual organisational issues. Having appointed a BI initiative champion or sponsor is extremely important. BI sponsor should be from the business function and should have a strong stake in the success of the BI initiative. The sponsor should have critical in the delivery of the BI capabilities for a specific business purpose (Yeoh & Koronios, 2009).

Any BI project must receive approval from top management (Nah, Lau, & Kuang, 2001) and align with strategic business goals (Sumner, 1999). Linking management incentives to project success KPIs improves staff motivation. Senior management must be committed to involvement and have the willingness to allocate valuable resources to the implementation effort (Holland & Light, 1999). This involves providing necessary personnel for the implementation and allocating appropriate amount of time to get the job done (Roberts & Barrar, 1992). These responsibilities do not rest solely with the top management. Middle management and other staff also have an important role to play (Somers & Nelson, 2001). However, if the senior management completely delegates their responsibilities to technical experts, the chances of project failure increase significantly (Ewushi-Mensah & Przanyski, 1991).

According to Martin (1998), there are two types of top management support roles associated with systems implementations projects: project sponsor and project champion roles. The role of a project sponsor is to support the budget and to ensure key business representatives take active role in the project. The project champion may or may not be a formal member of the project team, but can play a key role in change management efforts (Nah, Lau, & Kuang, 2001).

**Effective Information & BI Governance**

People, committees and processes must be in place to manage and support BI initiatives. Governance addresses many important issues such as alignment, funding, project prioritization, project management and data quality (Watson & Wixom, 2007).

Many BI projects claim that among common causes of BI failure is a lack of high quality data, users will not accept or rely on data they do not trust (Watson & Wixom, 2007). Quality of data in the source systems, obtained from operational data ( see figure 6. BI architecture ) is crucial for the success of a BI project, primary purpose of a BI system is to integrate 'silos' of data for analytics in order to improve decision making processes. Often many data-related issues within the sources systems are not discovered until source data is extracted to BI and queried in the BI system (Watson, Fuller, & Ariyachandra, 2004). Corporate data can only be fully integrated and exploited for greater business value once its quality and integrity are assured (Yeoh & Koronios, 2009).

Existing ambiguous data definitions in an enterprise cause issues in BI projects. In order to enable a consistent meaning at the enterprise level business definitions and rules must be standardised (Moss & Atre, 2003). An agreement within the business is required about the definitions and measurements used in BI project context, this agreement forms a part of the deliverables (Wadehra, 2007). When data is analysed from more than one system (cross system analysis) it is important to profile a uniform master data set that is compliant with the agreed business rules (Yeoh & Koronios, 2009).

According to a recent survey conducted for IBM by Forrester research (2011), companies that implement information governance strategy throughout their enterprise are more successful in their BI initiatives than those who are less mature in their governance initiatives. Results of the survey highlight that organisations are more likely to achieve success in their data security and privacy initiatives, than those of data quality, standardisation and data life-cycle management. Achieving data quality and information governance remains a challenging area for many organisations, these factors, however, are paramount for successful BI implementations.

**Flexible Technical Framework**

Establishing the technical infrastructure for a initial BI solution may be time consuming (Watson & Haley, 1998). Although selection of scalable and flexible hardware and software components may require extra time at the outset of a project, the effort would be minimised for the next delivery cycle. As a result the system would be able to adapt to the changing and emerging business requirements (Olszak & Ziemba, 2007).

According to Williams & Williams (2007) the data warehouse (DW) environment must be optimised to extract and load data from different source systems and to provide high performance information retrieval for reports generation, adhoc analysis, etc. Goals of these systems are significantly different from the transaction based systems in terms of storage, processing, network needs, tools and technologies applied. Many organisations do not recognise the unique nature of DW (Williams & Williams, 2007). It is common to hear that DW is not performing as expected, a major contributing factor to this problem often lies in the inadequate technical infrastructure. Also Williams & Williams (2007) argue that IT standards and policies have evolved over time and have been adjusted when problems have occurred. Many of these standards and polices have their roots in the days of mainframe system design, when information processing time was measured in months rather than days. As a result, many of these standards and polices are not applicable to the current state of applications development.

Architectural choices deserve a thorough consideration during the system procurement stage (Somers & Nelson, 2001), factors that need to be addressed include existing infrastructure compatibility, identification of additional systems such as financial, planning systems and others. Appropriate technologies are required for real-time BI applications to build upon and extend those that were used in traditional BI and data warehousing (Anderson-Lehman, Watson, Wixom, & Hoffer, 2004).

