POLITECNICO DI TORINO

Master of Science in Engineering and Management

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The impact of business analytics on strategic decision making

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ABSTRACT

The present scenario demands the scientific management of organizations are developed with software tools like business analytics. The objective of this work is to investigate how to implement business analytics to support strategic decision-making. Business analytics is being used by companies to create value and gain competitive advantages, it can also help to create alignment between business strategy and IT strategy thereby facilitating organizational transformation. A number of implications are discussed like the possibility of business analysis initiatives used for strategic alignment and organizational transformation, the potential of identifying and using the right metrics, benefits of good quality technology infrastructure and superior quality data, the necessity for the involvement of senior management complemented by strong leadership for the business analytics project. The methodology explores the importance of data accuracy and the data warehousing architectures that can be deployed strategically. The factors that influence the successful implementation of business analytics are identified followed by the significance of performance analytics and how it is relevant to combine with the tools of business analytics to form the branch of business performance analytics.

EXECUTIVE SUMMARY

The purpose of this thesis is to describe the application of business analytics (BA) in strategic management and evaluate the implementation of BA in terms of facilitating an organization with improved performance. BA is defined and its role in various applications like customer targeting, churn prevention, sales forecasting, financial modelling is explored. The innovations and new trends of BA are discussed in terms of widening its capability to branches of marketing, sales, supply chain, price optimizations, and workforce analysis. BA at the strategic level is reviewed in terms of studying the organization for its competence with respect to working with data at different levels and choosing an appropriate level of integration between the BA function and company strategy.

The methodology introduces the importance of data accuracy and why businesses must process and store data such that it is available at various levels so that critical decisions are taken on reliable information. The possible solutions to maintain data accuracy are suggested starting from the initial time every dataset is received or created. The strategic importance of developing an active data warehouse with supporting BA tools is seen with the case study of how DirecTV was able to utilize its data assets to gain a competitive advantage in the industry. The factors affecting the implementation of BA in an organization are outlined in terms of the information management context and organizational context. The framework for developing BA tools is defined with an approach focussed on enabling business actors to take efficient decisions at the strategic, operational, and tactical levels resulting in meeting business goals and the steps for the successful implementation of a BA program are recommended. Key performance indicators (KPIs) and operational metrics are defined and how they should be chosen based on the nature of the company for the monitoring of the BA performance are addressed. The cross-functional subject of business performance analytics is examined with the goal of combining performance analytics with strategic analysis to redefine the understanding of business outcomes by means of data.

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1. INTRODUCTION

1.1 Context

The appreciation of how business analytics (BA) systems deliver value and competitive advantages to companies has been the recent trend. BA systems enhance decision-making by arranging, storing, and retrieving a substantial volume of high-quality data in a well-designed data warehouse. Decision-makers can use the data to generate in-depth reports, dashboards and make use of online analytical processing (OLAP) technology as a support to refine their decision-making skills. BA systems can yield advantages by facilitating advancement in future business processes, operational efficiency, increase customer acquisition and retention and help organizations gain superior market position. Data and analytics are disrupting the current business models by helping organizations to better understand its business and markets.

Business analytics is turning out to be a critical strategic investment for many organizations hence research on this topic is important for the following three reasons. Companies are investing a significant amount of money in business analytics systems. Sisense mentioned in their State of BI and Analytics Report 2020 that business analytics is an important technology with organizations prioritizing the application to generate value. IT and business alignment were noted as the principal management focus for the information technology executives. Secondly, in spite of the fact it is well known about the beneficial impact of enterprise resource planning systems, this cannot be applied to business analytics as they are focused on data management and decision support. Thirdly, there is little or no previous research centered around data warehousing and decision-making systems that are strategically relevant.

This study intends to indicate if the implementation of business analytics in strategic management assists in improved company performance and how to incorporate business analytics in the performance management systems of the organization. In this study the alignment between business and IT strategy, enterprise architecture that helps to transform the objectives specified in the business strategy into processes, systems, and data that enables an organization to effectively enforce the strategy is explored. The author recommends how to use business analytics from the viewpoint of strategic planning and the utility of the analytical toolbox in the performance management framework from an academic point of view.

2. BUSINESS ANALYTICS

2.1 Definition and Statements

2.1.1 Definition

Business Analytics (BA) can be defined in many ways but all of them focus on the fact that it is how businesses use the methodical exploration of accumulated data to make better decisions. BA is used by companies that are committed to data-driven decisions by turning their data into a competitive advantage. BA refers to an emerging set of methods and techniques that demonstrates the remarkable importance of data in terms of its growing volumes, variety, and velocity (Department for Business Innovation and Skills, 2013). There is a lot of eagerness around analytics as organizations are trying to use their large volumes of data to create value for their businesses through strategic utilization of their data resources (Liberatore & Luo, 2010).

The present view of business analytics is often represented by (Davenport & Harris J G, 2007) compact and broadly used definition which refers to analytics as the exhaustive use of data, applied mathematics, instructive and prophetical models, and fact-based management to support selections and actions. The important feature of this definition is that business analytics basically provides insight which will be developed into business worth and not simply elaborated models. Thus, one of the key interests is linked to research into the shift needed to develop into data-driven and evidence-based organizations.

Business analytics can be seen as the combination of various disciplines, of which Operations Research, Machine Learning, and Information Systems are the most relevant (Figure 1). The process can be represented by descriptive, predictive, and prescriptive models building various 'big data' sources. Organizations can then use these models to make efficient and sound commercial decisions thereby providing a competitive advantage. In the present digital age flow of information is essentially equal to all companies. It is how well this information is exploited that could make the difference between survival and extinction for the organization in aggressively competitive markets (Mortenson, Doherty, & Robinson, 2015).

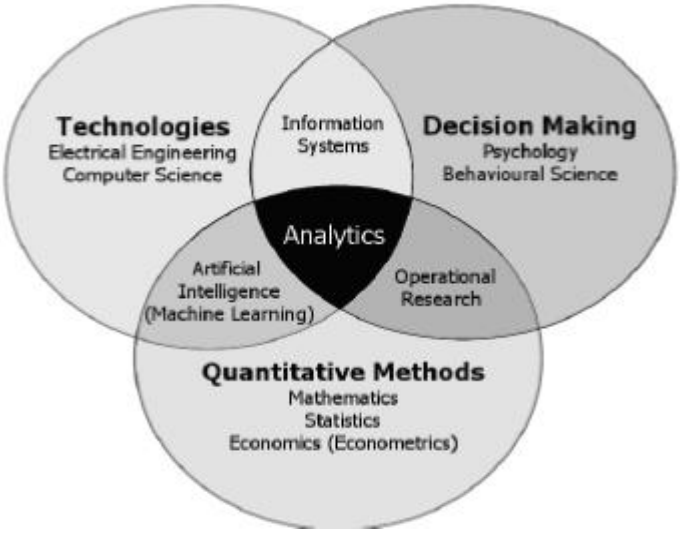

Figure 1: Business Analytics (Mortenson, Doherty, & Robinson, 2015)

2.1.2 Types of Business Analytics

In the various stages of BA, an enormous amount of data is analysed at several steps. The different types of BA come together to help organizations to understand right from what is happening in the company up to what solutions should be implemented to optimize business functions. The different types of analytics are commonly implemented in stages and a particular type cannot be chosen as superior to others. They are interlinked and each type provides a unique insight. Nowadays data is a significant asset in many different sectors and most companies depend on at least one or a combination of all the types of analytics (Mehta, 2017). According to (Sharda , Delen, & Turban, 2018) Business analytics can be classified into the following three types:

1. Descriptive Analytics:

It is the understanding of historical data to comprehend the changes that have occurred in a business. It is the retrospective analysis of historical data through which decision-makers attain a comprehensive view of performance and trends on which the business strategy can be developed. The reporting of financial metrics is done by the use of descriptive analytics- for example, month-over-month sales growth, year-over-year pricing changes, number of users, total revenue per subscriber. These metrics all report what has occurred in a business over a defined period.

2. Predictive Analytics:

It is the practice of using a combination of statistics and modelling to predict future performance based on current and historical data. The science of predictive analytics can generate future insights with an exceptional level of accuracy. It aims to foresee future events by observing patterns in data and determine if those patterns are likely to appear again thereby allowing businesses to modify their use of resources to take full advantage of possible future events. It must be noted that predictive analytics cannot predict if an event will occur in the future, but purely forecasts the probabilities of the occurrence of the events. Forecasting in manufacturing is a good example of the use of predictive analytics. Predictive modelling is used to clean and improve the quality of data to ensure optimal utilization of resources in a supply chain.

3. Prescriptive Analytics:

It is an application of decision science, management science, and operations research methodologies to help organizations make better decisions through the analysis of raw data. It aims to determine the best possible decision by using a combination of both descriptive and predictive analytics to weigh all the possible alternatives and find the best course of action or strategy to achieve a particular outcome. It relies on a robust feedback system that continuously understands and updates the connection between the action and the outcome. The calculations consist of optimization of functions to deliver desired results. For instance, when booking a cab online the application utilizes GPS to connect the user with the nearest driver amongst the drivers nearby. In this case, it optimizes the distance resulting in a faster arrival time.

Figure 2: Types of Business Analytics (Sharda , Delen, & Turban, 2018)

2.1.3 The Applications of Business Analytics

Organizations in various industries around the world are capitalizing on the power of data to gain a competitive edge. Every minute colossal volumes of data are being generated by users and collected by businesses. However, the bare process of gathering data does not provide benefits to the organization. Companies should study the data meticulously and remodel it into an asset that can add value to their businesses. The vital factor to success is the capability of the company to transform large volumes of data into strategies that strengthen profitability, increase revenues, and aids the company take a competitive stance in the market (Rai, 2018).

- Customer Targeting

Customer targeting is the business process that involves segmentation of a customer base into sets of individuals that share the same demographics or characteristics like age, location, interests, and spending practices. Segmentation is used by the marketing department to gain

insight into how to market to each group in the most compelling manner. BA can be used to recognize potential customers much more efficiently than traditional techniques. BA in marketing assists organizations to target customer needs by sending customized marketing messages to customers or timing a certain product on what best suits the customer (Lopez, 2020).

- Churn Prevention

Churn rate is defined as the rate at which existing customers stop doing business with a company and is measured over a specific period. Churn prevention is used to estimate which customers, when, and why they choose to end the relationship with a company. This metric is very useful for companies because it is cheaper to retain an existing customer rather than acquiring a new one. BA exploits the potential of customer data sets to create predictive models that provide an opportunity to intervene proactively and thereby reduce the churn rate. The company can understand the factors for churn and take the necessary steps for the retention of customers by offering discounts or added features (Lopez, 2020).

- Sales forecasting

Sales forecasting is the practice of predicting the quantity of goods and services a business can realistically sell for a particular forecast period which is usually monthly, quarterly, half-annually, or annually. It is a fundamental part of business management that provides a company with information to take business decisions regarding areas like inventory management, cash flow, estimation of profit. BA can provide more accurate sales forecasting as it can foresee customer response and changing attitudes by examining variables like historical sales, calendar data, company marketing data, social data. BA can be used to help lighten the pressure on sales planners by automating rolling forecasts using real-time data and offering executives higher transparency and an intelligent decision support system for improving business agility and versatility (Ward, 2020).

- Quality Assurance

Companies are using data and analytics to redefine the process of quality improvement. The most significant change is the switch from the sole reliance on post-manufacturing inspection work and retrospective analysis to the prediction and advanced detection of problem areas and maintenance conditions. Businesses are collecting data from new sources like sensors and call center conversations and with the help of innovations in BA are able to improve defect

prevention and predict needed asset servicing. BA is able to revolutionize quality assurance by helping organizations shift to intelligent quality where quality becomes a predictive business function thus providing a superior customer experience (Davenport, Tom; Patil, Ashwin; Snaidauf, Derek;, 2018).

- Risk Management

Risk management is the practice of determining potential risks well in advance, reviewing them and undertaking preventive steps to mitigate the risk involved for the business. Insufficient risk management can lead to dire implications for companies. BA can be applied to develop decision support systems that can evaluate with certainty the profitable and unprofitable divisions of the company. In the instance of a particular client risk assessment can be performed taking into account data regarding education, marital status, default history, credit amount, previous payments. An example is the use of BA in the banking sector to evaluate if an applicant is eligible to receive credit. Predictive analytics is deployed to estimate the probability that a customer will default on the loan payments thereby reducing the effect of default risk (Lopez, 2020).

- Financial modelling

Financial modelling is the process that involves generating an overview of a company's earnings and expenses as a spreadsheet that can be used to measure the implications of a future event or decision. The financial models help company executives to take decisions about issues like choosing the amount of debt or equity to raise capital, the capital allocation for projects, budgeting and forecasting, making acquisitions. Financial models are used for the estimation of the valuation of a business or for the comparison with a competitor in the same industry (Kopp, M.C., 2019). The result of financial modelling is representing a set of hypotheses about the estimation of behaviour of markets into numerical predictions. BA analyses these numerical predictions to develop predictive models which are utilized by firms to make informed decisions regarding investments or returns (Kopp, 2019).

2.2 Business Analytics Model

BA projects are a culmination of individuals as well as different teams in an organization. For a BA to work the entire team must follow a common frame, if not the project fails as it is a cross-sectional activity. The BA model in figure 3 describes how business analytics is a multi-

layered and hierarchical domain. Information needs be due the business-driven setting towards the technically directed setting. The ensuing information payoff upwards from the technically directed setting to the business-driven setting. This movement of information shows clearly why different teams working for a project must come together for a project to be successful. The business analytics model by (Laursen & Thorlund, 2010) can be further explained as follows:

- Strategy Creation:

The top management drafts an information strategy based on the organization's business strategy. In large organizations, there may be a dedicated business development function that undertakes the development of the strategy. The implementation of these strategies requires the use of key performance indicators (KPIs) with a target of measuring the extent of growth and success. The KPIs are chosen such that they contain information regarding the particular business process of interest. For example, KPIs could concern about gross profit margin, return on Equity (ROE), or sell-through percentages.

- Business Processes and Information Use:

After the strategy and strategic KPIs are clearly defined by the top management a framework, focus and objectives are determined for the operational business processes. The information and analyses described in the lower layers of the model must be funnelled towards modifying and managing business processes so that they are aligned with the strategic objectives as conceived by the KPIs. For instance, the information and insights developed by BA can be used by operational managers from marketing, sales, production, finance, general management to optimize their day-to-day activities.

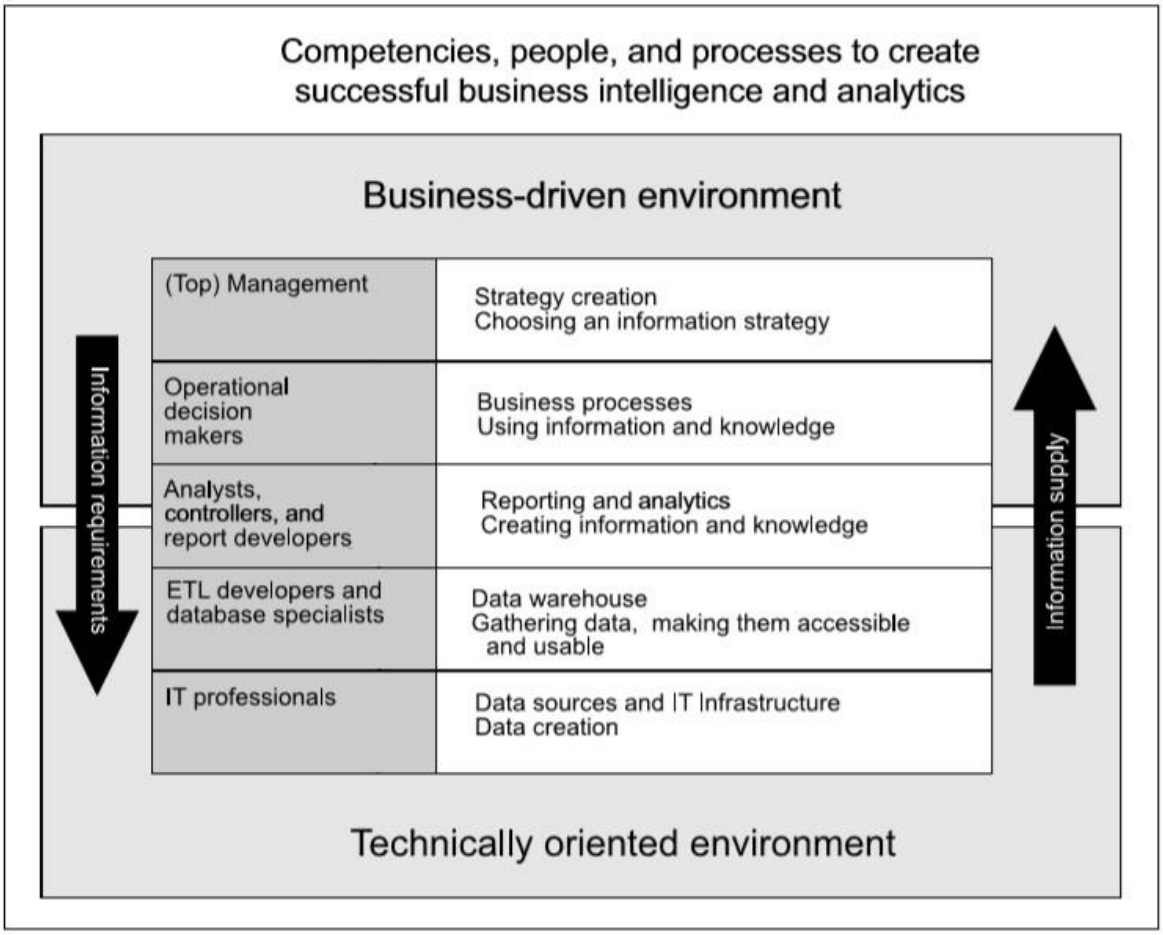

Figure 3: The business analytics model (Laursen & Thorlund, 2010)

- Types of Reporting and Analytical Processes:

In the analysis and reporting development environment, analysts indicate which data and information are critical for obtaining the intended behaviour of operational managers in the business environment. In this phase information and knowledge are produced regarding the deployment of analytical and statistical models, which are applied to analyse data from the data warehouse. The requirements for front-end applications, reporting, and functionality are defined precisely with the objective of satisfying the demand from the higher layers of the model. The analysis and reporting development environment are positioned in the boundary between the business-driven and technically oriented environment, and the teams here usually specialize in both fields.

- Data warehouse:

Database specialists and ETL (Extract, Transform, Load) developers acquire requirements from the analytical environment about data deliveries. If the required data is present in the

warehouse, the next step will be to provide access to this data to the front-end applications of the business. If data is not stored, the data warehouse will have to fetch data from operational data sources in the organization's environment. Data can also be acquired from an external supplier, or the IT department may be assigned to enforce new infrastructure with the purpose of developing a new operational data source.

- Data Sources – IT Operations and Development:

Information technology operations and development must comply with the needs of the data warehouse by providing them access to data from the fundamental operational data sources or by creating new data sources. The company's operational systems generate source data for business analytics, for example, account entries carried out using financial management system and sales data generated using order pages on the company's website. Data quality is of paramount importance here because this layer is where data is created.

2.3 Emerging Trends in Business Analytics

The field of Business Analytics is in high demand as organizations seek to use information assets to provide managers with better insights, improve customer relationships and operational efficiency. The primary consumer of these analytics is the business user, a person who is not directly involved in analytics (e.g., a manager, salesperson), but normally uses analytical tools to obtain improved results in terms of one or more metrics for example profit, time to market (Berry & Linoff, 2000). Data mining, analytic applications, and business intelligence systems are being integrated with transactional systems thereby building a direct link between operations and analyses thereby allowing data to be analysed faster and the results are swiftly deployed in business actions. Mined information is being used by a broad number of users across the organization who are making use of business analytics in day-to-day activities. Analytics are now typically used in several areas like operations, marketing, sales, fraud detection, and supply chain optimisation (Fayyad, Piatetsky-Shapiro, & Smyth, 1996).

The motivation for the emerging trends and innovation in business analytics is a result of finding solutions for business problems. According to (Kohavi , Rothledern, & Simoudis, 2002), the following approaches can be used to overcome these business challenges:

- Verticalization

In order to decrease discovery cycle time, accelerate the implementation and accomplishment of business goals, and provide analysis results to broader audiences, developers of analytical

solutions began verticalizing their software. The first task in verticalization is the integration of task-specific knowledge. Examples include knowledge about techniques to analyse customer data to measure the impact of a marketing campaign, knowledge about how an investment bank combines the information in its general ledger and can build numerous types of forecasts. In the process of integration of industry-specific knowledge, organizations are also able to enhance the performance of their applications for specific verticals. The use of industry-specific knowledge is not restricted to the data mining components of analytic applications. It also has an influence on how the extracted information is visualized and accessed. For example, companies in manufacturing, retail, financial services, and telecommunication industries increasingly anticipate their field personnel to access relevant information using the wireless devices that they carry. Analytic applications companies are developing technologies that will automatically recognize the type of wireless device and its specifications, and will spontaneously display analysis results to befit the configuration of that device.

- Comprehensible models and transformations

With the rising demand to let business users analyse data and offer insight quickly, and with the objective to reduce the dependence on data mining experts, comfortably comprehensible models are preferred to opaque models. Business users prefer not to deal with advanced statistical concepts and instead want simple visualisations and task-relevant insights. Figure 4 describes a Naïve-Bayes model for forecasting who in the U.S. earns more than $50.000 annual salary. Instead of displaying the log conditional probabilities that the model analyses, the simple visualisation uses bar height to represent the values of a contributing factor listed on the left of the figure and colour saturation to indicate the confidence of that evidence (Becker, Kohavi, & Sommerfield , 2001). For example, it can be seen that there is evidence that higher salaries increase with age, until the last age bracket where it decreases. It can further be seen that salaries increase with the number of hours worked, years of education, and certain occupations.

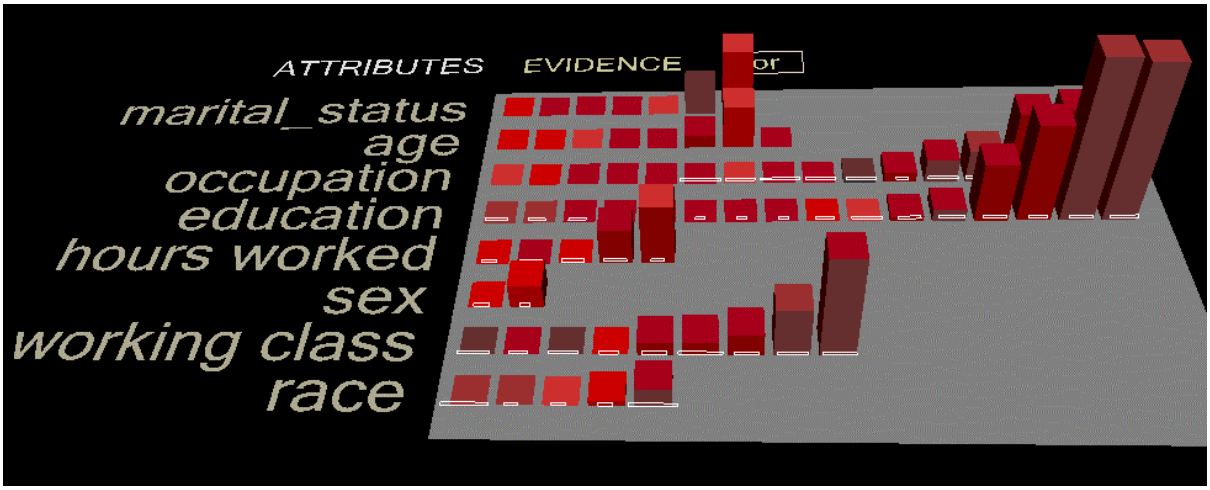

Figure 4: A visualization of Naive Bayes model ((Kohavi , Rothledern, & Simoudis, 2002)

- Analytics is part of the larger system

  Data Analytics are being designed into systems that frequently address the following areas:

  1. Data Collection

  You cannot analyse what you do not collect, hence collecting rich data is very crucial. For example, e-commerce systems collect information about the user which includes attributes like user local time, network bandwidth, and screen resolution which can be used to determine the quality of images to send.

  2. Generation (and storage) of unique identifiers

  To help combine data from several records and remove duplicate records, systems must implement unique keys to join data and store them. For example, all clickstream records collected in a single session can store session id so that they can later be joined to the session record stored on another table

  3. Integration with multiple data sources

  The analysis is more successful when data is collected from multiple sources. For example, in customer analytics it is critical to merge data from multiple touchpoints, such as the web, physical stores, call centre, wireless, and campaigns. Behavioural data can be more influential when combined with demographic and socioeconomic data from other sources.

  4. Hardware sizing

  The consequence of using big data for analysis is that it brings a substantial requirement for hardware. There is a tendency for companies to underestimate the need for complex

IT infrastructure and advanced hardware to ensure analysis is feasible and can be done in a timely manner.

- Analytics in new areas

The analysis of customer data has grabbed a lot of attention from businesses as it has consistently provided success in customer retention, increasing customer profitability, increasing the value of e-commerce purchases, and the response for marketing campaigns. This led to the rise of new applications of business analytics in different stages of the value chain. Among the various applications three are especially promising: supply chain visibility, price optimization, and workforce analysis.

Organizations have automated a majority of tasks in the supply chain. It is now possible to collect large amounts of data about the performance of the suppliers, inventory, logistics, etc. The new applications can analyse this data to derive insights about the material expenditures, performance of suppliers and partners, improve the accuracy of sales forecasts to enhance efficiency in materials inventory, the accuracy of production plans, the accuracy of plans for order delivery, etc.

The widespread adoption of CRM and Supply Chain Management software has led organizations to digitally integrate their demand and supply chains. This integration is used by enterprises to collect real-time data about the demand of a specific product, as well data of a similar nature about the corresponding supply data. By analysing these two data sets companies can set the price of a particular product using several dimensions so that the demand will meet the available supply. For example, a particular product can be priced differently on various channels like on the web and retail stores respectively. These price optimizations allow organizations to extract a higher profit margin for each item sold.

After analysing data about their customers and suppliers, organizations began to analyse data about their employees. The latest generation of analytic applications allows corporations to follow workforce trends, such as attrition rates, execute tasks like compensation and benefits analyses. Companies whose cost or revenue model is based on hourly models, e.g., contact centers or systems integrators can utilize this new generation of employee-centered analytics to refine staffing levels and skills requirements to constrict the number of employees who are not able to bill.

- Integration of analytics with action and measurement

The increasing understanding and experience in analytics by the business users has led to them developing a keen interest in the areas of action and return on investment (Souza, Manning , & Gardiner, 2001). Organizations are increasingly asking two important questions "How do I turn discovered information into action," and "How do I know the effect of each action?" Earlier, data mining was used to obtain new analytical results. The present trend is to use the analytic results as the primary step towards the final goal- action and measurement. It is no longer sufficient for cluster-discovery algorithms to discover potential groups of customers. The successful analytic solution must ensure that the user can comprehend the importance of these clusters in terms of the business action plan. Integration with other existing systems is crucial for the success of both action and measurement. For example, if the analytics application can determine customers who are probably going to respond to a promotion, but it requires a large team of IT specialists to integrate the relevant data into the advertising system to implement the promotion, then the results will not be used because it is not practical for the company. Similarly, if promotion targeting solutions are utilized but the order submission system isn't closely linked to analytics the consequent lag in the ROI reports will restrict a timely modification in the next targeted promotions. These types of integration between operations and analytics systems have seen massive developments which include entire products whose value proposition is specifically the optimization of the collect-analyse-act-measure cycle.

The innovations and trends of business analytics are being driven by business value extending into areas such as process design, user interface design, and systems integration. In order to ensure analytics is more comprehensible and functional for the business user, new software is focusing on specific vertical applications and adapting the solutions and interfaces towards the business audience, so they are more relevant and provide human-level insight. Analytics are being instilled into larger systems to ensure ease of use, simple and effective deployment. Therefore, subjects such as data collection, storage, and processing particularly analytics are progressively being considered critical issues in overall system design. In order to widen the capabilities of analytics in the business process, solutions are emerging that go beyond the customer-facing applications in marketing, sales, supply chain, visibility, price optimizations, and workforce analysis. Finally, to ensure powerful impact and value, a majority of analytic solutions are making results actionable and measurement of changes key components.

3. STRATEGIC MANAGEMENT

3.1 Definition and Statements

Literature does not provide a unique definition for strategy. Sun Tzu in his renowned book The Art of War, states that strategy is the wonderful result of the organization. In things of life or death, it's the Tao of survival or extinction. The construct of strategy has been obtained from the military and amended for use in business. A conclusion from several noted writers is that adopting the concepts has been easy because the changes required are minimal. In business, as in the military, strategy is the liaison between policy and tactics (Nickols, 2016). In modern times, managers use the word "strategy" constantly and in many different contexts. To sum up, strategy means different things to different people as follows (Fries, 2006):

3.1.1 Henry Mintzberg

Henry Mintzberg defines in his book, Five Ps for Strategy,1987, developed his 5 approaches of developing strategy. These five components can be used by organizations to implement a robust business strategy and are explained as follows (Mulder, 2018):

- Plan

  A plan has to be present before possible actions are taken and it is crucial that the plan is executed meticulously. A strategy is a plan for handling various situations. Plans permit managers to provide clarity to their teams and work towards interim assessments and final goals. However, planning is not enough on its own and the other 4 P's are to be used to make a clear organizational strategy.

- Pattern

  Patterns are about strategies that have emerged from past organizational behaviour. Earlier strategies that have been successful are an important part of formulating the new strategy. It is about intentionally or unintentionally persistent behaviour followed by employees. The inclusion of such patterns in an organization ensures that its strengths are included in developing a strategy.

- Position

  The position of the organization in the market is the result of the interaction between internal and external factors. It is significant to consider in advance how the organization positions itself with respect to its identity in the market and the

expectations of the stakeholders. This can contribute substantially to building a lasting competitive advantage and a firm place in the market.

- Perspective

  When developing a strategy, it is important to know how different target audiences perceive the organization. This can be achieved by asking questions like What do the employees think of their employer? How do customers regard the organization? What is their opinion among investors? These individual perspectives and thought patterns are a vital source of information for the organization, which can be used to make strategic choices.

- Ploy

  Mintzberg explains that overwhelming the competitors by trying to disrupt, discourage or influence them in any manner can be part of a strategy. For example, a phone service provider can misguide others by abruptly offering internet service and digital television that brings them to compete with potential providers of these services. It is a ploy to outthink the competition.

3.1.2 Michael Porter

In a 1996 Harvard Business Review article Michael Porter defines competitive strategy as *"It means deliberately choosing a different set of activities to deliver a unique mix of value."* Porter argues that strategy is about the competitive position, differentiating the company and its products in the view of the customer, about providing additional value as a consequence of a mix of activities distinct from those of competitors. The diverse set of competencies utilize all the resources and capabilities of an organization and is the source of the economic value of an organization. The competitive advantage thus developed generates a sustained level of profitability above the industry average (Fries, 2006).

3.1.3 Tracy and Wiersema

The concept of limiting the basis on which strategy might be developed has been taken a step ahead by Michael Treacy and Fred Wiersema who claim that a company can become an industry leader by narrowing and not expanding its business focus. Treacy and Wiersema state three "value-disciplines" that can provide the basis for strategy: operation excellence, customer intimacy and product leadership. Similar to driving forces only one of these value-disciplines

must be used when formulating the strategy. When the strategy is based on operational excellence the focus should be on managing business and operational processes efficiently and evolving the right culture. The goal is to outperform the competitors in terms of the price achieved through lower operational risk and lower operational costs. Customer intimacy is a strategy characterised by a high attention to customer needs by targeting certain markets and providing offerings to meet their niche demands. The objective is to connect closely with the customer and ensure long-term customer profitability. Product leadership as a strategy includes providing customers top-of-the-line products and services that makes the competitors' products obsolete. This is achieved by making superior products by investing in R&D, having superior product development to ensure a longer first-mover advantage (Fries, 2006).

3.2 Strategic Management Process

The strategic management process describes the manner in which an organization formulates and executes plans to meet the organization's goals and targets. Strategic management is a continuous process and that evolves with the goals and aspirations of the organization. It involves defining objectives, evaluation of internal and external environment of the organization, strategic allocation of resources to obtain a competitive position in the market. Strategic management activities help to implement the plan to create a system that relays strategic performance feedback to decision-makers thereby allowing the plan to evolve as per changes in requirements and market conditions. It must be noted that the goal of strategic management is not to predict the future but to be prepared for it and actively ensure the organization implements its strategic plan to ensure a competitive advantage (Maleka, 2014). The following Figure 5 describes the key steps in the strategic management process:

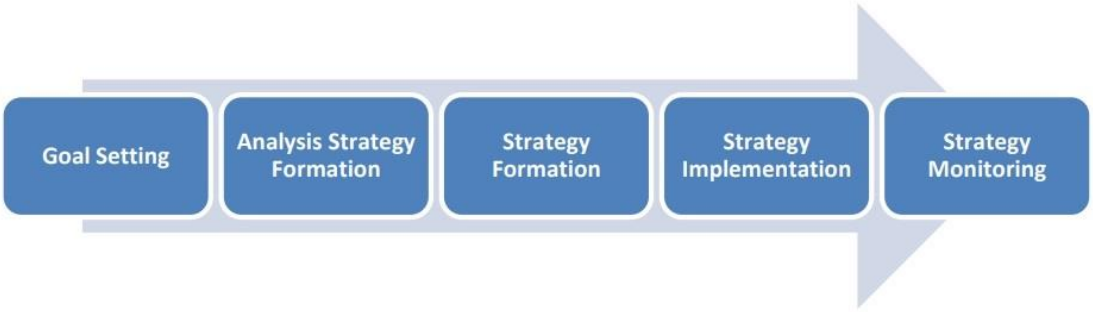

Figure 5: Key Concepts for Strategic Management Process (Maleka, 2014)

- Goal Setting

The primary and most critical step of the strategic management process is defining goals, a mission statement, values and organizational objectives. The organizational goals, mission statement, values and objectives lead the organization towards strategic opportunities. The goals guide the managers when they have to make strategic decisions regarding how to reach targets and increase revenue.

- Analysis Strategy Formation

The analysis of strengths and weaknesses is a vital phase of strategic management. Following the internal analysis, the external analysis is conducted to identify factors such as new competition and emerging technology. The result of these analyses is strategic objectives to sustain and grow the business and adapt to changing technology and emerging markets.

- Strategy Formation

Strategy formation involves elaborating specific actions that will facilitate an organization to meet its goals. Strategy formation includes applying insights from the analyses, prioritizing, and taking key decisions on how to address critical issues to be overcome by the organization. Furthermore, an organization seeks to find sources of sustainable profitability and competitive advantage through strategy formation.