***Change Management***

Managing organisational change is critical to deliver bottom-line results and typically organisations underestimate the effort required to institutionalise and optimise the use of BI applications (Williams & Williams, 2007). Use of information and analytics for decision making contrasts with decision making based on intuition or gut feelings. Not everyone can make this change easily, and new people might need to be put in place (Watson & Wixom, 2007). Organisational incentives may need to be considered to encourage end users to adapt to the new way of making decision with the help BI. Williams & Williams (2007) confirm that in many cases organisations unwilling to incorporate any changes to operational systems (source systems) to ensure the required business information is available and is of high quality.

Change is a rather difficult issue that organisations have to handle during BI initiatives(Nah, Lau, & Kuang, 2001). Even though the new system will be beneficial to the company and make life easier for employees, still some employees prefer to work in the old way as they are afraid that the change will bring more work and allow less time for completion. They don't want to learn new things as they are used to work in a particular way. Encouraging employees to embrace and support the change and to mitigate resistance is the main objective of a change management program (Nah, Lau, & Kuang, 2001). The key to change lies in the willingness of individuals throughout the enterprise to adopt not only the new technology but also new ways of working (Norris,2000).

# 9 Expert Views

Organisations may find attending to ALL reported critical success factors due to resource limitations and other priorities. It is important to prioritise critical factors to help organisations focus and allocate resources to make the business intelligence initiative successful. Top five CSF reported in literature are:

- Alignment between Business strategy and BI strategy
- Top Management Support
- Effective Information & BI Governance
- Flexible technical framework
- Change Management

In order to gain an insight of the relevance and validity of these factors in the real world, we interviewed experienced professionals who had extensive experience of delivering BI initiatives as well as their customers. Their views are discussed in this section.

**Alignment between Business Strategy and BI Strategy**

This top success factor, alignment between business strategy and business intelligence strategy, concerns the basis on which a business intelligence strategy is formulated. The focus of a business intelligence strategy is to:

- make use of information for strategic long term planning,
- help middle management with tactical reporting and
- help operations with day to day decision making to run the business effectively & efficiently.

BI experts interviewed highlighted the importance of alignment between business strategy and business intelligence strategy for the success of business intelligence initiatives. Business intelligence should be used as a tool to help and drive the growth of the organisation and to be competitive in the market.

The business intelligence strategy needs to be aligned to business but at the same it should be flexible enough to accommodate short term changes to the business strategies. Business intelligence manager from a fast moving goods company (FMCG) said in his interview: *"Alignment is critical because organisation's direction and information requirement decides the business intelligence strategy. Business intelligence strategy should be wider not just covering current business strategy but with enough room/flexibility to move around when the business strategy and market dynamics change*". Appropriate alignment enhances the probability of success for business intelligence initiatives. From an IT Director's perspective: *"Alignment is very important, matter of fact we don't build any systems without proper business case and justification. Every year we formulate a 5 year plan for the business followed by the business intelligence strategy for the next 2 years and gets it approved from the CEO*". Also he went on to say, "*this is one of the main reasons the cost to serve project was so successful and delivering benefits to the business in terms of improving the profitability by 10%"*. This statement is well supported by Managing Partner's view: "*you might have perfect BI system but unless it delivers the information requirement that organisation do need to support their strategic growth & direction what is the point in having a BI system*".

Among main organisational objectives for the introduction of business intelligence is the leverage of BI tools to generate necessary information for strategic growth of an organisation. Over a period of time organisations tend to slowly lose track of alignment between business strategy and business intelligence strategy. Managing Partner's view on this was: "*I have seen in many organisation that initially everything is aligned with business strategy but over time operational aspects takes priority. The responsibility of putting the BI system in place falls on the middle management and their priority is always operational and direction swifts from strategic to operational*". Similar view is expressed by the Managing Director: "*The problem that I found is business and business intelligence strategies are not communicated down the organisation, some pockets in the business decided to start looking into some kind of performance metrics there is no support or wider interest in the organizations*".

Business intelligence helps deliver business advantage overtime by producing information from different sources. It is not a single project or deliverable, it is an ongoing journey with measureable benefits. Organisations should understand this before initiating business intelligence, once this is understood, the importance of alignment between business and business intelligence strategies becomes clearer.