- Strategy Implementation

Strategy implementation is the deployment of the formulated strategy to meet organization goals. The aim of this step is to collect all the available and required resources to put the strategy into action. The strategies are implemented by allocating budgets, creating programs and policies to meet management, financial, operational, and human resources goals. The level of success for the implementation of the strategy depends on the coordination between the top management and other personnel.

- Strategy Monitoring

The final step is monitoring the strategy after its implementation. Strategy monitoring involves assessing the strategy to determine if it will meet the requirements as defined in the organizational goals. An organization demarcates the areas of the plan to be measured and the methods to be used for measuring these areas. Finally, the actual measurements are compared to expected values so that the organization is able to comprehend when and how to alter the plan to adapt to changing trends.

The strategic management process thus assists organizations to analyse their current situation, sketch out strategies, execute them and monitor the effectiveness of the implemented strategies. This is achieved as the strategic management process works as a reference for major decisions as it helps to guide the company to its future with alignment to the company's vision. It also ensures that the organization is proactive and not reactive which is done by a thorough analysis of competitor's behaviour and market conditions and hence taking steps to succeed in the market. When properly conceived and implemented strategic management process can help improve an organization's activities thereby achieving greater operational efficiency, competitive advantage and profitability. At the same time, ineffective strategic management can lead to losing out to competitors and even bankruptcy which can sabotage the careers of executives (Masumi, 2017).

3.3 Strategy Analysis Techniques

Strategic Analysis tools are used by companies to determine and evaluate the appropriate data required to build the strategy, describe the external and internal environmental factors that affect the company activities, and make informed decisions based on the analysis. Strategic analyses must be implemented meticulously because they lead to decisions that have a profound effect on the company (Francois, 2014). The top managers, decision-makers, and analysts commonly use strategic models to develop insights about the strategic position in the market. The inclusion of both data and analytics into the models greatly improves the quality of the analysis and might reveal previously hidden information that may produce different views for business intelligence. Therefore, the quality of decisions is improved and the consequent actions. The most popular and commonly used strategic analysis techniques namely SWOT analysis and BCG analysis are discussed below (Fries, 2006).

3.3.1 SWOT Analysis

SWOT analysis is used to assess the internal strengths and weaknesses, and the external opportunities and threats present in an organization's environment. The internal analysis

identifies resources, capabilities, core competencies, and competitive advantages deep-rooted in the organization. The external analysis determines market opportunities and threats by examining the competitors' resources, the industry environment, and the general environment as described in figure 6. The goal of a SWOT analysis is to utilize the knowledge an organization has about its internal and external environment and develop its strategy accordingly.

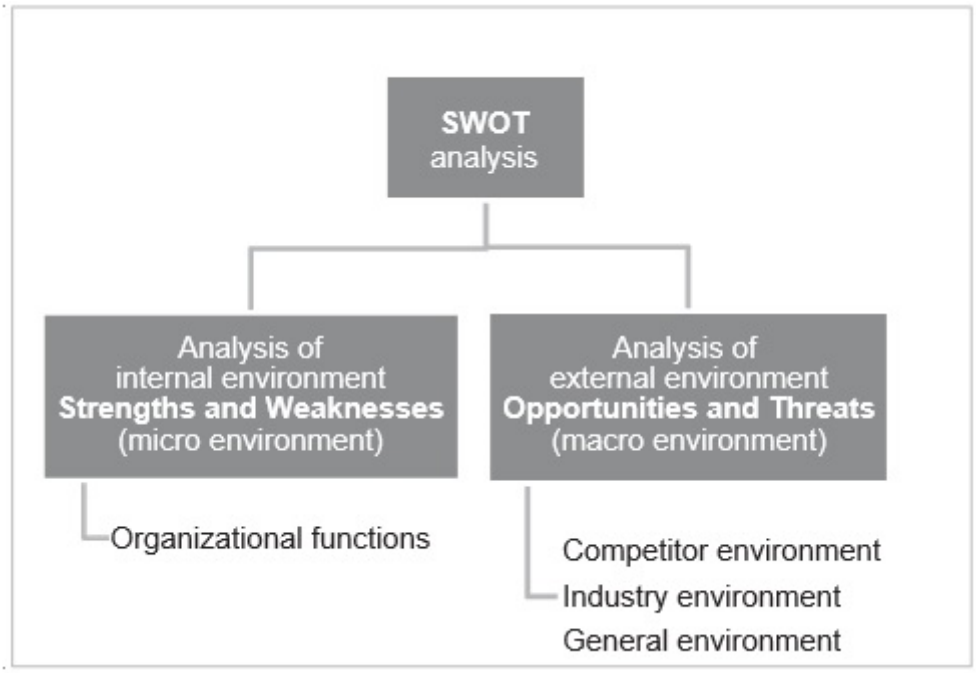

Figure 6: SWOT Analysis main components (*Sammut-Bonnici* & *Galea*, *2015*)

An adaptation of the SWOT Analysis is Weihrich's TOWS Matrix (see Figure 7). The matrix defines potential tactical strategies that can be employed with the intention to exploit opportunities or defend against threats by making use of the existing strengths and the mitigation of weaknesses. The TOWS Matrix aims to establish tactical strategies based on four different positions. In the first quadrant lies the WO strategy which seeks to take full advantage of the opportunities emerging from the external environment and phase out the organization's internal weaknesses that prevent its growth. The SO strategy in the second quadrant describes an ideal situation in which an organization can accelerate both strengths and opportunities. In the third quadrant, the ST strategy seeks to utilize the organization's internal strengths to neutralize the threats from competitors, the industry, and the wider environment. A company with a strong market presence may have to face threats from the external environment like charges for non-competitive strategic action. The fourth quadrant consists of the WT strategy

which is the worst-case scenario where the organization has to defend itself against weaknesses and its threats. The external forces are not avoidable as in the instance of the tobacco industry where the survival of organizations relies on the precaution-oriented strategy to offset strict regulation and lawsuits in many countries.

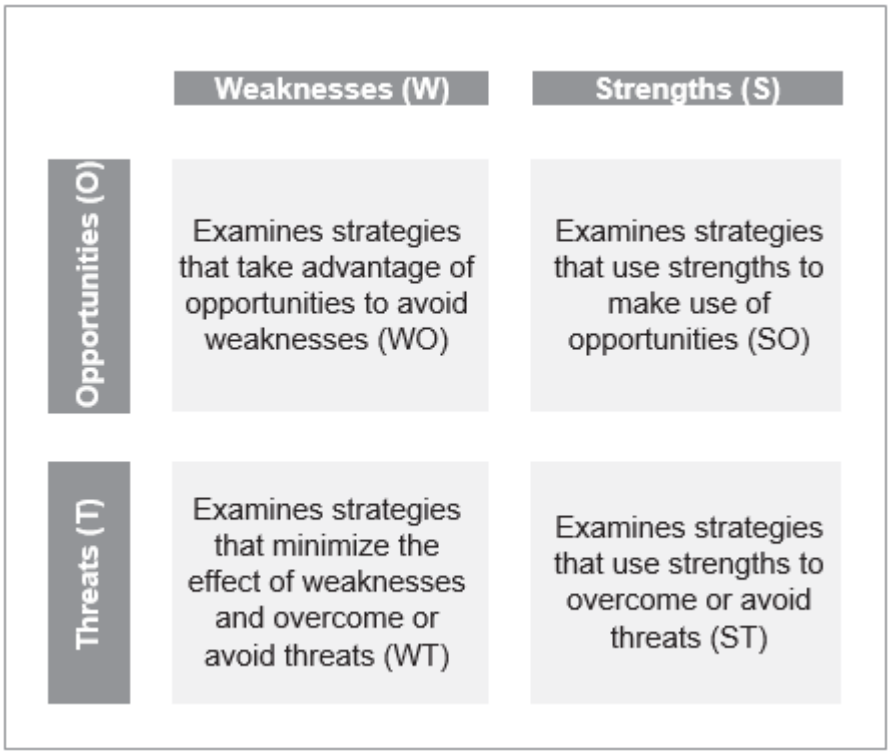

Figure 7: WOTS Matrix (Sammut-Bonnici & Galea, 2015)

In the SWOT model, business analytics can be useful inputs when identifying both internal and external factors. For example, after analysing trends in data for an organization it may be found that there is a 10% increase in contracted prices over the last 5 years due to poor procurement practices. This particular finding obtained through analytics will be noted as a weakness in SWOT analysis. Analytics can be used to understand the needs of present customers and probable future interests of new customers to create new opportunities for the organization to exploit. Therefore, it can be concluded that SWOT analysis can be improved with the help of business analytics (Sammut-Bonnici & Galea, 2015).

3.3.2 BCG Growth/Share Portfolio Matrix

The Boston Consulting Group (BCG) growth/share portfolio matrix was developed in 1986 by Boston Consulting Group to assist organizations present in multiproduct and/or multimarket businesses to formulate the corporate level strategy. It is an analytical tool that consists of a

framework to build the most optimal business portfolio and generic strategies to ensure efficient resource allocation throughout the business portfolio (Fries, 2006). The business portfolio is categorized into four types based on the attractiveness of the industry measured by the market growth rate and position with respect to competitors which is measured by relative market share. Market growth refers to the maturity of the market. New markets tend to grow and expand hence providing additional opportunities for revenue to be divided between market participants. The market share represents the percentage of the overall market accounted for by a company's business unit (Adams, 2013). Figure 8 illustrates a graphical representation of the BCG Matrix.

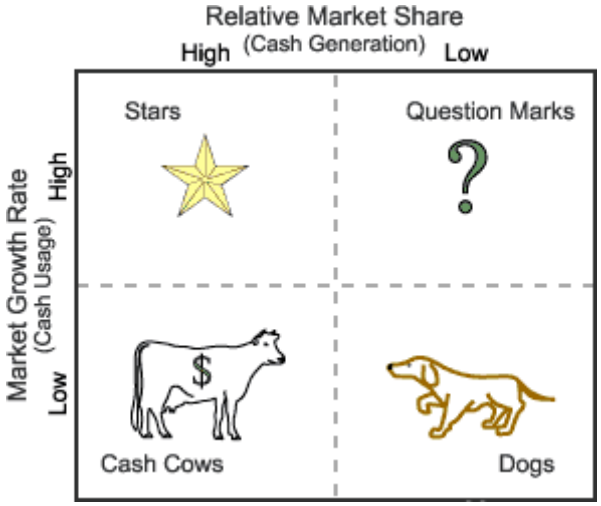

Figure 8: BCG Matrix (*Mahajan*, 2018)

A company's business portfolio consists of Stars, Cash Cows, Question Marks, and Dogs and is explained by (Mahajan, 2018) as follows:

- Stars:

  Stars are characterized by a high market share in a fast-growing market with opportunities for growth and a tendency for large profits for the business. Stars are cash generators due to the higher market share but also cash consumers due to high growth rate leading to investments in new plant and equipment, high R&D expenses. As the market share increases and the industry matures leading to declining market growth rates, stars are expected to become cash cows as shown in figure 9.

- Cash Cows:

  Cash cows enjoy a large market share in a mature industry with a low growth rate. Cash cows should be "milked" to generate large positive cash flows. They require very little

investment and the significant amount of cash generated should be invested in stars in order to induce higher growth. The top management generally finds cash cows less attractive in terms of growth but acknowledges their value due to their cash-generating abilities.

- Question Marks:

  Question marks are business units having a low market share in a market with a high growth rate hence consuming large amounts of cash and facing losses. They have the potential to capture a large market share and transform into a star and eventually cash cow but this requires a large investment from the organization accompanied by a detailed strategy. If question marks do not gain market share in spite of large investments they decline into dogs (figure 9). Question marks need to be examined closely by the management to decide if they deserve further investment.

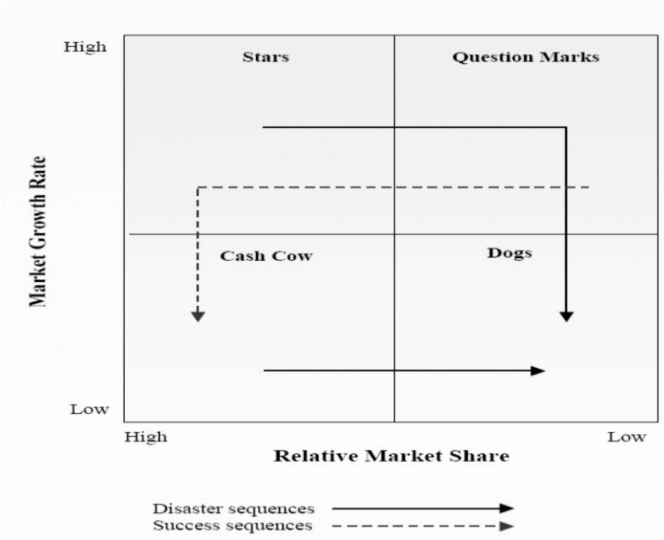

Figure 9: Flow Chart of BCG Matrix (Mahajan, 2018)

- Dogs:

  Dogs are business units having a low market share in mature industries characterized by a slow growth rate. The low market share is due to factors such as high costs, low-quality products, unsuccessful marketing. On some occasion's dogs might be profitable in the long term or play a role of strategic importance against competitors. An exhaustive analysis should be performed to ensure the business units are not worth investing over and should then be divested, liquidated, or trimmed down. The resulting cash flow should be used to evolve question marks into stars (figure 9).

3.4 Business Analytics at a strategic level

Organizations that are building an effective business strategy need a comprehensive business analysis from the beginning because this illustrates thoroughly what the business needs are. The BA analyses the needs and problems faced by the business and formulates the possible options for the future which forms the base to articulate a coherent strategy. The BA deeply studies the organization to identify its values, expertise in management, organizational structures which helps them to harmonise operational and strategic decision-making across all levels of the organization. The advantage of involving BAs at an early stage ensures that the changes that they propose are in synchronisation with the strategy, targets, and goals of the organization (Osborn, 2018). The various levels of integration between the BA function and the company's strategy can be described by the following four scenarios. Each of the scenarios gives the understanding of whether the organization has recognised and utilised the capability of the BA to the fullest or if there needs to be some improvement in BA as follows (Laursen & Thorlund, 2010):

Scenario 1: No formal link between BA and Strategy

The first scenario is a case where there is no formal link between the implementation of BA and strategy. This is seen in companies that do not possess much data or with trivial amount of data distributed over a multitude of source systems, which are usually unable to make a link between corporate strategy and BA. In most companies, strategy is developed with respect to sales targets, production targets, or cost targets which are associated with primary functions like sales department, production, and procurement departments. BA being a support functions in a manner such that it meets the demands from the owners of the primary process thereby indirectly interpreting the business strategy. This results in a situation where BA primarily focusses on the daily target achievement rather than what is important for long-term strategic goals.

A few other reasons why there could be no link between strategy and BA is if companies have recognised that they do not possess the data, the experts, or technology to perform analytics. In the case of small businesses, the cost encountered to create and maintain a data warehouse is higher than the value of the decision support generated. In some companies, the strategic targets may be defined in a manner such that they cannot be measured. For example, one of the targets could be to improve customer relationships, which is very challenging to quantify thereby applying analytics a very complicated task.

Scenario 2: BA supports strategy at a functional level

In the second scenario, the BA function has a reactive role, merely for the purpose of monitoring if the targets defined in the strategy are accomplished. The same is described in Figure 10 below. The results or key performance indicators are submitted to individual departments hence the feedback to the strategic level is absent. The BA function proactively assists company performance, but only reactively in the case of company strategy.

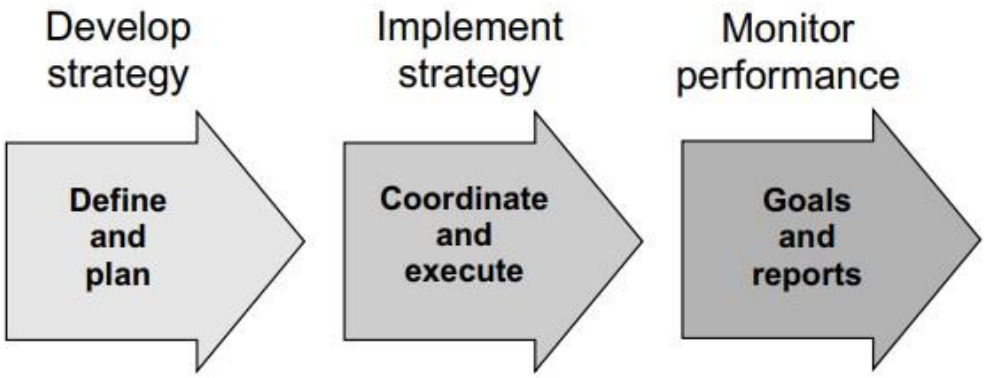

Figure 10: BA Supports Performance (Laursen & Thorlund, 2010)

The BA functions in such kinds of organizations have to be exceptional at determining targets based on strategy. It must be noted that the targets are internally linked and that together form the target defined in the strategy. It is essential that the BA function is technically proficient to translate these targets into reports and ensure that these reports are easily available to the users and consist of the latest updated information.

Scenario 3: Dialogue between the strategy and the BA functions

The third scenario exists with a combination of an organized data warehouse and to store and handle data and a competent BA function with analytical skills to utilize this data. In this scenario, there is regular communication between the strategy and BA functions. The governance and measurement of the operational processes are done by reporting methods like business performance management (BPM) systems, customer profitability/ segment analyses, and scorecards. This implies that there is a feedback of information to the strategy function with the help of the produced reports. The information is used in a cyclical manner with the strategy as the starting point. The following three steps are followed based on the strategy:

benchmarking is implemented; the deviations from targets are identified and analysed; lastly the strategy is modified and optimised based on the analysis.

In this scenario strategy may be adjusted depending on the changes in the market and the company itself. The reports summarize the measurement of performance of individual departments and verify if they are meeting KPIs failing which actions will be taken. In this manner, there is always continuous feedback between defined targets and strategy. As described in Figure 11 the process is an ongoing cycle where the company as the starting point has determined a strategy to be executed by the various departments. The various departments should ensure that they are in coordination with respect to the critical success factors for the strategy to be successful. The progress is measured regularly and checked if KPIs are higher or lower than the targets and in both cases, learnings are obtained after thorough analyses. The optimization of this strategy occurs when the learnings are used to strengthen the business processes and ensures a positive impact on the organization. The cumulative learnings from previous analyses can assist to understand observations in terms of the strategy for future iterations.

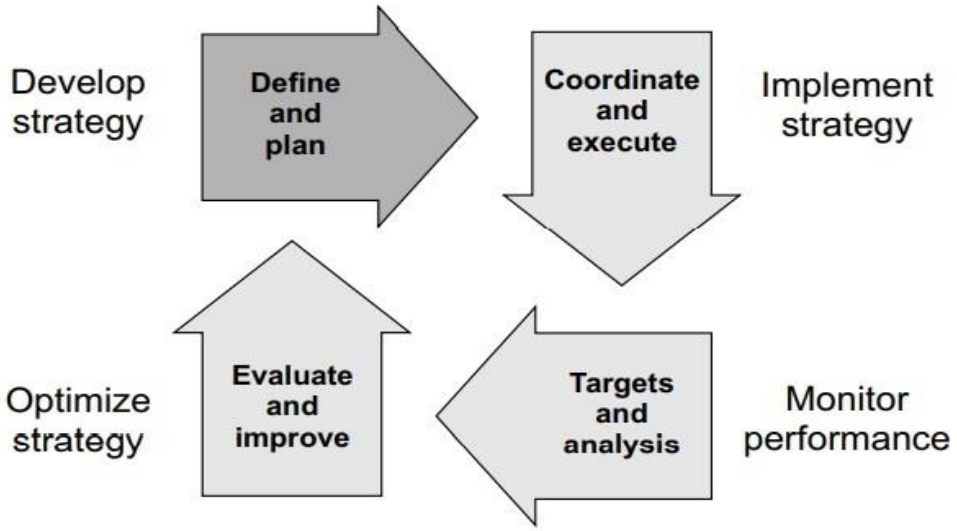

Figure 11: Feedback processes and Learning at the Strategic Level (Laursen & Thorlund, 2010)

Section 4: Information as a Strategic Resource

Organizations in the fourth scenario consider information as a strategic resource. The distinguishable feature of these organizations is the in-depth analysis of their market strengths and weaknesses and how they use this information along with their strategies to gain a competitive advantage. Figure 12 below illustrates that the focus is on people competencies rather than technical specialization as demanded by the strategy development process. The

organization should have resources with strategic and information expertise represented at the top management. This is a common occurrence in the age of information.

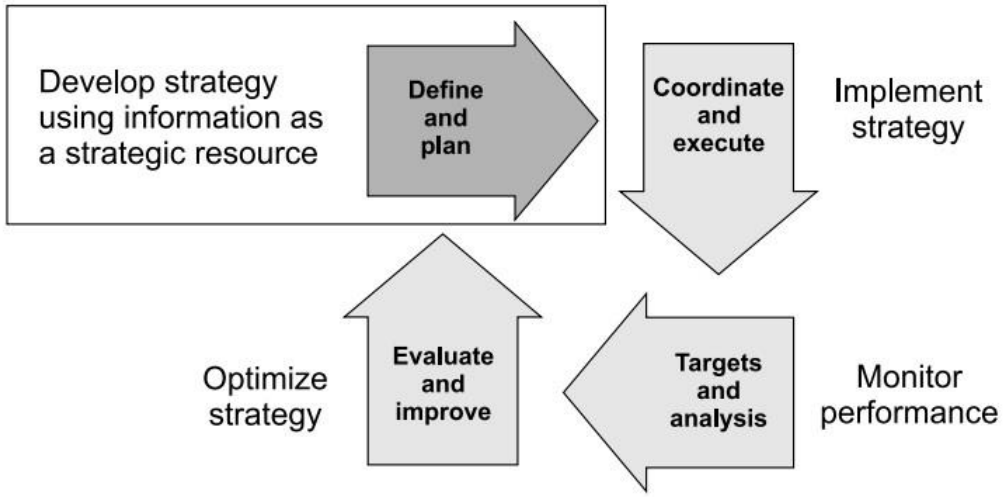

Figure 12: Information as a strategic resource (Laursen & Thorlund, 2010)

A company can be considered as one that uses data or information as a strategic asset when its strategy consists of certain characteristics. The strategic implementation plans will not have a narrative of how to gain competitive advantages using data and analytics in the case of companies that do not use information as a strategic asset. On the other hand, a company that uses information as a strategic asset will provide guidelines to meet the objectives with the use of information. The traits of an organization that uses information as a strategic asset can be seen in its culture where its employees will actively engage themselves to use data to gain a competitive advantage. In such organizations, if one department realizes how to strengthen its processes using data, the learnings will be picked up by the strategy team and circulated throughout the organization in the strategy creation process.

The four scenarios show the readiness, capability, and competence of an organization to work with data on different levels. It cannot be said that one level is always superior to the others. The suitable level is decided based on the business strategy. BA information is critical for business success in some industries and a vital competitive criterion in others. In the case of scenario 1 for example, the business should recognise that it does not have the data, infrastructure or expertise to use BA. From the strategic point of view, the company should take appropriate measures to move to the next phase or select an alternate strategy that is not reliant on information.

4. METHODOLOGY

4.1 Data Accuracy

4.1.1 Introduction

In 1999 when the NASA Mars Climate Orbiter neared the destination planet it lost communication with mission control and burned up in Mars atmosphere because of a miscalculation induced due to inaccurate data. The Orbiter's thrusters were operated by two separate software programs. One of the thruster's software was measuring the required force to stay at a certain altitude in pounds(lbs), the other thruster considered the data was in Newtons(N). The above is an extreme example but it describes the need to cautiously address the issues that could be caused due to poor data accuracy. There is a large amount of web data available in present times hence problems due to high volumes of inaccurate data should be given the highest importance.

The two significant characteristics that accurate data has are form and content. Form refers to the structure of data meaning that data must be present in a standard format. This avoids uncertainty and aims to provide the unambiguous meaning of the data content when processed by a computer. Content relates to the information represented in the form of data, the different formats in which a single date can be is an example that shows how form can affect the processing of data. April 5, 2020 can be written as 5/4/2020 or 4/5/2020 and hence can mean two different dates depending on who is interpreting the data. An American would read it as April 5, 2020 while a European would read it as May 4, 2020 if they do not know the data source. If the data is to be analysed properly it must also be consistent failing which a computer will not be able to group and summarize information by spotting resemblance in the available data. For example, city names can be written in multiple ways like "New York City" can be referred to as "NYC", "New York" or "NY, NY". A computer will not be able to establish that the content represented by each piece of data is the same hence forbidding it from grouping and summarizing the data accurately. The data cannot be considered ready for analysis just by meeting the criteria for form and content. Data, being the portrayal of real-world information should be factually correct so as to accurately describe reality. An efficient system to ensure data is reliable and inaccurate is crucial if useful business insights are to be obtained from the information.

Anywhere between 1% to 10% of data in databases maintained by large organizations is inaccurate. The increasing digitization of an organization's operations makes it all the more susceptible to inaccurate data. The large amounts of data being generated every day have led

to problems related to data handling and storage which in turn leads to inaccurate data. The accuracy of data used for analytics can influence the organization's performance. In recent years organizations have been relying on business analytics tools to make informed decisions regarding topics like financial planning, supply chain decisions, predictive measures, and budgeting among others. The interdependence of various units of enterprise resource planning (ERP) systems induces a situation such that inaccurate data from one unit can adversely affect the functioning of other units. Business analytics, which completely relies on the underlying source of data might lead to inefficient decisions and outcomes as managers usually assume that the data they are depending on is near perfect (Choughri, Kamaleddine, Soubjaki, & Baytieh, 2018).

Organizations have shown a lot of interest regarding the consequences of poor data quality on inefficient decision making which has led to inferior customer satisfaction. Nowadays decision-making in most organizations relies heavily on business intelligence which has established itself as a competitive differentiator. The successful implementation of business intelligence depends on availability, integrity, consistency, and quality of customer data. The detrimental effect of the usage of inaccurate data is harm to brand reputation, lower customer loyalty which ultimately leads to financial loss. It can lead to inefficient use of company resources as they are dedicated to conforming and verifying inaccurate data, undermined audits, poor strategy making, and inaccurate forecasting of future trends. The negative effects of inaccurate data can be further analysed as direct and indirect costs. Direct costs are composed of errors during delivery and payment, poor efficiency, and late deliveries. Indirect costs consist of discontent of customers and staff, duplication of data, inefficient production planning, improper understanding of market conditions. The concerns regarding inaccurate data can occur at three different levels namely tactical, strategic and operational levels and the constraints are generally technical, organizational, or behavioural. Technical challenges occur due to the processes or systems that collect, analyse and process data, Behavioural constraints arise depending on the methods users use data to tackle issues and improve processes. Organizational challenges are caused by the organizational structure, company culture, and processes that require and handle the data. The challenges of data accuracy have resulted in providing awareness to decision-makers regarding the review and analysis of data. If data has to be an important part of decision-making throughout the organization the key resources must have the competency to investigate, understand, analyse, and utilize the data. A few methods to ensure data accuracy are by performing edit checks, verification of dependent values, and

thorough documentation of source of data. A few other measures can be implemented like ensuring strict internal data governance procedures, deleting redundant data from the company's databases, using monitoring and prevention control mechanisms, and enforcing efficient data accuracy processes and data standardization (Choughri, Kamaleddine, Soubjaki, & Baytieh, 2018)

4.1.2 Why data accuracy matters

To say it in a brief manner data offers insight. It is the cornerstone based on which business stakeholders take important decisions. The decisions are not associated solely with the upper management. All the employees make decisions across the entire organization every day hence they require access to accurate data at every stage. Data, however, is seldom beneficial in its raw state hence businesses must process and organize data in a manner that it is useful at the respective levels so that decision-makers can exploit it properly. The vast number of analytic tools make this a simpler task but there are a lot of operations data must go through to be valuable across the organization. In the case that data accuracy is poor at the beginning of this process, the insight will be insufficient resulting in decisions that are of poor quality. Therefore, businesses must understand that quality is more important than quantity and thereby the goal should be to think about the reliability of the data gathered and how it can be utilized rather than collecting as much information as possible. An organization must always ask itself if it is basing its critical decisions on reliable information (Deeney, 2014).

Data can have a wide variety of uses for businesses. It can help with tasks like the correct market segment to target, pick between vendors, staff to hire or make an informed choice when choosing between multiple strategies. This can be done by the information systems in the business only if the data is reliable. The growth of a company relies on a well-coordinated approach, leveraging the core competencies to obtain a superior market position. Weak quality of data makes it harder to promote growth as high-value resources are wasted in unproductive tasks. A lot of upcoming technologies like artificial intelligence and marketing automation rely heavily on data quality. The tremendous potential these technologies possess to help companies succeed depends directly on the quality of data. The algorithms can deliver faster and more valuable results when the input data is accurate. The other aspect of data quality comes in the form of particular compliance-related concerns (Beck, 2019). The following points are reasons describing the importance of data accuracy:

- Data accuracy paves the way for better business decisions

Data has to be a precise depiction of reality. The saying "garbage in, garbage out" clearly describes the importance of reliable and accurate data for analytics on that data. Analytics can be used to boost revenue as good quality data helps support efficient decision making which in turn drives sales. High-quality data helps to send the correct message to the targeted audience thereby making marketing more efficient which leads to an increase in sales. The customer experience can be improved as marketers can use data to prompt potential customers to step into a long- term customer journey. Once the organizations' databases are properly organised, lesser time and resources are consumed to remediate (Fogg, 2020).

- Data accuracy promotes trust in the data

Stakeholder acceptance and the impact of analytics rests on their belief in the data. The top-level management and end-users don't always take into account the efforts needed into creating a dashboard. Nevertheless, they do have an intuitive idea regarding accurate data hence they do know the consequences of obviously inaccurate data. A report released by KPMG in 2016 titled "Building trust in analytics" stated that only 45% of 2165 data and analytics personnel constantly use meticulous quality checks to assure the accuracy of data and analytics models. It further mentions that:

- 60% of business are convinced that their data and analytics is not completely accurate
- 16% believe that they are up to the mark in providing accuracy of analytical models
- 10% believe that they are skilful in handling the quality of their data

There exists a chance to improve this trust gap which will ensure the efficient utilisation of data to create business value. This can be done by infusing a culture of consistent data governance that actively promotes data accuracy. Data governance must be included in the processes that bring the data into the data warehouse to ensure data fed into the analytical tool is correct (Fogg, 2020).

- Data accuracy leads to lower cost

Data errors can be incredibly costly for any organization, but the consequences can be beyond monetary losses. Apart from being a strain on financial resources, poor data quality will have a negative effect on the brand value, productivity, and overall operations of an organization. In the worst-case situation, it can cause irreparable damage to the brand name of the company. The major challenge when it comes to bad quality data is that it can cause a chain of lapses which will require a monumental amount of time and resources to detect and repair these errors. Accurate data helps the employees to focus on crucial tasks of the company rather than

spending time on investigating and fixing data errors. Poor data can lead to opportunity costs due to the failure to identify the latest market trends, the result of which could be missing good business opportunities (Roberts, 2019).

- Data accuracy is a fundamental prerequisite for artificial intelligence

Data accuracy is more relevant for businesses that engage in strategies relying on artificial intelligence (AI). A joint study conducted by MIT/Google to investigate the considerable adoption of machine learning (ML) in the marketplace states that:

- 60% of the participating companies have introduced ML activities
- 50% are utilizing ML to have a greater perception of customers
- 48% presume ML will ensure they compete more aggressively
- 22% say that the top management will assume principal responsibility for their organization's ML activities

The beneficial impact businesses will gain from AI and ML depends on good quality data. At the core of AI technologies are algorithms that employ data to make projections and iteratively alter these models with more data inputs. AI models require little or no human intervention once they are deployed which makes accurate data all the more important. While AI can learn and manipulate data by itself, it cannot identify inaccurate data. The end result being predictions delivered by AI models may be inaccurate thereby harming customer relationships, competitive position, and revenues (Fogg, 2020).

- Data accuracy facilitates compliance

Data accuracy and compliance are not just about managing risk, it has the possibility to be a competitive differentiator as companies are moving away from disruptive marketing towards purposeful customer relationships. Compliance has become an essential aspect for all customer-facing businesses as the laws and regulations concerning user's privacy are increasing with severe punishment for violators. This means that organizations need to strategize with care when handling the quality of their contact data. The new laws like the U.S. Telephone Consumer Protection Act (TCPA) or Europe's new General Data Protection Regulation (GDPR) deal with data quality and expect organizations to have a systematic method that assures valid and legal marketing contacts. As regulations keep evolving companies need to ensure they evolve with them and this can be done by preserving data accuracy (Roberts, 2019).

4.1.3 How to ensure data accuracy

Before data science became as popular as it is today, data quality was referred to only in reports provided to internal or external clients. At present, since machine learning demands a considerable volume of training data, the internal data sets managed by businesses have strong applications. Besides, analytics is always on the lookout for data and is continually looking for data assets that can conceivably add value, which has resulted in rapid admission of newer datasets previously unexplored. This trend can be the starting point on the path to ensure data accuracy. The first step to improve data accuracy is to evaluate and improve an array of quality dimensions which are shown in figure 13 below:

Figure 13: The array of quality dimensions (Profisee, 2018)

Uniqueness is the most important data quality dimension in the case of customer master data. Customer master data often contains duplicate entries, that is two or more database rows representing the same object. It must be noted there are numerous methods to identify the duplicate records at the integration point or for large-scale deduplication of records present in one or several databases. In the case of product master data completeness is often the topic of concern. The reason being completeness implies different terms for different categories of products. With location master data consistency of data is the biggest obstacle. An example is addressing the numerous postal address formats around the world which can be a herculean

task. At the intersection between the location domain and the customer domain lies the data quality dimension called precision. This is particularly tough to handle as various use cases involve different precision for a particular location be it a postal address and/or a geographic position. The conformity of product data is dependent on locations. For instance, in the USA small-sized objects are measured in inches while the same would be measured in centimetres in other parts of the world. Timeliness is the dimension which talks about the availability of data at the right time is one of the most lasting quality dimensions.

The key to success when it comes to data quality is that any organization needs to pay attention to every dataset from the time it is received or created. This eventually means that data quality is guaranteed and the following steps can help to achieve the same.

- Stringent data profiling and regulation of incoming data

In the vast majority of cases, bad data originates from data receiving. In most cases, data is usually imported from outside sources not in control of the company. The data could be generated from another organization or in most cases gathered by third-party software. Data quality from a foreign source cannot be assured, hence strict quality control is necessary for incoming data and can be called the most vital data quality control task. A good data profiling tool that can scrutinize data format and data patterns, data consistency on every record, completeness of data is invaluable. It is advantageous to automate the data profiling and data quality alerts to ensure that the accuracy of incoming data is systematically monitored as and when received. Every piece of incoming data must be controlled applying the same standards and best practices and must be recorded on a centralized directory and the accuracy of data monitored by a KPI dashboard (Shen, 2019).