**Top Management Support**

The success factor emphasises the need of the strategic level support and decisions taken in order to deliver BI initiatives in organisations during all the stages of live cycle. BI implementation includes identifying the need, preparation, infrastructure procurement & setup, building a team, identifying partners, project management and continuous evolution of the solution in response to business changes. The importance of management support is expressed by the Business Intelligence Manager: "*if the CIO supports, he would drive it down the organisation and he is focused until he sees the result. That make's to go open and make things happen*". During the interview he also points out that some projects do have top management support, but not the real drive or push from the top management. In such scenarios projects are successful but the business benefits tend to be lower: "*for one project we had a high level sponsor and he is one of the board of directors and he was in favour of the project. He did give us people to do the project, but then when we went live one of the partners said it doesn't fit because they changed and we are not going to use it. The high level sponsor didn't push it and he let it go*". This makes it clear that partial support is not enough, top management should drive the BI initiatives. This point is well supported by the Managing Director, "*normally the responsibility of driving the business intelligence is delegated to middle level without the proper involvement from the top*".

Budget for the BI initiatives is in the hands of top management, and if executives do not have faith in the business intelligence initiative then they would be reluctant to allocate appropriate resources for the project. Senior business intelligence consultant expresses this concern in his interview: "*if they don't commit the finance required for seeing through the BI initiative it is doomed to fail. You might have spent a year on the initiative but if the additional 10%–20% of finance required for evolution of the initiative is not approved, then the whole initiative becomes a waste*".

Top management support is important but in most of the organisations the task of driving the BI initiative is delegated to the middle level managers. So it is important to have the total management support from top to bottom to be successful with Business intelligence initiative. This view is confirmed by Principal Consultant: "*I think it should be full management support top down with buy-in from all the stakeholders. I have seen projects fai, even though you have top management support because the people at the bottom don't buy in and carrying on doing what they were doing before and this leads to not enough traction in the projects*".

Views from the experts expressed above support conclusions by Nah & Kuang (2001) that projects must receive approval and support from top management to be successful. Entire management buy-into the BI project is needed, although the top management support is paramount.

**Effective Information & BI Governance**

Effective information & BI governance deserves its merit among other factors as it helps manage and support business intelligence implementation and evolution. Governance addresses many important aspects such as data quality, data access, data security, and data life cycle management. Other aspects covered include standardisation of business definitions, funding, project prioritisation and project management.

All interviewed experts agreed that data aspects such as quality, security and data life cycle management is critical to the success of business intelligence initiatives. Business Intelligence Manager said: "*There is nothing worse than two people coming to meeting with different sales figures and both these figures come from BI*". This statement sums up the importance of the data aspects for the success of business intelligence. Business Intelligence Manager continues, *"even if one user questions the data you are out and the reliability is gone*". Data quality is an issue for business intelligence because it sources data from different systems and combines data to produce information. Various types of source systems are used in BI, such as standard ERP, home grown systems and other non-structured external sources such as Internet, etc. Standard ERP systems quality depends on its master data and data out of these systems tends to be good quality, whereas data quality from other systems may not be of good quality. This creates incoherent data image on the business intelligence system as a whole.

Standardisation of business definitions helps to have the same meaning across the organisation, but there is always a tendency by business users to tweak the definitions to their advantage. Managing Director emphasises: "*you need to make sure your data definitions are standardised in a right way. Any changes to the definitions should be done with the Business intelligence gatekeeper's approval. There is a tendency in the organisations to change the definition of information by different stakeholders to their advantage because of this the main purpose of driving the business based on information derived from BI is lost*". It is very important to standardise the definitions during initial stages of the business intelligence initiative. As expressed in experts' words, "*the information blue print should capture and standardise the definitions and communicated to all the stakeholders*".

Experts also highlighted the importance of project management and scope management in managing deliverables from the business intelligence initiatives. During the initial stages of a BI initiative a clear set of deliverables should be established and agreed by all stakeholders and this becomes the governing document during the project and after the project to measure/compare the deliverables. Communication between the stakeholders is as important as the other factors to keep up the momentum with in the project. Managing Partner pointed out: "Scope *creep is one of the reasons the business intelligence projects fail*". This highlights the importance of defining the deliverables in the early stages of a BI initiative.