- Data Quality Reporting

The results from data profiling must be used as an input to monitor data quality KPIs depending on the data quality dimensions which is of concern to the given business. Data quality reporting needs a managerial oversight of the information being processed. There is a possibility the operations department and executives might incorrectly think that their data is in a great state due to unintentional poor-quality reporting. Effective data quality reporting is important to any strong data analysis and can be used to develop strategies to improve the quality of information. It is also beneficial to maintain a data quality issue log where all the data quality issues are recorded which also includes preventive and data cleansing activities. Companies trying to improve data quality can implement a data quality dashboard emphasising the trend in the data

quality KPIs and trend in the problems being handled in the data quality issue log (Profisee, 2018).

- Meticulous data pipeline design to prevent duplicate data

Duplicate data occurs when part of data is developed from the data source, using similar reasoning, by different analysts or teams most probably for different purposes. Thus, duplicate data generated will not be in sync leading to inaccurate results with cascading effects across multiple systems or databases. This will eventually lead to data issues which will require laborious efforts to identify the root cause and fix it. In order to ensure this does not happen a data pipeline must be precisely established and meticulously defined in areas such as data modelling, data assets, and architecture. A data governance program that expressly outlines the ownership of a dataset and efficiently communicates and notifies teams about dataset sharing is useful to prevent duplicate data from being formed. This can be supported by centralized data assets management and data modelling which should be examined and audited at regular intervals. The presence of an unambiguous logical design of data pipelines that is communicated across the organization is the most long-lasting solution for the prevention of duplicate data (Shen, 2019).

- Accurate collection of data requirements

A substantial facet of maintaining good data quality is to meet the requirements and to provide the data to users such that they get what it is intended for. The first problem is that data cannot be properly presented hence making it difficult to comprehend exactly what a client is looking for. This usually requires data analysis, data discoveries, and constant correspondence accompanied with examples and visualisations. Secondly, the requirement should consist of all the data conditions and scenarios such that all the dependencies and conditions are examined and recorded. The data governance team should make precise documentation of the requirements and ensure easy access shared across all the relevant teams. Business analysts perform gathering of data requirements by interpreting the customers' needs and the condition of present systems. Business analysts must also carry out impact analysis to develop testing to ensure the data produced satisfies the requirements.

- Strong Master Data Management (MDM) Framework

The most complicated data quality issues are associated with master data which consists of product master data (roles of supplier, customer, employees, etc), product master data and location master data. The MDM framework must be enforced so that data cleansing activities do not have to be performed often. MDM and data quality must be interlinked as a part of the

organization's data governance framework and share responsibilities with data owners and data stewards. When data profiling activities are performed the results must be stored in data assets handling the merged and purged records and the data attributes associated with those records. The customer master data are created over a range of applications like Customer Relationship Management (CRM) applications, customer service applications, and so on. In addition to the technical complexities of compiling customer master data from multiple sources ensuring data accuracy is a daunting task. This can be done by efficient data matching with the goal to ensure data completeness, superior data consistency, and appropriate data accuracy (Profisee, 2018).

- Automated regression testing included in change management

Data quality issues initially arise when a new dataset is introduced or an existing dataset is amended. For successful change management test plans should have a system to verify if the change fulfils the requirement and assures the change will not have an unintended influence on the data in the pipelines. In the case of particularly important datasets, periodic regression testing should be performed for every deliverable and each field of every row of a dataset should be examined. The rapid advances in technologies related to big data have led to periodic system migrations which occur in a few years. In order to continually maintain good data accuracy automated regression testing with meticulous data comparison is advised (Shen, 2019).

4.1.4 The dangers of data inaccuracy

Bad data is similar to cracks in a foundation; building on it is exceedingly risky. Partial and incomplete data collection can end up with lost revenue, wasteful media expenditure, and inefficient decision-making. Garbage in, garbage out is a description of poor-quality data. Poor data input results in inaccurate decision-making and negatively affects performance. The advent of the internet has led to an ever-increasing sophistication in the consumer journey. An organization must precisely track the channels or campaigns that are boosting conversions failing which leads to a loss of awareness about optimization insights, possible sources of revenue, and the capability to analyse why conversions are or are not materialising. For example, partial data causes undervaluing specific channels that in reality might be providing more conversions in a cost-effective manner. Nevertheless, without understanding the complete data the company may shift its focus to subpar or more high-priced channels which leads to higher media spend and lower sales potential (Francis, 2016).

A real-life example of inaccurate data is the Enron scandal of 2001. Enron was one of the most influential and biggest companies in the world. In the early 2000s, they granted astonishing

executive compensation and experienced towering stock prices. Nonetheless, multiple instances of fraudulent financial data can be linked to the collapse of the company. The internal whistle blowers and the evidence of destruction of documents by Enron's external auditors is proof that the data presented to the shareholders was predominantly incorrect. The data that was given to the Board of Directors by Enron's executives and their auditing firm to stockholders in the form of annual reports and financial statements turned out to be false. Another example is the 2016 U.S. Presidential Elections which involved a lot of bad data. The endless number of poll aggregators, the media, most pollsters, and predictors made a wrong prediction about a landslide victory for Hillary Clinton. The Democrats believe that this incorrect forecast led to a remarkable number of voters staying home on Election Day. The circulation of bad data could be stopped by the aid of advanced statistics to study previous elections and using artificial intelligence and machine learning to develop models based on voter rolls. This may seem like a complex task but it is an efficient solution to refine the principal assumptions about the polls. It must be noted that these methods are expensive and time-consuming for most polls when in reality online surveys and freely available census data are used.

To summarize bad quality data causes poor decision-making leading to business inefficiencies resulting in very costly rework activities validating and verifying data errors rather than concentrating on core business. Poor quality data leads to a loss in revenues, for example, communication that cannot convert to sales since the underlying customer data is inaccurate. This further leads to erroneous targeting and marketing which can be disastrous in the case of multichannel selling. Companies in industries where regulations impact the relationships with customers must be sensitive about data else it can lead to loss of time, resources, and reputation hence negatively affecting business and creating mistrust. In such companies conserving good data can play a major role which results in compliance otherwise fines worth millions of dollars. A competitor with better quality data has an upper hand when it comes to new product developments or understanding the needs of a customer. Accuracy, consistency, completeness, uniqueness, and timeliness are the five principles to be followed to ensure good quality data. Accurate data is an important factor that plays a crucial role to manage projects, evaluate performance, handle finances, prevent fraud and provide services efficiently.

4.2 Data Warehousing

4.2.1 The case of DirecTV

DirecTV is an American direct television broadcast satellite service provider and has been a consistent contributor to the advancement of TV by its advanced HD (high definition) programs, interactive features, digital video recording services, and electronic program guides. At the time in 2008, DirecTV had more than 13,000 employees in the United States and Latin America and revenues of 20 billion dollars with a total number of subscribers approaching 50 million. The case of DirecTV can be reviewed to understand how interactive data warehousing and business analytics software can provide business benefits much beyond the technical advantages initially predicted. DirecTV utilised software solutions from Teradata and GoldenGate to create a product that incorporates all its data assets in real-time across the entire organization.

DirecTV enjoyed continued blistering growth which led to a new problem of handling high transactional data volumes generated by a growing number of daily customer calls. The fundamental issue which DirecTV had to handle was the significant amount of data and quickly evolving market conditions. A few years earlier the company was looking for new ways to deliver daily reports regarding its call-center activities to the business management side of the company. Management wanted reports which included metrics talking about customer service, engaging new customers, avoiding customer churn. At the same time, the technical team sought to minimize the resource load that the present data management system enforced on its CPUs. An early application of data warehouse was able to tackle the data issues quite well but as the business grew further its boundaries were realised. Prior to the implementation of the active data warehouse data was being pulled by the server every night in batch mode which was a very lengthy process and was crippling the system. In the case of organizations where the timeliness of data is not particularly important the daily batch-data upload can be accepted as the standard procedure. Contrarily, DirecTV was competing in a particularly dynamic consumer market and its business users required to obtain the data from customer calls in a timely manner.

The solution was to develop a new data warehouse system with an initial goal of sending fresh data to the call centre at least daily. As the company discovered the potential of the integrated solutions the new aim was to send fresh data every 15 minutes. An additional goal of the software solution was to facilitate easy changed data capture to decrease the burden of maintenance work for the developers. Initially, data sourcing across multiple platforms was not

part of the plan but that changed when DirecTV understood the potential of the GoldenGate integration system. GoldenGate enables the integration of a number of data management software and platforms. DirecTV could integrate the HP NonStop platform, Oracle, IBM DB2 system, and the Teradata data warehouse. This meant that GoldenGate ensured the company was not stuck to one system which meant they were sourcing out of their call logs and NonStop and multiple data sources. The top management was convinced this was the tool to purchase as it was operable with all the platforms DirecTV supported.

The result is that the system helped DirecTV to measure the churn in real-time which turned out to be a massive business benefit. The real-time reports generated were then used to instantly minimize churn by targeting certain customers. The fresh data could be used by call center sales personnel to get in touch with a customer who had just requested to be disconnected to pitch a better sales offer to retain the customer only hours later the same day. After the IT group arranged the required reporting tools, the sales teams could focus on particular customers for retention and present them with special offers. This campaign clearly worked and DirecTV was soon outperforming its competitors. An additional feature of the system was that it could log customer service calls, thereby it could continuously report the technical issues stated in the field. The maintenance team can use this information to assess and respond to field reports in an efficient manner by providing better service and dispatch technicians as and when necessary. The real-time call-center reports can be analysed to administer the centre's workload using the everyday information regarding call volumes. This data can be used by management for exception reporting by drawing a comparison between daily call volumes and past averages. Another business-centric application that was not foreseen is employing real-time operational reports for fraud detection and order management. The real-time order information about new customers can be used by fraud management experts to study the data and use their insights to eliminate fraudulent orders directly helping to reduce labour and product costs.

The case study describes the strategic importance of developing an active warehouse along with supporting BA tools. DirecTV was able to utilise its data assets present across the entire organization to be used by decision-makers however the need came up. The data warehouse combined several databases across the enterprise into a single, in-house unit to generate a common insight for the company hence giving all the employees the same strategic direction and thinking. Moreover, real-time data was made available to help improve decision making eventually helping DirecTV gain a strategic competitive advantage in the industry. The most important teaching is that a real-time, organizational-level active data warehouse together with

a strategical use in decision making can result in substantial economic and many other benefits for a company (Sharda , Delen, & Turban, 2018).

4.2.2 Data warehousing definitions

Data warehousing is a process for gathering and managing data from various sources to produce relevant business insights and support decision-making. A data warehouse is generally used to relate and analyse business data from diverse sources. It is also a storehouse of current and historical data of possible future concerns to managers across the enterprise. A data warehouse is the core of the BA system which aids in data analysis and reporting. It is a combination of technologies and components which support the strategic use of data (Guru99, 2018).

In the past, companies that didn't have data warehouses were stranded with a lot of detail-oriented but disorganised and unstructured data, which was not of much help to the end-users on the business domain of the enterprise. A data warehouse can process the unstructured data and organise it into a large systematic relational database using a technique called Extract-Transform-Load (ETL). In this manner, a company can take an enormous burden off of its transactional systems and provide better data quality and support to set up data for analysis. It also ensures that during extraction or adding data the operational systems are not adversely affected. The complexities with the above become more pronounced the data is used for business analysis. There is no analytics engine capable enough to execute queries that can filter through every piece of data present in the database. In practice executing such a query would require an extraordinarily powerful hardware setup which would be extremely expensive (Sisense, 2019).

A possible solution to this problem is for companies to use "data marts". A data mart is a basic version of a data warehouse that concentrates on a single topic or function like Operations, Sales, or Finance. Data marts work by allocating multiple groups of people access to one section of the entire data warehouse. It is often developed and handled by a single department in an enterprise and given that the concentration is on a single discipline data is taken from limited sources like an internal system or a larger central data warehouse (SAPinsights, 2017). This lessens the stress on an individual's system when they execute a query but at the same time, no individual can get the full idea from all the data the company possesses which is not a satisfactory result.

A typical data warehouse consists of four primary components which are a central database, ETL (Extract, Transform, Load) tools, metadata, and access tools. The components are designed to be fast so that results can be extracted and data analysed swiftly. The central database is the foundation of the data warehouse. Conventionally, they are standard relational databases working on site or in the cloud. The popularity of big data led to the demand for true, real-time performance combined with a sharp drop in the cost of RAM in-memory databases are quickly drawing attention. Data integration is done by pulling data from source systems and altered to arrange the information for rapid analysis using a number of data integration methods like ETL (extract, transform, load) and ELT with real-time data replication, data transformation, bulk-load processing, and data quality and enrichment tools. Metadata is data about data containing information about the source, values, usage, and other details about the datasets in the data warehouse. The business metadata is used to give context to the data and technical metadata represents how to access data containing information about where it is stored and how it is structured. The data warehouse access tools can be used by users to interact with the data present in the data warehouse. Query and reporting tools, application development tools, executive information system (EIS) tools, data mining tools, online analytical processing (OLAP) tools are examples of access tools.

The future of the data warehouse is on the cloud as companies make a shift to the cloud their databases and data warehousing tools. The benefits of shifting to the cloud are that it offers flexibility, provision for collaboration, and ease of accessibility. The most popular tools like Amazon Redshift, Microsoft Azure SQL Data Warehouse, Google BigQuery, and Snowflake offer straightforward methods for companies to warehouse and analyse their cloud data. The barriers to entry are lowered by the cloud model as the cost is lower, lesser complexity, shorter time-to-value which has led to large adoption and popular use of data warehousing technology. The process of getting started with a cloud data warehouse is quick and relatively simple as it does not require a large up-front investment nor a time-consuming deployment process. Further, the company has the option to scale up or scale down its data warehouse capacity as required with cloud technology. The cloud data warehouse substantially reduces the risks associated with having an on-premises data warehouse. The budgeting processes to purchase hardware and software or for annual maintenance and support can be avoided. The conventional data warehouse engineers have to worry about budgeting for both planned and unplanned system upgrades which is not required with the cloud technology.

4.2.3 Data Warehouse architectures

A data warehouse architecture is used to determine the pattern of data and storing structure. Modern data warehouse architectures are focused on ascertaining the most efficient method of extracting information from data and turn it into a basic consumable form that provides beneficial business intelligence. It is a method to establish the entire architecture of data communication processing and visualisation that exists for end-clients using the system within the company. Many basic information system architectures are perfectly suited for data warehousing. In general, these architectures are referred to as client/server or n-tier architectures, of which two-tier and three-tier architectures are the most popular but a basic one-tier architecture does exist. The multi-tiered architectures have long been serving the needs of large-scale, high-performance information systems such as data warehouses (Fatima, 2021). The three types of data warehouse architectures are defined as follows:

- One-tier architecture

In the majority of instances, a data warehouse is a relational database with partitions to enter multidimensional data or one that can differentiate between domain-specific information to ensure effortless access to users. In the most basic form, an enterprise data warehouse can have just one-tier architecture in which a database is directly linked with the analytical interfaces for the end-user to perform queries. The direct connection between the data warehouse and analytical tools means working on the database directly which leads to disorderly query results and lower processing speeds (Altexsoft, 2019). There is a necessity to have precise input when querying data else the system will not be able to filter the unnecessary data hence making it complicated to use presentation tools leading to limited analytical capabilities. This kind of structure is seldom when large amounts of data are involved as it has lower processing speeds and unpredictable results.

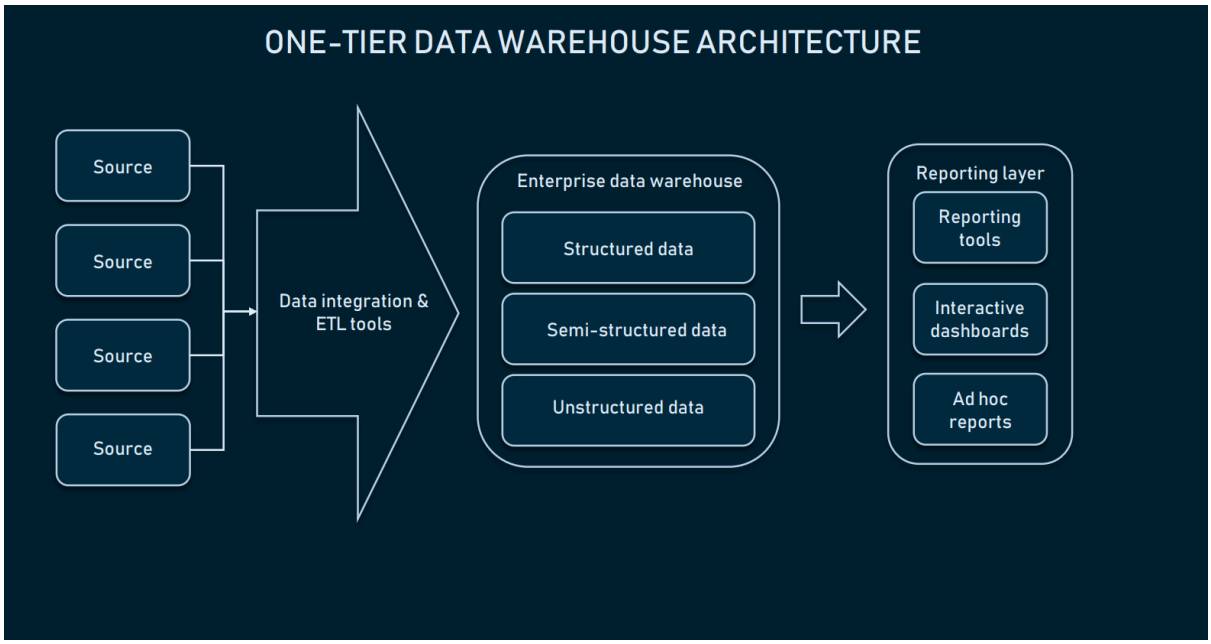

Figure 14: One-tier architecture: reporting tools are connected directly to the enterprise data warehouse (Altexsoft, 2019)

- Two-tier architecture

In order to execute advanced queries, low-level instances can be included in a warehouse to make data access easier, a data mart layer is added between the data warehouse and user interface. A data mart is a smaller-sized database that stores information about a specific topic like sales or marketing or finance etc. The process of creating a data mart layer requires supplementary resources to configure hardware and consolidate those databases with the data platform (Altexsoft, 2019). In this manner, each department can access data more easily because a given mart will only contain department-specific information thereby solving the problem regarding querying. An added advantage with data marts is that it restricts access to end-users making the enterprise data warehouse more secure.