**Flexible Technical Framework**

Organisational agility is the ability to sense and respond to market opportunities and threats with speed. Flexible technical framework is one of the major sources of organisational agility. Though all interviewed experts felt that this is an important factor, the views onto the technical framework characteristics varied between management and technical roles. Business intelligence manager said: *"I know I have reporting requirements that we can't deliver within the existing technical framework"*. He continues to make a point that due to non flexible technical framework the team have to adopt workarounds to get the same output which involves more time and money. The expert concludes by saying: "*The main aspect is that it reduces credibility of the BI systems. If framework doesn't support how the business user works, the BI system loses the credibility and users will go outside the system, say turn to excel spreadsheets*".

Those organisations moving towards user **self service** enable users to create their own analysis and reports. Senior BI Consultant said: "*flexibility is one of the key factors that decide the success of the self sufficiency drive*". There are counter arguments: to attain self sufficiency users need extensive training and there is a chance of losing standardisation as every user could produce different figures for the same questions. Managing Director's view supports this: "*I know a lot of organisations are going towards self service reporting I don't think that work. One has to know lot of information about the data. Unless you get it right in the first couple of tries the confidence would be lost*".

Business users expect fast retrieval of and access to decision making information. This depends on the IT infrastructure, architecture, volume of data and housekeeping, etc. Business users can get frustrated waiting for the information. This is emphasised by the Business Intelligence Manager: "*If the reports keep getting slower and slower, at some point business users would stop using the system*". One of the reasons of poor performance in BI systems, is the sizing of hardware components and wrong selection of the software. One has to understand the purpose of the BI initiative in the short term, as well as long term perspective to decide the sizing of hardware and software selection. In the view of the BI Principal Consultant, *"Proper alignment between business strategy and BI strategy is the pre cursor to the technical framework"*.

***Change Management***

Change management is one of the essential success factor of business intelligence initiatives. Experts emphasised the barriers in managing change following business intelligence implementations. For example, Business Intelligence Manager said "*You need to spend time in training people on the new tool how it works, what measure to be used, what are benefits etc. It is a part of change management. If you don't, and you just pump it out and leave it on the door steps, the users would ignore it*". He continues with a recent example from his organisation. During the first phase of the business intelligence project there was a dedicated role set up to look after the change management process. This helped to make everyone aware of what they are doing, purpose and change process involved and the initial phase was a great success in terms of business benefits, legal requirements and usability. Phase 2 of the project was to roll out of the initiative to other countries, management felt it is just a rollout so to have a change management role was not justifiable. When the phase 2 went live users at the new markets were unaware even of the basic objectives of the project and process changes involved. Now the management is struggling to bring people up to speed and implement the process changes. This highlights the importance of a consistent change management approach even for small initiatives.

A consensus on whether BI initiatives need extensive change management has not been reached yet. Some advocate that business intelligence initiatives are simply analytical and reporting tools, therefore they do not require change management processes. IT Director said "*though cost to serve (CTS) is a business intelligence initiative, there was lot of changes in the source systems to capture right information, in addition partners, hauliers were also involved in the business process. Without a change management role it is not possible to manage the change among all the stakeholders*". Business intelligence tools easily highlight the issues related to business process, discipline in maintain the underlying source systems. When such issues are highlighted, change management is very important to fix the issues in the source systems. Managing Director supports this view: "*business intelligence systems highlight the business and data issues that are not easily identifiable in the source systems directly. Process change has to happen in the underlying systems and change management is very important in this space*".

Acceptance level of business intelligence systems depends mainly on the change management process. This is justified from a statement of the Managing Director, "*Some people do think that 'I don't need to use BI for making business decisions', so if it is a part of the business process then change management would help to improve the acceptance level*". The lack of training and education about how the business intelligence initiative affects decision making is one of the major causes of failure. In most cases training is limited to how to use new tools. Acceptance level can be improved by educating staff to how to use available information for decision making **(analytical culture)** and training them to exploit tools and technologies to their full capability.

# 10 Strategic View and BI

Business intelligence critical success factors discussed so far are important for any business intelligence initiative irrespective of the organisational type or industry sector. This section addresses best practices and what other organisations can learn and use with respect to the top five critical success factors.

Success factor "Alignment between business strategy and BI strategy" deals with the strategy formulation for business intelligence initiatives. Review of extant literature and expert views reflect that the business intelligence strategy should be aligned to the business strategy and be flexible to accommodate the changes to business and market dynamics.