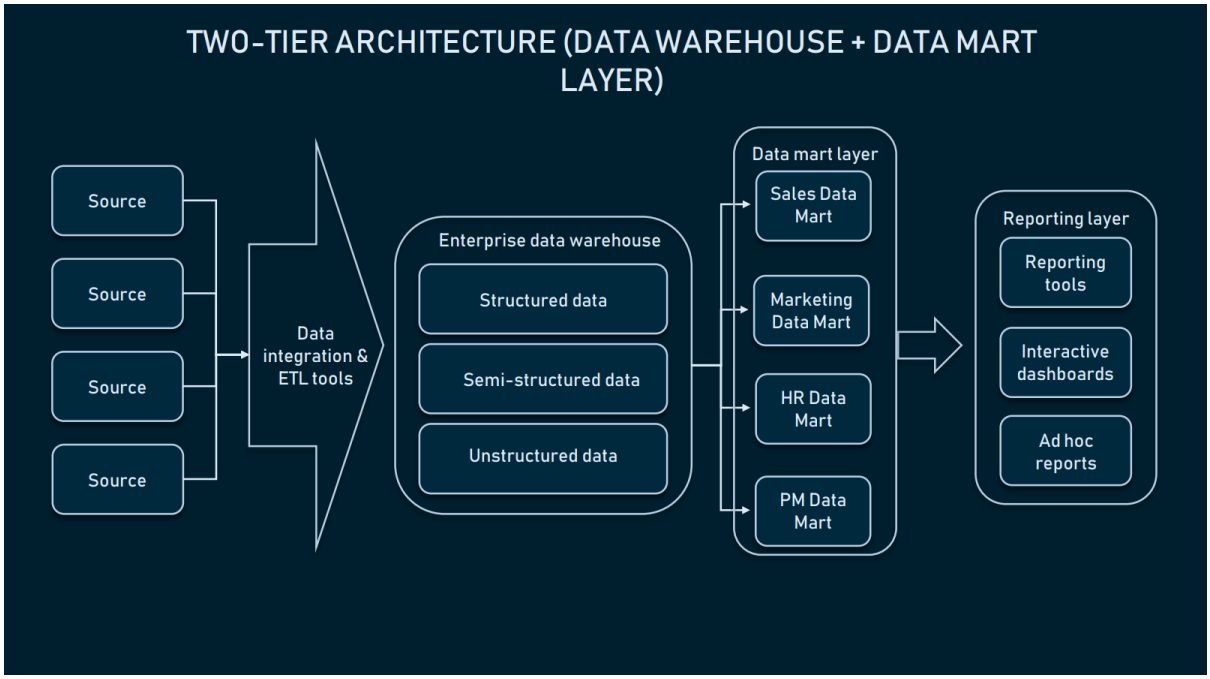

Figure 15: Two-tier architecture: Enterprise data warehouse is extended by data marts to provide domain-specific data (Altexsoft, 2019)

- Three-tier architecture

The three-tier architecture is the most popular modern data warehouse architecture as it generates a highly organised data flow to transform raw information into valuable insights. Online analytical processing (OLAP) cubes are present on top of the data mart layer which is a type of database that represents data from multiple dimensions. OLAP can be used to compile data in many dimensions and move between them, unlike relational databases which use only two dimensions. This layer groups the data into a structure such that it is more suited for analysis and multi-layered querying. The value added by using the OLAP layer is that it permits users to slice and chop the data to produce detailed reports. It must be ensured that the cubes are configured to work with warehouses and can be used directly with an enterprise data warehouse to access the entire data of an organization or with specific data marts (Altexsoft, 2019).

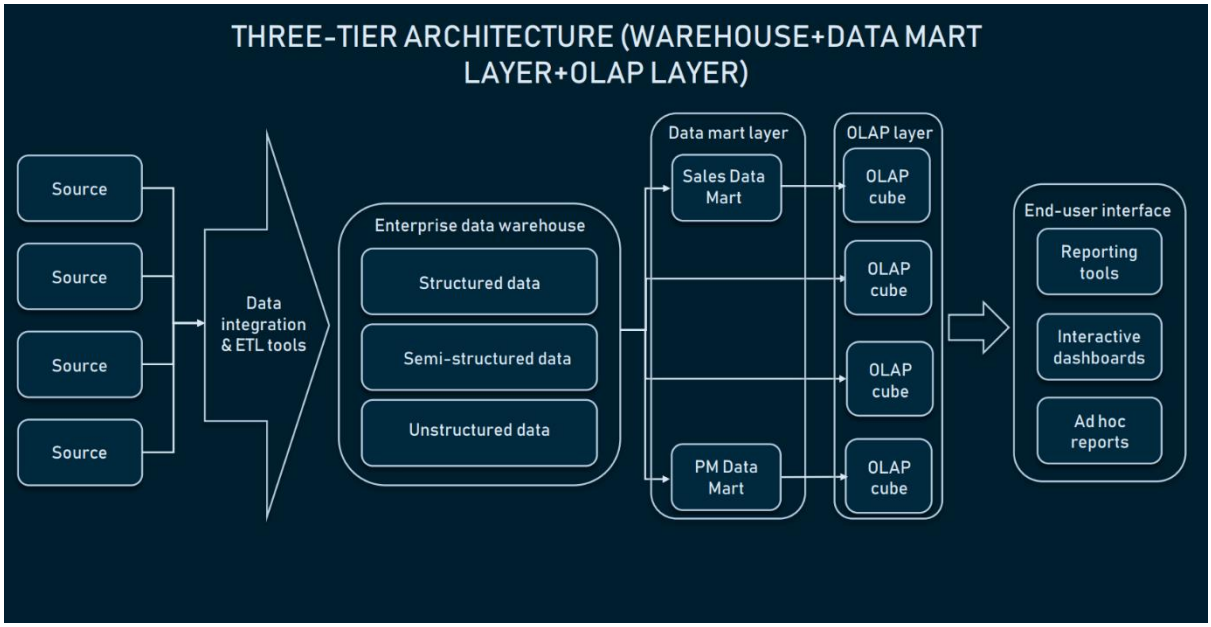

Figure 16: Three-tier architecture: OLAP cubes layer can source information either from distributed marts or from the enterprise data warehouse (Altexsoft, 2019)

4.2.4 Alternative Data Warehouse architectures

There are many elements to be considered when choosing the data warehouse architecture like the strategic view of the data warehouse, data interdependence between different units of an organization, limitations on resources, compatibility, and technical issues with present systems. Every data warehouse architecture has its own set of characteristics where it is most or least effective accordingly bearing its impact on the organization. In the simplest sense, data warehouse architecture design can be divided into enterprise data warehouse and design and data mart design. Although there are some architectural designs that are neither enterprise data warehouse nor a data mart design but a mixture of the orthodox architectural styles as shown by (Turban, Sharda, Delen , & King, 2010):

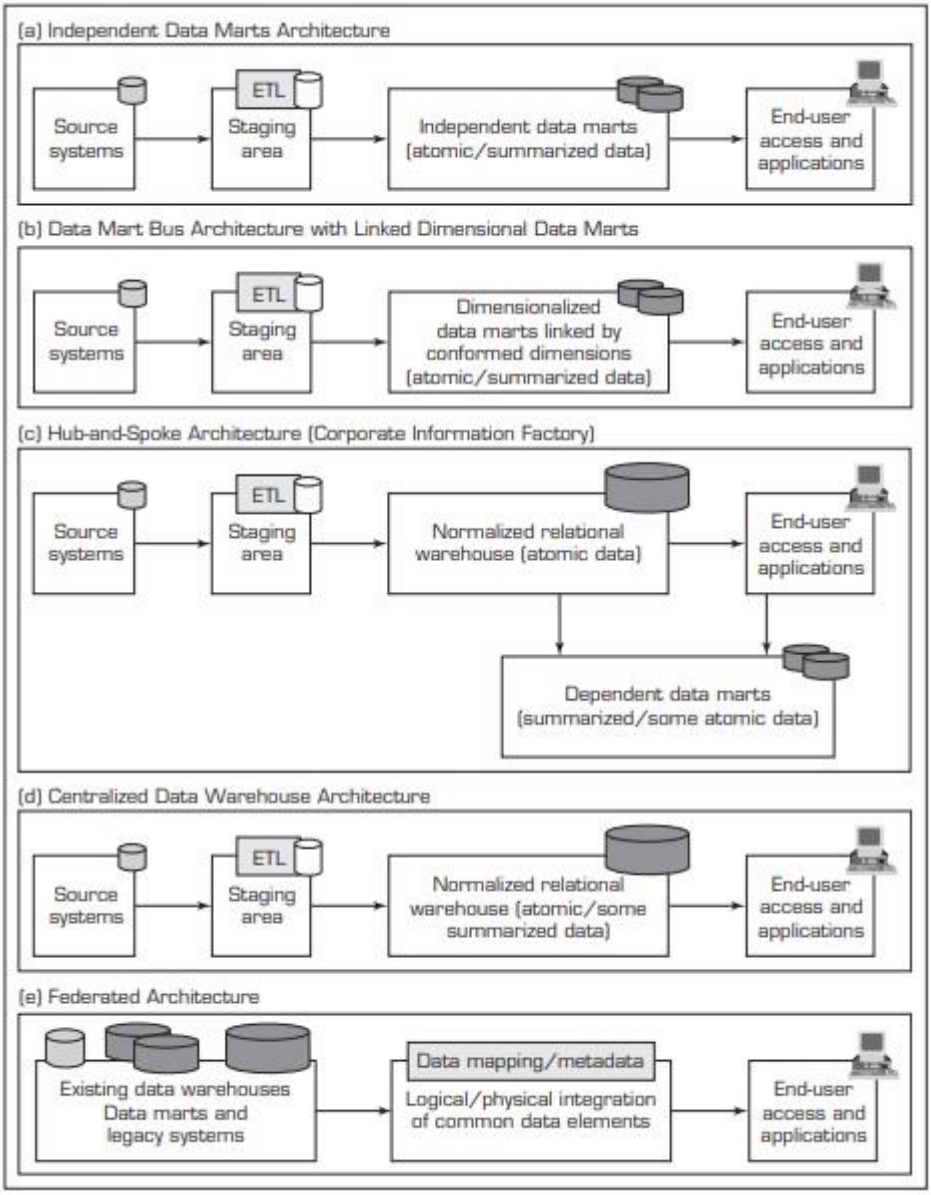

FIGURE 17: Alternative Data Warehouse Architectures (Turban, Sharda, Delen , & King, 2010)

- Independent data marts

This architecture is the most basic and economic architecture alternative. The data marts are designed to function individually to meet the needs of certain organizational units. The independent functioning of data marts leads to contradictory data definitions and measures hence making it complex to analyse data across a set of data marts thereby making it impractical to obtain “one version of the truth”.

- Data mart bus architecture

The data mart bus architecture is a practical alternative to the independent data marts where each data mart is connected to the others by a certain type of middleware. In this case, the data

marts are linked hence there is a higher probability of preserving data consistency across the entire organization. Although complex queries can be executed across data marts, the performance of this architecture is not always adequate.

- Hub and spoke architecture

The hub and spoke architecture is one of the most popular data warehousing architecture where the emphasis is on constructing scalable and sustainable infrastructure which includes a centralised data warehouse and multiple data marts for each organizational unit. This architecture enables easy customization of user interfaces and reports but it lacks a comprehensive view of the enterprise data warehouse which may result in data latency and data redundancy.

- Centralized data architecture

The centralized data warehouse architecture is identical to the hub and spoke architecture with the difference being dependent data marts are not used. It is replaced by a massive enterprise data warehouse that meets the requirements of the entire organization. This approach enables users to access the entire data present in the data warehouse as against just data marts. Further, it minimises the volume of data the technical team has to transfer or modify thereby making data management simpler. This architecture offers a timely and comprehensive view of the enterprise to whomever, whenever, and wherever they are present in the organization as long as it is designed and configured properly.

- Federated data warehouse

The federated data warehouse architecture tries to incorporate analytical resources from numerous sources to satisfy evolving requirements or market conditions. The approach is focussed on integrating diverse data systems. In the federated warehouse architecture, the current decision support systems are left as is and the data is retrieved as and when required. This approach relies on middleware vendors that provide distributed query and join options. The eXtensible Markup Language (XML) based tools allow users to query objects such that the tool automatically queries the diverse sources, merges the results, and displays them to the user. Due to the presence of performance and data quality issues the federated data warehouse architecture is better suited to function as a support to data warehouses and not displace them.

4.2.5 ETL and its importance in business analytics

ETL is a data integration process of extracting data from different data sources, transforming the data as per business calculations, and loading the modified data into the data warehouse system. ETL function is the heart of the Business Analytics systems due to the in-depth analytics data provided by it. Enterprises can apply ETL to get historical, current and predictive views of real business data. ETL is a three-step process as shown in figure 18 below:

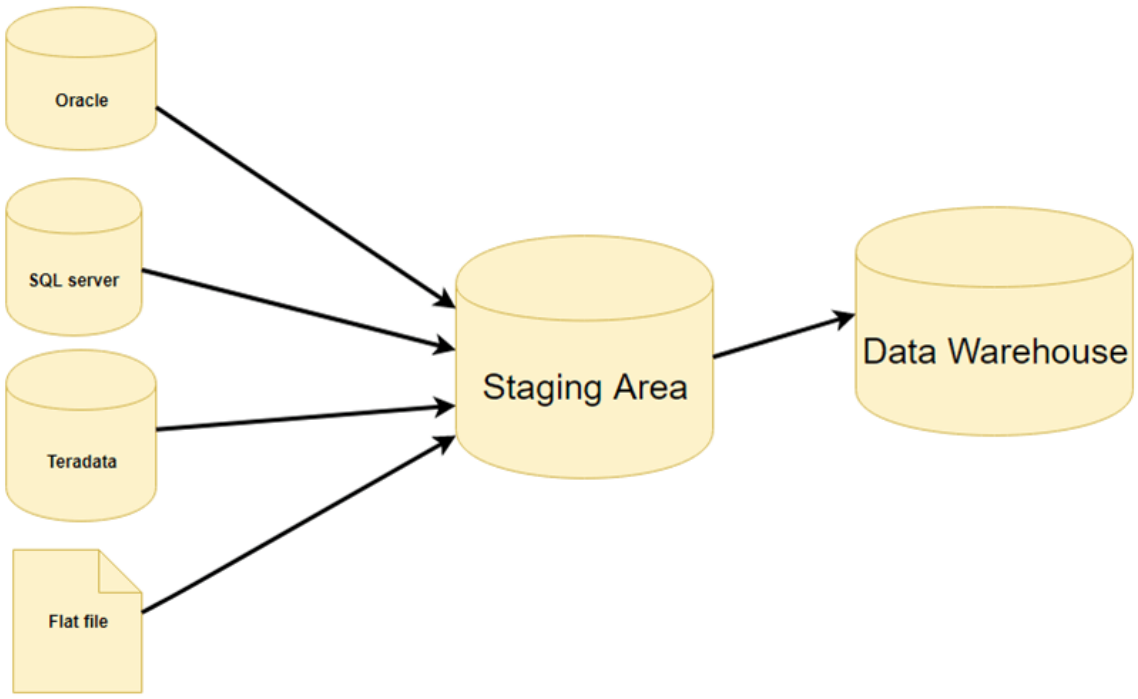

Figure 18: ETL Process (Guru99, 2018)

- Extraction

Most companies handle data from a range of sources like mobile devices and apps, sales and marketing applications, and so on and rely on analytical tools to provide business intelligence. The primary step of the ETL process involves importing structured and unstructured data and consolidating it into the staging area. In the case that corrupted data is loaded directly from the source to the data warehouse, rollback will be a complex problem hence the staging area can be used to verify extracted data prior to loading it into the data warehouse. Data extraction can be done via three methods namely full extraction, partial extraction without update notification, and partial extraction with an update notification. The extraction should not inversely affect the functioning or response time of the source system as these are live production databases. The resulting slow performance or locking may have an impact on the organization's bottom line. It is possible to do the extraction manually but hand-coded data extraction may be time-

consuming and susceptible to errors hence ETL tools are used which automate the extraction process thereby building an effective and dependable workflow (Guru99, 2018).