Some organisations start business intelligence initiatives with a proper strategic view and proper alignment with business strategy, but over a period of time slowly lose track of the alignment. Organisations should understand that it is not a single project or deliverable it is an ongoing journey. It is very critical to keep the alignment in place throughout the life cycle in order to reap the benefits from business intelligence initiatives.

Success factor "Top Management Support" is about high level decisions taken to support business intelligence initiatives throughout the life cycle of an initiative. In the view of BI experts top management support is important for the success of business intelligence initiative.

Some initiatives might have top management support but lack the real drive from the executives. Normally the responsibility of driving the business intelligence initiatives is delegated to the middle management without proper involvement from the top. This situation may lead to a successful implementation but the business benefits tend to be lower. It is critical that top management support is secured, but at the same time the top management should drive the initiatives to achieve the business benefits fully.

Effective information & BI governance support business intelligence implementation and evolution. Other aspects encompass data quality, data access, data security, data life cycle management, standardisation and project management. There was a mixed response from the BI experts on the importance of this factor, however all agreed that data quality is critical to the success of a business intelligence initiative.

Data quality is an issue for business intelligence because it sources data from different systems and combines them to produce information. The quality issue can vary between organisations; it depends on the source systems being used, existing IT infrastructures and business processes. However is the organisation is mature with its IT processes and IT source systems, it is less likely to have data quality issues.

Standardisation of business definitions is very important to ensure consistent meaning of information throughout the entire organisation. Experts highlighted this as an area where organisations could improve to make the business intelligence successful. Data quality and standardisation is important for all organisations irrespective of the industry sectors.

Organisational agility largely depends on the flexible technical framework, without a flexible technical framework it is not possible to detect and respond to market opportunities and threats in time.

If the technical framework is not flexible enough, it may not deliver all needed business requirements, this may lead to the loss of credibility and users might stop using the systems.

Organisations are moving towards self sufficiency for the information analysis and building their own reports. Flexibility is important for the self sufficiency drive but this alone cannot make self sufficiency a success. It requires proper governance and giving consideration to aspects such as standardisation of business definitions and data accessibility.

Though it is a critical factor its importance was less emphasised by the experts in comparison to the other top 5 factors. For example if BI strategy is aligned with business strategy, the technical framework can be based on the BI strategy. This shows that technical framework doesn't come on its own, it depends on the BI strategy and top management support as well as available budget. If the initiative has a strong BI strategy and top management support, then creating a flexible technical framework will be straightforward.

Change management is one of the most important critical success factors of business intelligence initiatives. From experience, there are organisations that perceive change management as unimportant for business intelligence initiatives. In the experts' views the value of change management for business intelligence initiatives is even for small initiatives is indisputable.

Acceptance level of the business intelligence systems depends on the change management process. Lack of training and education on the use of new tools in the organisation and the information available through the business intelligence implementation is one of the problem areas that restrict drawing full benefits from business intelligence. Analytical culture and decision making based on information should be encouraged within the organisation to make business intelligence successful.

# 11 Recommendations

Increased global competition, demands for profit and demanding customers all require organisations to take better decisions as quickly as possible. In this highly competitive environment the principle of managerial task is to reduce uncertainty by processing information. The ability to swiftly take advantage of growing amount of information has become extremely critical for any business to be successful, however Data Warehousing Institute estimates that business analysts spend an average two days per week in gathering and formatting data instead of analysing the data. Business intelligence is implemented to reduce the time to gather, format and analyse the data.

Business intelligence systems are widely implemented by a vast range of organisations and an appropriate business intelligence system could lead to benefits such as increased profitability, decreased cost, improved customer relationship and decreased risk. Business intelligence has great promise and even small investment could yield good returns. However business intelligence initiatives have been delayed or scrapped altogether as the initiatives deliver far short of their expectations due to various reasons.

Following best practice is paramount to realise successful implementation of business intelligence initiative, whereas absence of the CSFs observance is likely to lead to a failure of the system (Yeoh & Koronios, 2009). Literature review conducted on the business intelligence initiatives yielded a comprehensive list of critical success factors. Among identified top critical success factors are:

- **Alignment between Business strategy and BI strategy**
  Business intelligence helps deliver business advantage overtime by producing information from different sources. It is not a single project or deliverable, it is an ongoing journey with measureable benefits.