- Transformation

During the transformation phase of the ETL process, the raw data extracted from the source server is cleansed, mapped, verified, and transformed. This is the most crucial step in the ETL process that generates value by changing data such that valuable BI reports can be developed. Rules and regulations and other customised operations on data can be used to confirm the data quality and accessibility. Data integrity problems like different spellings of the same person like Jon, John or multiple ways to denote a company like Apple, Apple Inc. can be solved. Data validations like filtering, applying rules and lookup tables for data standardisation, and other complex data validations (to automatically reject certain rows if pre-defined conditions are not met) can be done (Agarwal, 2020). The transformation step improves data integrity and makes sure that the data arriving at the new destination is fully compatible and is available for use.

- Loading

The last step of the ETL process involves loading the newly transformed data into the target data warehouse. The large volume of data has to be loaded moderately short time therefore performance is a very important criterion in the loading process. The recovery mechanisms must be designed to restart if any load failure occurs so that there is no data integrity loss. In the initial loading method, all the data warehouse tables are populated while in the incremental loading method the ongoing changes are applied periodically. In the full refresh approach, the contents of one or more tables are deleted and reloaded with new data (Agarwal, 2020).

In present times enterprises have a lot more access to data from a vast number of sources thereby making data strategies more sophisticated than ever. ETL approach can be used to analyse the large volumes of data and generate insightful business intelligence. Consider an example of a manufacturer who is presented with a large amount of data from various sources like sensors in the production lines and assembly lines, company data from sales and marketing, logistics and financial data. The complete set of data must be extracted, transformed, and loaded into a data warehouse for analysis. ETL can help to deliver a single point of view by integrating multiple databases and types of data into a single combined view. In this manner large data sets can be easily analysed, visualised, and used to extract insights whereas multiple

data sets lead to inefficiency and delay due to time and coordination. ETL makes it possible to merge legacy data acquired from newer applications thereby presenting data with historical context. This creates a long-term view of data in which historical data sets can be compared with the latest data. ETL software can boost efficiency and productivity by automating hand-coded data migration. Therefore, engineering teams can focus on innovating rather than handling the exhaustive task of writing complicated codes to move and format data (Talend, 2018).

The ETL approach has certain features to it which to provide insights that can drive better business decisions. The primary step of taking advantage of data and translating it into practical insights is complicated with scattered and massive amounts of data that can be simplified using data mapping which in turn uses database functionalities like integration, warehousing, and transformation. ETL can also be used for data mapping for certain applications thereby establishing a correlation among various data models.

ETL can boost data quality and helps with big data analytics as it can structure, analyse, and interpret large volumes of data systematically. The data quality is improved by applying standardisation and removing duplicates in the warehouse. ETL tools integrate data integration and processing into a single operation greatly simplifying the task of handling voluminous data. This is achieved by ETL by assembling data from various sources in the data integration module and applying business rules during processing to generate an analytical view of the data to the end-user. The modern ETL tools utilise scripts to ensure automatic and efficient batch data processing. Scripts are bits of code that automates the execution of certain tasks in the background. In this way, it can 'batch' data processes like transferring the enormous amount of data between two systems in a predefined schedule.

4.3 Factors affecting the implementation of business analytics

4.3.1 Introduction

The primary function of a BA system is to help define the business performance measurement, assess business processes, forecast business future and provide data-driven suggestions and reports to executives and stakeholders. The above activities lead to the rise of new and complicated data which has to be handled by organizations. Thus, information management plays a crucial role in strengthening decision support. Information management involves analysing information infrastructure for technology-dependent requirements, ensuring the usability of the given information, information utilisation during decision making. BA implementation is also associated with activities like data gathering and warehousing, historical

data management, and analysis to generate valuable insights for decision support using relevant technology. BA is largely responsible for using the information system of an organization to comprehend the needs of a customer by processing the required data it is the best manager of information management practices especially for decision support in companies (Isobar, 2020). The implementation of business analytics can be seen with the information management context and the organizational context as follows:

4.3.2 Information management context

Information management is concerned with adhering to the manager's information-based requirements along with proper guidelines of information systems. It deals with the infrastructure that allows to gather, manage, store and deliver information and the directives to ensure is available to the right audience at the right time. The following factors affect the information management capability (Ali & Miah, 2017):

Technological capability

Technology is used by organizations to collect, share and utilise insights extracted from gathered information. Further, it helps businesses store historical data, compare historical data with the present data and use the findings for decision making. Technological infrastructure plays a crucial role in BA implementation because it is the ability of organizations' technological infrastructure to deliver, manipulate and handle information as per the application requirements. The right technological capabilities can enhance the internal and external ability of the organization as it meets the managers' information infrastructure-based requirements and also helps to build the competencies of users. In addition, technological capability helps organizations in data gathering and collection, dissemination, storing and retrieving, and knowledge generation that supports decision-making systems.

Personnel capability

Technology plays an important role in BA but technology itself is not useful unless accompanied by skilled personnel. Skilled personnel take advantage of the capabilities Technology plays an important role in BA but technology by itself is not useful. Skilled personnel who can utilise the capabilities and competencies of the BA application along with the right technologies are needed to provide invaluable insights to the decision-making systems. BA requires skilled personnel who can evaluate, analyse, predict and boost business performance and collect, store and retrieve data and information to help with managerial decision making. Information management is associated with information organization and governance but it involves the selection of the right technology, operating challenges of data

organising, and management which requires skilled managerial talent. Information management capability is very important in the BA implementation as the interaction between technology and users plays a big influence in the data which is used to support decision making. The efficient use of the available technology depends on the skilled personnel while the quality of technology helps users to enhance their skills and competencies. The process of implementation of information management capability in an organization must be considered during BA implementation.

4.3.3 Organizational Context

Organizational context is a term that refers to the setting in which a comprehensive care unit is deployed to capture all organizational factors that do not directly contribute to the initiative, for instance, organizational culture, managerial approach, and governance structures. It deals with topics like the leadership style is aligned with the organizational goals, how far down into the organization do the employees have a shared understanding of the common goal, and systems in place to sustain high degrees of comprehension and alignment. The following factors influence the organizational context as described (Ali & Miah, 2017):

Organizational Capability

Technology and skilled personnel interact with each other to work for the organization, the organizational capability how they behave with each other. Organizational capability is the set of tangible resources (e.g., computers, machines, infrastructure) and intangible resources (e.g., personnel, business processes, patents, trademarks) that are developed internally and complex for others to imitate thereby helping to differentiate the company. BA implementation being a continuous process depends on the readiness of the capabilities. Organizational readiness with the appropriate technology leads to building newer technological capabilities while the organization's management and customisation of technology for BA strengthen users' competencies. There are other external factors that influence organization capability with respect to information management capabilities like support from the government, favourable regulations, and financial assistance.

Managerial Decision Making

The popular use of BA for decision-making has got a lot of attention from managers in the business world. The impact of BA to promote efficient decision-making depends on the skills of a manager and his ability to comprehend the positive impact of BA and take decisions in its

implementation across the organization. The implementation step involves the comprehensive adoption of a system related to its actual practical utilisation. An inefficient decision by a manager or user in the BA implementation can pose a threat to the organization. A manager's decision is the result of his/her skills to recognize the insights from BA and utilise them to forecast the business future. The other external factors which affect managerial decision are objectives of the firm, return on investment, taxation, business cycle fluctuation, etc. Information management capability can lead to the managers' decision-making process repetitive as it is a continuous process and the unpredictable changes require constant changes in information management.

Organizational Culture

Organizational culture is the personality of an organization which includes beliefs, values, behaviours, practices which make up the unique social environment of an organization. Organizational culture and dedication to data-oriented decision-making is a decisive factor of a company's success with BA. It is not easy for every company to adopt a new BA tool or promote a culture where analytics is involved in all operations. BA can affect how employees make decisions, the expertise required when hiring new employees, information sharing between different teams, and the overall functioning of the organization. Company culture is built over a period of time based on the habits, beliefs, and leadership from the birth of the company. If data and analytics have not been included or used only by a few managers then creating a data-oriented culture can be a complicated task. For BA to successfully become a part of the company culture, data must be accessible throughout the organization and everyone should know the value that data has in their roles and overall impact on business.

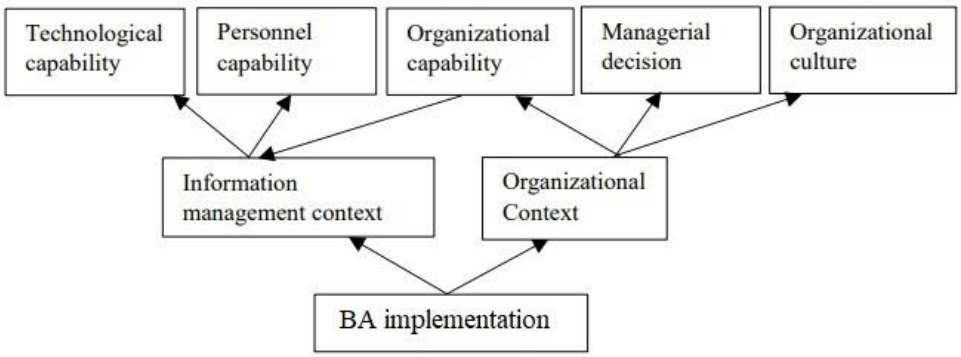

Figure 19: Tree focussed diagram of factors affecting BA implementation (Ali & Miah, 2017)

The figure describes the dependence on Information management context and organizational context in the implementation of BA. The information management context is a combination

of technological capability and personnel capability both of which depend on the organization's capability. The organizational context deals with the organizational capability, the capabilities of managers to take the right decisions, and organizational culture. To conclude, information management capability is the prime subject and organizational capability is the supporting structure for the successful implementation of BA in an organization.

4.4 Developing business analysis tools and applications

4.4.1 Introduction

The executives and managers in many areas of business are looking for ways to meticulously assess their intuition with data to confidently improve decision-making. The BA tools which are presently in use are not widely accepted across organizations because there is no means by which executives and managers can incorporate analytical models and results acquired using business analytics tools to their current sensemaking processes. Sensemaking is the process by which humans work to retrospectively detect patterns and assign meanings to experiences with the intention to give them meaning. Decision-makers in organizations demand thorough insights about business processes rather than just using intuition, experience, and presently used decision-making tools. They require ways to assist sensemaking when unforeseen complicated changes occur in the decisional scenario to react swiftly and with a correct response. Usually, comprehending business processes involves analysing large volumes of data and the crucial insights are usually in hidden patterns which are difficult to locate without the help of data analysis tools.

4.4.2 Framework for developing business analysis tools

In a technological sense, the EBDM framework is as follows: when an individual or an organization realises their interpretation of current events is insufficient, they tend to opt for the set of processes known as sensemaking. Sensemaking is a dynamic two-way recognition process of suiting the data to a frame (mental model) and also suiting a frame around the data. The data and frame are equally important, as the data is used to reveal the right frame, and the frames pick and connect data. In the case that there is no appropriate fit, the data can be re-examined or an older frame can be remodelled. For the execution of this idea, the decision-making processes must be considered in three different levels – strategic, tactical, and operational levels. Consider a retail business as an example the strategic level determines the business goal – "increase sales revenue". The tactical level consists of questions like – "Practice up-selling or cross-selling? What goods sell together? To whom special discounts can be offered?" In the operational level, the business actors like goods, customers, discounts have properties (e.g., a good has a price) and relations (e.g., a customer purchases a product). The

actions conducted by the business actors in the best possible manner to meet business goals are the result of operational decisions (Guadagno, Ruffolo, & Verteramo, 2007).

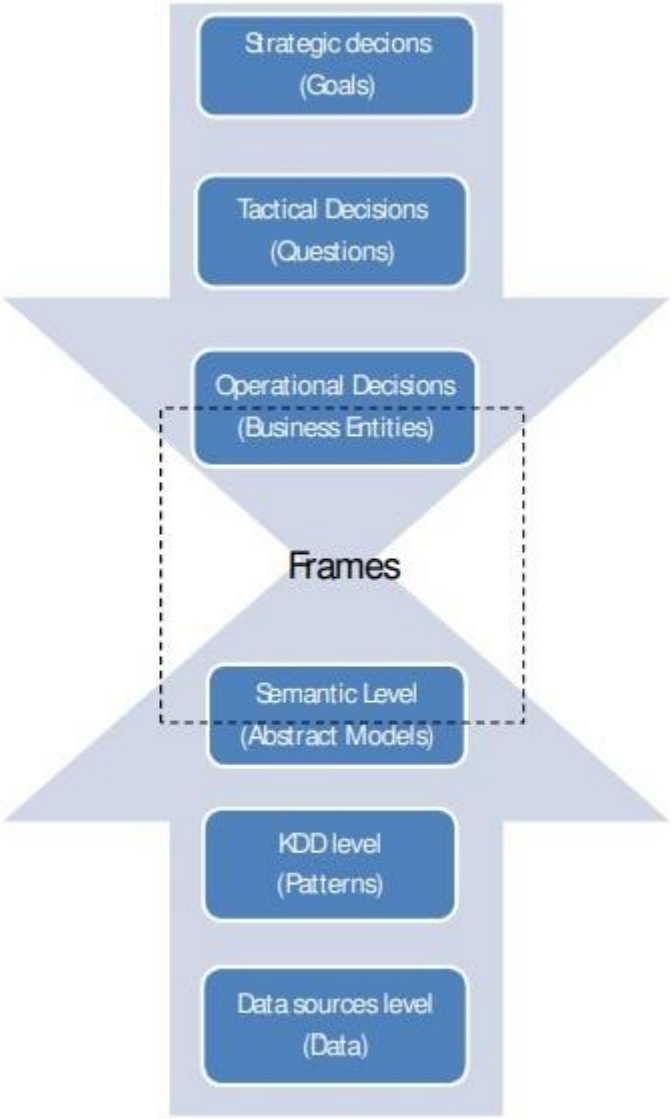

Figure 20: The EBDM Framework (Guadagno, Ruffolo, & Verteramo, 2007)

Figure 20 depicts the approach to realise the EBDM framework. The top-down approach involves fitting frames according to data and patterns. It is used to make a machine-readable semantic-enabled illustrations of decision makers' cognitive frames. In this approach, the configuration of business entities and rules that are an integral part of the decision-making process must be clearly established in a conceptual model. The first step in the top-down process is to define a business goal. The next step is to outline the questions/events with the objective of formulating the tactical details to achieve the goal. The third step is to illustrate the business entities and rules used in the decision-making process as an abstract model. The fourth step deals with the determination of the most suitable analytical process for the particular

decision-making process. The last step is to elucidate the presentation models appropriate for the decision-making process.

The bottom-up approach is centred on fitting data and patterns into frames with the objective of fitting data and patterns from the enterprise database to the conceptual model. It is necessary to define the following in the bottom-up process:

- Holistic vision on data source
- Acquisition (wrapping) approaches
- Transformation and Integration approaches
- Mapping approaches that facilitate the usage of patterns into abstract models

The bottom-up approach can be used to authenticate, amend and enhance the abstract model. The abstract model can be improved by using analytics algorithms to detect patterns and tendencies which may either validate or alter the existing abstract model. Moreover, the findings from the analytics algorithms can be directly described in the form of classes, objects, and relations to the abstract models thereby providing the new classes and relations with the potential to improve the abstract model that can be realized and utilised to enhance the abstractions. The intersection of the top-down model and bottom-up model denotes the business insights that substantiate sensemaking thereby ensuring that business analytics is a technology that facilitates decision-making (Guadagno, Ruffolo, & Verteramo, 2007).

4.4.3 Implementation of business analytics program

The successful implementation of business analytics is a significant factor in a company's success. It is not possible for all companies to successfully implement business analytics in their decision-making. When utilised properly, the insights and intelligence obtained from a business analytics program can be used to enhance strategic decision-making. Contrarily, an organization that does not use business analytics correctly will not experience efficient decision-making. Business Analytics helps an enterprise to examine the different types of statistical analysis that can be used to implement a business strategy and achieve the objectives of an organization. The proficiency of a company to use business analytics in its strategy is what permits a supply-chain company to discover ways to deliver products to clients faster. It is what allows retail firms to efficiently handle inventory and predict the products to stock by understanding the needs and wants of their customers (Keller, 2019). The steps to implement BA are as follows:

- Needs Analysis

The needs analysis must answer the question “How can the particular business profit from data?”. The answer should cover how data can affect the company’s culture and decisions, in what manner the data can be presented in an influential way, and how the data can help meet business goals. The creation of a business analytics implementation plan is the primary step but implementation is complicated as businesses work on different models and a one-size-fits-all solution does not exist. Similar to business requirements gathering, a rigorous analysis of the business is necessary to understand the requirements for specific scenarios. The next step is to find distinctive and relevant ways to measure targets hence making it easier to understand data (Keller, 2019). It must be noted that some wants of a company are not feasible. Data is good, but having a lot of data without meaning is like not being able to differentiate the forest from the trees.

- Establish the Analytics Features

The biggest beneficiaries of business analytics are processes and productivity while technology operations also gain supplemental benefits. The area of deployment must be kept in mind like if it is organization-wide or the departments for example, finance or marketing when determining the analytics features. It must be noted that implementing throughout the organization demands complex retooling and optimisation to help the enterprise reap the highest rewards but it can very easily land the company in big trouble. For example, there may be a situation where there may be a large amount of data without any means to interpret it or the team may not be experienced enough to handle such a substantial archive of data. In practice, no two vendors are similar hence it is very crucial to decide the specific features needed and choose the correct type of tool for the particular use case (Isobar, 2020).