- **Top Management Support**
  Top management support is paramount, however in most of organisations the task of driving a BI initiative is delegated to mid level managers. So it is important to have full management support from top to bottom to be successful in Business intelligence initiatives.

- **Effective Information & BI Governance**
  Governance addresses many important aspects such as data quality, data access, data security, and data life cycle management. Standardisation of business definitions helps maintain the same data image/definition across the organisation, but there is always a tendency by business users to tweak definitions to their advantage.

- **Flexible Technical Framework**
  Business users expect fast retrieval of and access to decision making information. This depends on the IT infrastructure, architecture, volume of data and housekeeping, etc. Appropriate choices with regards to size and architecture of hardware/software portfolio to accommodate short term and long term objectives for organisational flexibility and growth.

- **Change Management**
  Business intelligence implementations easily highlight the issues related to business process, discipline in maintain the underlying source systems. When such issues emerge, change management is very important to fix the issues in the source systems. User awareness and training, alongside allocation of a change management role are important factors in achieving BI success.

- **Organisational Analytics Culture**
  Determines whether the decision making process is well established in an organisation and is known to its stakeholders

- **Balanced Team composition**
  Representation of stakeholder views in the BI project is very important. The emphasis is on a 'balanced' approach to select the BI project team to ensure that technical and managerial views are equally represented.

- **Adequate resources and funding for support efforts**
  Recognition of the BI role in the enterprise is essential. Special attention in terms resourcing necessary support is needed to ensure that the BI users can make the most of the capabilities offered by complex software.

- **Business-driven and iterative development approach**
  Business strategy and objectives need to drive the BI initiative. To minimise the probability of failure due to user unacceptance, an iterative approach is usually followed.

- **Users having necessary tools, training and support**
  Users are ultimately the main agents who ensure that the benefits of BI information are leveraged throughout the enterprise. User awareness, training and technical support are required for an effective use of BI systems upon deployment.

CSFs above are listed in no order of priority, but it is always useful to derive the order of importance so that the organisations can prioritise the allocation of resources to make the initiative successful.

# 12 Conclusions

This manager's guide focused on critical success factors for business intelligence initiatives in organisations. Key findings of this report were derived from an extensive literature review on BI and interviews with experts in the field. Five critical success factors identified from literature were discussed and reflected upon from the best practice perspective. Alignment between business & business intelligence strategy, top management support, change management, effective information & BI governance and flexible technical framework deserve prime attention from managerial and technical staff in when planning or executing a BI initiative. Throughout this guide the following questions set at the beginning have been addressed:

- ***What are the critical success factors for business intelligence initiatives?***

In academic and industry literature, material related to business intelligence and its critical success factors are very limited. Through an extensive research on the business intelligence articles and enterprise resource planning (ERP) articles the it was possible to identify the critical success factors for business intelligence initiatives. Some of the critical success factors, extensively supported by the BI experts, are: top management support, change management, alignment between business strategy & business intelligence strategy, analytical culture, education & training etc.

- ***What are the top 5 critical success factors for business intelligence initiatives?***

For organisations to direct the resources on all the identified critical success factors is not always possible. It is a general rule to direct the limited resources on the most important critical success factors, to make this happen it is necessary to identify the most important factors. Strongly influenced by the literature review and the number of citing in the articles the author has identified the top 5 critical success factors as "Alignment between business strategy and BI Strategy", "Top management support", "Effective IT & BI Governance", "Flexible technical framework" and "Change management".

- ***Do organisations view these factors as critical to their business intelligence initiative success?***

This question directly relates to the points made in the interviews with business intelligence professionals. Top 5 critical success factors "Alignment between business strategy and BI Strategy", "Top management support", "Effective IT & BI Governance", "Flexible technical framework" and "Change management" received a positive response from the experts for the success of business intelligence.

**Limitations**

Different people have different opinions on whether the business intelligence system has been a success or not. While interviewing people with different background and experience and roles in different organisations, the researcher received a number of different viewpoints, based on the interviewees' background and their relation to the business intelligence initiatives. This research is about the people's interpretations of success factors for deriving business benefits from business intelligence. From the best-practice perspective this managerial guide provides an objective assessment of success factors in BI initiatives.

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# 14 Endnotes

1. Data Warehousing Institute http://tdwi.org/