- Identify Vital Insights & Metrics

Along with the business analysis implementation plan, the company should have clear end goals for implementation to ensure success. If the vision is too wide it will lead to inefficient data while a narrow vision means that the ideal amount of data is not being collected to meet the end goals which are in the form of insights and metrics. Insights originate from metrics, which are points of data that can give perception about business processes according to the slicing of data. In the planning stages, the focus must be on using the metrics to reach the end goals (Isobar, 2020). Business analytics is more fruitful when applied for a particular target instead of a vast, conceptual idea. The goal of the implementation plan should be to target a particular audience rather than one-size-fits-all.

- Selection of data sources

The Economist published an article in 2017 which said that the most valuable resource in the world is no longer oil, but data. Nowadays a voluminous amount of data is available for organizations. During the planning of implementation of business analytics, it is very important to choose the right data from which the insights and metrics will be derived. For instance, not all companies have an IT department or a requirement to monitor inventory while there are a few who record the employees' time off and associate it with their quarterly sales performance. To explore the business potential, the business analytics implementation plan should be used to collect insights and take relevant actions (Keller, 2019). Data can be very brutal, showing the deviations from targets or the negatives of a precisely executed process. The management and executives should take a clear look at the revelations of the insights without any presumptions in order to successfully execute the business analytics plan.

- Selection of Software

It is recommended to select software that has wide applications and is useful in a diverse array of situations. This enables the users to spin out fresh insights and address the business demands suitably. The comprehensive features of the tools may not tend to all the requirements immediately. This can be overcome by opting for modular software. Modular software permits users to decide the particular features to be enabled or implemented at a specific time. In this manner, there is a central operational product with optional micro-features that can be joined with on-demand features like batch processing or reporting on various metrics. Disney uses software modularity at an individual level thereby giving improved flexibility to end-users as they can update every specific part of the software independently and at the desired time (Isobar, 2020). The market is steering away from monolithic software updates as modularity allows companies to obtain the latest forefront features without having to risk the core operational product.

- Present Competencies of the Organization

The implementation plan is focussed on scalability and wide applications but it is the employees who determine the extent of technical skills. Staff with basic IT and tech-related competencies are in high demand but deep knowledge about systems may seem insufficient when it comes to handling sophisticated business analytics suites. It is generally accepted that the ease of use of software leads to an increased degree of adoption among employees especially the ones who require actionable data. High-end software with a lot of functionalities is more appropriate for data scientists and professional analysts who can handle complex

algorithms and appropriately prepare data. Therefore, it is necessary to hire a data scientist and it must be noted that hiring and retaining one can be expensive. IT departments prefer software that can be installed easily and demands minimal maintenance effort like cloud solutions which do not require direct efforts from the IT department. Another solution is to use on-premise tools as long as the company is capable of installing the software and maintaining it for the long term. To conclude, the business analysis software must be easy to use for most users to obtain maximum benefits for the enterprise and fewer support tasks for the IT staff (Keller, 2019).

4.5 Performance management

Performance management is a process that facilitates managers to supervise and assess employees' work. Performance management is focussed on creating an atmosphere where employees give in their best to deliver high-quality work efficiently and effectively. Managers can use it to track the performance of the business strategy by comparing the current findings with the strategic goals and objectives. A performance measurement system usually consists of methodically monitoring business goals along with frequent feedback reports that denote progress against objectives. Performance management works on continued accountability leading to a wholesome, open work environment with a focus on periodic meetings resulting in better communication. The explicit rules mean that all employees have a clear perception of the objectives thereby making the work atmosphere stress-free (Tardi, 2021).

4.5.1 Key performance indicators and operational metrics

Key Performance Indicators (KPIs) are the crucial pointers of the advancement towards anticipated targets. KPIs help to improve the strategic and operational focus by developing an analytical view for decision making thereby ensuring the company is attentive to the most important factors. KPIs present objective evidence regarding the progress towards objectives and it helps to measure the vital characteristics that help with better decision making. A KPI depicts a strategic objective and measures the progress towards an objective hence they are a strategically inclined metric. KPIs have the following features (Sharda , Delen, & Turban, 2018):

- Strategy: KPIs incorporate a strategic objective
- Targets: KPIs compare actual achievements against predefined objectives
- Ranges: Objectives have performance ranges (e.g., over, on, or lower than the target)

- Encodings: The ranges are included in the software to extract a visual representation of performance based on colours or percentages or more multibranched rules

- Time frames: Targets are allotted time frames before which they must be achieved. In most cases, a time frame is cut into smaller parts to check for performance milestones

- Benchmarks: Targets are gauged with a guideline or benchmark. Usually, the previous year is chosen as the baseline but external numbers or extraneous benchmarks can also be used

KPIs can be distinguished based on whether they are results or future outcomes. A leading indicator is aimed at future outcomes and events. New product development, capturing new market segments or sales channels, brand recognition are all future-oriented indicators that show trends that can anticipate future shifts. Leading indicators are very helpful for obtaining a clear picture of performance as they shed light on probable future outcomes. It is hard to determine leading indicators as they are usually unique to every organization making it hard to develop, quantify, and benchmark. A lagging indicator is an output measurement. Lagging indicators describe events that have already occurred examples are profit, revenue. They are easy to recognise, measure, and contrast against the industry hence they are very useful. The disadvantage of lagging indicators is that the insights are given so late that nothing can be done moreover, it does not indicate the reason for a particular trend or how it can be stopped (kpi.org, 2018).

In some cases, leading indicators are also referred to as operational KPIs. Organizations collect a wide variety of operational metrics as they help reduce inefficiencies or redundancies and perform in the most efficient manner. These metrics are key performance indicators that give a view of a project's standing or what's happening in the business in real-time or by the hour, day, week, and month. By ensuring the operational data is prevalent throughout the organization it becomes easy to chart out the performance against corporate objectives and the key performance indicators as agreed upon by the management and conveyed to all employees (kpi.org, 2018). The following are some of the ranges of operational disciplines addressed by these metrics:

- Sales Operations

  Metrics which include new funnel accounts, sales meetings obtained, converting queries to leads, and average time to resolve calls
- Sales plan/forecast

Metrics to check the accuracy of price to purchase, quantity gained, plan to forecast ratio, purchase order to implementation ratio, and total completed contracts

- Service Performance
  Metrics for service call closing rates, service renewal rates, service level agreements, delivery execution rate, and the rate at which shipped items are returned
- Customer Performance
  Metrics regarding customer retention, agility, and accuracy for resolving issues, customer satisfaction

The nature of the company and the choice of management decide whether an operational metric is strategic or not. In many cases, though the metrics are a major factor when it comes to strategic outputs. (Lopez, 2020) gives the example of a mid-tier wine distributor who was being extracted by both sides of the value chain; upstream by the set of suppliers and downstream by the group of retailers. To overcome this situation the company decided to pay attention to four important operational metrics namely on-time inventory availability, exceptional open order value, net-new accounts, costs for promotions, and returns on investments in marketing. The new strategy resulted in a 12 percent increase in revenues over a period of 1 year. This could be achieved because the operational metrics were the leading factors in decision-making. However, most organizations only measure what is easily accessible without considering the reason why the data is being collected resulting in a waste of resources, time, and money.

4.5.2 Problems with existing performance measurement systems

Performance measurement systems are used by almost all companies all over the world. The most popular of these systems is usually one of the variants of Kaplan and Norton's balanced scorecard (BSC). A wide variety of surveys and benchmarking studies claim that between 50 to 90 percent of all companies have put into practice some version of BSC at some period of time. The BSC methodology is based on a comprehensive view of a measurement system associated to the strategic orientation of the organization. It consists of four approach vision of the world made of financial measures assisted by client, internal, learning and growth metrics. Nonetheless, the Saxon group realised that a big portion of the performance measures was financial (65%), based on lagging indicators (80%), and focussed on internal rather than external factors (75%). This results in companies having a collection of reports, charts, and visualisations that can be used to verify obtained results against planned results for an unimportant set of metrics (Klipfolio, 2016).

One of the major constituents of performance measurement systems is calendar-driven financial reports where executives do not give importance to anything other than financial or operational numbers. Research shows that executives consider various other factors like market and customer but believe that these are just suspects and thereby are unwilling to take the risk and stick to financial and operations metrics. The disadvantage as the heart of a performance measurement system is as follows:

- Financial measures are generally provided by the organizational structures rather than the processes that incurred them
- Financial measures are lagging indicators that give information regarding what happened not the reason behind the event or indications about likeliness in the future
- Financial measures are concentrated on the short term and contain little or no details about the long term
- Financial metrics are applied to non-financial activities like service functions (e.g., IT, HR, and legal) to formulate return on investment number to prevent themselves from being outsourced

Measurement overload is another problem afflicting performance measurement systems. Most companies have this habit of tracking 200 or more measures at the corporate level. It is well known that humans have a tendency to track only a small set of issues and the rest is just postponed for later. Additionally, companies rarely let go of measures they collect which adds on new data thereby magnifying the problem. Markets and competition keep evolving and yet there are no actions to verify if the measures that are being tracked are valid to the present position. Another issue to be handled is that management cannot directly control the measures being tracked and is referred to as the principle of obliquity. Important measures like earnings per share, profitability, market share, and customer satisfaction must be supervised yet they can be controlled only in an indirect manner. The actions of workers and employees can be controlled but again the influence of any employee on the business strategy of a company is insignificant. The solution for this is to build a business model that begins at the top and ties the company's goals and targets to the initiatives executed by individual employees at the bottom level (Sharda , Delen, & Turban, 2018).

Most senior executives find the task of improving the measurement of a company's performance to be intimidating and very tough. Hence, they usually assign to teams good with spreadsheets which results in a pile of numbers and comparisons that gives minimal insight into an organization's performance or even worse lead to a decision which may harm it. Executives should instead find qualitative and quantitative measures that will ascertain how

the firm can compete in the future. They need to think bigger than the easy metrics and include a range of complex ones which ensures the employees do not base the measures on yesterday's business model. In order to measure how the company is performing the most important benchmarks should be from outside the company. This helps to identify factors to make a company more competitive and relate executives' compensation such that they are paid to perform better than the competition. The biggest hurdle is that information about competitors cannot be obtained very quickly. One way to overcome this is to gather data from customers while another way could be to approach professionals from outside the company. Performance assessment usually consists of comparisons between the present year and last which leads to companies focusing on the past rather than on the coming months. The quality of managerial decisions plays a crucial role to the success of performance management systems. Boards should focus on the wisdom of top executives and their readiness to be open. It must be noted that qualitative, individualised judgments built on a director's first-hand experience with an executive are more suggestive as compared to a formal assessment of the executive's track record or his or her division's financial performance (Likierman, 2009).

The metrics in performance management systems whether favourable or not are in the form of numbers. The issue with that is managers focussed on numbers will have a tendency to produce a lot of poor-quality data. When companies collect feedback about their service from customers' they must protect the anonymity of the respondents if they want to get the real story. Further, if the employees who have watched them fill the form submit only the favourable ones and there is a possibility of making the negative feedback vanish. The minute management is done based on a metric most managers will try to manipulate it. Metrics are representatives for performance but someone with the knowledge of how to maximise a metric without the need to perform will regularly do that. One possible solution is to broaden the metrics as it is harder to modify multiple metrics at a time. Performance measurement systems have to be particular about what to evaluate, be unequivocal about the metrics analysing it and ensure that the organization has understood both (Likierman, 2009). To conclude, a good measurement system must bring finance and line managers in coordination such that the company can profit from the independence of the former and expertise of the latter. Although it seems simple it can be a very difficult task in the business world.

4.5.3 Business performance analytics

Business Performance Analytics (BPA) involves the utilisation of the combination of data and analytical methods for the purpose of business performance measurement. BPA is a cross-functional subject with the goal of improving a company's performance to meet its goals. It is achieved by evaluation of previous performance, outlining the dependencies and patterns in data sets and performance indicators, finding ideal values and actions to ensure the predefined objectives are achieved. It also consists of formulating a hypothesis about data interrelation, cause, and consequence linkages, and producing a perspective about future performance, and checking if the hypothesis is right or wrong while iteratively modifying the hypothesis as required. Additionally, BPA encourages dialogue and plays a major role in establishing crucial performance variables and the probable point of risk and its interdependencies (Accenture belux, 2019).

Financial Planning and Analysis (FPA) teams do something similar and have been doing so for a long time. The fundamental distinguishing feature of BPA from FPA is the substantial amount of data and the capability to acquire, store and analyse the data using relevant software. This helps to obtain insights that are much detailed due to the vast data points, and more accurate because of the complex algorithms which can be used to take advantage of any kind of data. The generated insights are also faster as modern technology supports faster processing power and more reliable thanks to the facility to iteratively change the logic, conduct multiple tests, and make use of digital solutions. An example of how a global oil and gas company was able to derive value from BPA and implementing predictive analytics for maintenance and process-control thereby optimising costs and experiencing better business outcomes is as follows (Accenture belux, 2019):

- Decrease in transportation costs by streamlining the transportation routes and taking effective decisions regarding where shipping happens
- Lower inventory levels with better sales forecasts and supply planning
- Minimise inventory write-offs with earlier identification of possibly unusable articles
- Enhanced customer service levels by early prediction of possible problems in the supply chain and resolving it before customers are affected
- Highly effective marketing campaigns by focusing on customers who can be convinced rather than those who will buy an item without marketing or those who probably will not buy even if approached

BPA must be implemented on a robust foundation of strong data governance, a system with a blend of data management analysis and decision making based on logical insights. In order to experience the possibilities with BPA, the exact business goals and challenges which need to be overcome have to be identified. As the goals evolve, the analytics methods and strategies have to be examined to confirm if they are still relevant. The most important factor to produce valuable insights is that data used for analytics must be handled keeping the business goals in mind. The data should be correctly available, reliable, and meaningful for business goals. It is well known that top management wants 'one version of the truth' to be present across the entire organization. At times, making sure the right data is available at the right place may involve modifications in the underlying processes. This requires that analytics be involved in the broader business context where it considers the complete set of processes that will deliver inputs in addition to processes that will utilise its outputs. In the case of generating insights from a considerable amount of cross-functional data stakeholder alignment and end-to-end integration are important. As most business decisions are based on the potential of the value case, the finance team will find it easy to define the outcomes in terms of financial value and relate them to the strategic goals. Historically, strategic business decisions were rendered on the understanding and experience of management and a lot of times on the intuition of business experts. In order to replace this with data-driven approach management will have to realize the assumptions employed in the analytics model, the logic to come to conclusions, and the dependence of the results and business outcomes (Raffoni, Visani, Bartolini, & Silvi, 2017). The lack of acceptance from leadership is usually due to inability to understand and poor awareness. A data-driven decision-making culture demands dedication, investment in skilled personnel, and an exploratory mentality. The best approach is to begin small, gain knowledge, ensure dialogue is present between top management and data scientists, and then make way towards difficult business scenarios.

The business performance analytics should be designed such that it provides the organization with the insights when they need them. This helps to provide the top management with evidence to make better, more aware decisions in terms of strategy as well as operations. Business Intelligence provides managers with the "what" BPA can help them with the "why" so that they can realise how to modify the business to help with performance and accelerate organization value. BPA must be instilled in the core business processes to make sure that performance improvement is retained. BPA is about identifying the real drivers of cost,

revenue, and profitability across the enterprise and also outline the impact of making changes to these drivers to demonstrate evidence to help with strategic choices. BPA should include profitability analysis to truly understand the profitability across the various geographies, customer segments, industry sectors, and business units along with the reasons for the variations in profitability. The numbers and data collected can be made presentable through visualisations for easy understanding of operations information and financial data and their effect on business outcomes (Capgemini, 2017). Performance root cause analysis can be used to obtain further information about the causes for business performance and make strategic decisions accordingly. The best way to improve business performance is to have a dedicated set of skilled resources who are involved in planning, strategic analysis, and performance analytics thereby redefining the manner in which information is delivered to the business.

5. CONCLUSION

A business analytics program that supports a robust strategy is fundamental for an organization to be competitive. The key business metrics can be analysed by the management to make smarter decisions and bring increased value to the business and concentrate on the key opportunities for the organizations both immediately and in the future. BA with the help of statistical techniques and business acumen can help an organization understand its business and take efficient decisions which are based on data of the market conditions. The business strategy must mirror the ever-changing market conditions as demonstrated by the analytics. BA meets the needs of organizations for continual analysis and innovation to remain ahead of the competition through new opportunities.

The study has shown how BA can play an influential strategic role and assist the business strategy of an organization. A mix of technical and business knowledge is required to ensure the alignment of business strategy, IT strategy with the support of BA systems. The implementation of data warehousing and performance analytics leads to benefits like high-quality data, advanced capabilities in terms of dashboards and scorecards, high quality reporting about the business processes. Several important insights were derived that are important for future research including the significance of clearly defined globally standard metrics, good quality technology infrastructure, involvement of the top management combined with responsible leadership in the BA structure, a good performance measurement system that encourages dialogue in the organization structure, and teams with competencies in technical and business fields with outstanding communication skills. The BA program is successful only when the enterprise develops trust with data and analytics. To build trust in analytics the top management needs to assess their data and analytics life cycle starting from the sourcing and formulation of data to the measurement and outcomes to the insights and finally to creating value. It can be argued that the insights gained in this study can be generalised to most global organizations developing BA systems in relation to the business strategy to be more cohesive using similar core business processes, data, and regularized metrics for reporting.

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