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A Review of Trends and Technologis in Business Analytics

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Abstract: Analytics are becoming more and more part of the decision making process of management and operational work. However, the definition of this term can be rather ambiguous, and is constantly changing. In a nutshell, Analytics can be defined as a set of practices, skills and technologies designed for investigating and analysing business performance in order to achieve more strategic decision making and structuring in the future. There are many different ways to investigate and analyse business performance in order to restructure processes for more profitable results. Analytics produce fact-based business intelligence through the automated discovery of patterns, relationships, and trends in data. Analytics inform decision-making with descriptive and predictive modelling of future states and conditions. Most organizations now use analytics to uncover insights from marketing data to target customers with new programs. Others are using analytics to mitigate risk and project returns on investment. Companies and organizations of every size and in every industry are looking at their data to see if they can use it to make predictions that will help them be more effective, more customer-centric and more profitable. The onslaught of the Big Data phenomenon and development in corresponding technologies is giving rise to new trends in the Analytics domain. The current trend showcases the rise in value for integration and consolidation of information for forming policies and meeting strategic objectives. This paper reviews the trends, opportunities and underline technologies in business analytics.

Keywords: Analytics; Descriptive; Predictive; Prescriptive; Big data

I. INTRODUCTION

In a world of exponential data explosion, it is of prime importance for businesses to effectively navigate through the expanse of data using analytics and derive meaningful insights.[1] The majority of raw data doesn't offer a lot of value in its unprocessed state. By applying the right set of tools, powerful insights can be pulled from this raw data. Organizations need analytics solutions that can extract meaning from huge volume of data to help improve decision making, handle wide varieties of data and sources from within and outside the enterprise, and keep up with the rapid velocity of data in motion. They need capabilities for analyzing historical and real-time data, as well as forecasting the future, to distill what's valuable, detect patterns and reveal insight they may not even have thought to ask about. With such solutions, organizations can achieve benefits ranging from increased revenue to lowered operating expenses, enhanced service availability and reduced risk. The data mining community has derived a broad foundation of statistical algorithms and software solutions that allowed for statistical analysis to become a standard approach used in science and industry. Much emphasis has been placed on the development of predictive models, which usually encompasses a lengthy data mining and analysis phase followed by model development and evaluation.[4] The goal of any analytics solutions is to provide the organization which actionable insights for smarter decisions and better business outcomes. Different type for analytics, however, provide different types of insights. So it is important for managers to understand what each analytics type delivers and to match analytics functions to the organization's operational capabilities.[2][3]

Analytics solutions are of three principal types:

- **Descriptive**, which uses business intelligence and data mining to ask: "What happened?"

- **Predictive**, which uses statistical models and forecasts to ask: "What could happen?"

- **Prescriptive**, which uses optimizations and simulations to ask: "What should we do?"

The three type build on one another, which descriptive analytics being the most common and prescriptive analytics the most advanced. Prescriptive analytics mitigate significant risk in strategic decision making to improve profitability, increase customer satisfaction, and create first-in-market opportunities by leveraging the promise of big data.[5][3]

First of all, these three types of analytics should co-exist. One is not better than the other, they are just different, but all of them are necessary to obtain a complete overview of your organization. In fact they are more consecutive and all of them contribute to the objective of improved decision-making.[6] Figure 1 presents a graphical view of these three types of analytics.

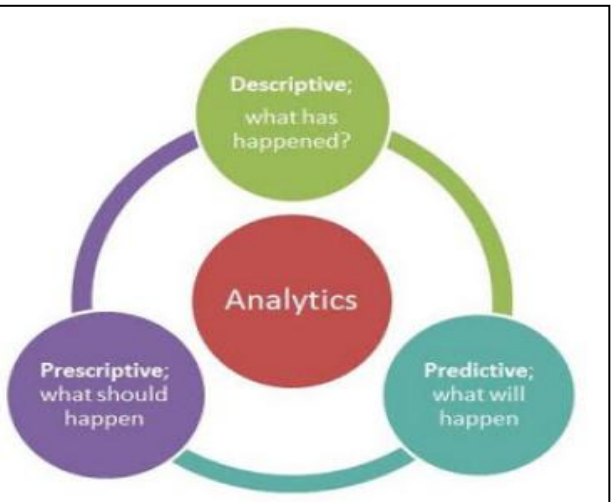

Fig 1:- Three Types of Analytics

II. DATA ANALYTICS

Data analytics (DA) is the science of examining raw data with the purpose of drawing conclusions about that information. Data analytics is used in many industries to allow companies and organization to make better business decisions and in the sciences to verify or disprove existing models or theories. Data analytics is distinguished from data mining by the scope, purpose and focus of the analysis. Data miners sort through huge data sets using sophisticated software to identify undiscovered patterns and establish hidden relationships. Data analytics focuses on inference, the process of deriving a conclusion based solely on what is already known by the researcher.[7]

The science is generally divided into exploratory data analysis (EDA), where new features in the data are discovered, and confirmatory data analysis (CDA), where existing hypotheses are proven true or false. Qualitative data analysis (QDA) is used in the social sciences to draw conclusions from non-numerical data like words, photographs or video. In information technology, the term has a special meaning in the context of IT audits, when the controls for an organization's information systems, operations and processes are examined. Data analysis is used to determine whether the systems in place effectively protect data, operate efficiently and succeed in accomplishing an organization's overall goals.

Data analytics is used to describe everything from online analytical processing (OLAP) to CRM analytics in call centers. Banks and credit cards companies, for instance, analyze withdrawal and spending patterns to prevent fraud or identity theft. Ecommerce companies examine Web site traffic or navigation patterns to determine which customers are more or less likely to buy a product or service based upon prior purchases or viewing trends. Modern data analytics often use information dashboards supported by real-time data streams. So-called real-time analytics involves dynamic analysis and reporting, based on data entered into a system less than one minute before the actual time of use.[7]

III. DESCRIPTIVE ANALYTICS

Descriptive analytics are the most commonly used and most well understood type of analytics. It is the simplest class of analytics. Descriptive analytics categorizes, characterizes, consolidates and classifies data. Descriptive analytics helps organizations understand what happened in the past. The past in this context can be from one minute ago to a few years back. Descriptive analytics includes dashboards, reports (e.g., budget, sales, revenue and costs) and various types of queries. Tools for descriptive analytics may provide mechanisms for interfacing to enterprise data sources. They typically include report generation, distribution capability and data visualization facilities. Descriptive analytics techniques are most commonly applied to structured data, although there have been numerous efforts to extend their reach to unstructured data, often through the creation of structured metadata and indices. Descriptive analytics help provide an understanding of the past as well as events occurring in real-time.[8]

Many descriptive analytics applications are implemented though out-of-the-box business intelligence software solutions or spreadsheet tools; however, version control difficulties may result from a proliferation of spreadsheets. The advantage of a descriptive analytics software platform (business intelligence and information/data management software) is the connectivity it provides to the underlying trusted information management system, as well as the ability to work with data along multiple dimensions to gain insight. Insight into what is happening now or has happened in the past can be useful in making decisions about the future, but descriptive analytics relies on the human review of data and does not contain robust techniques that facilitate understanding what might happen in the future, nor does it provide the tools to suggest decisions of what should be done next.

Descriptive analytics does provide significant insight into business performance and enables users to better monitor and manage their business processes. Additionally, descriptive analytics often serves as a first step in the successful application of predictive or prescriptive analytics. Organizations that effectively use descriptive analytics typically have a single view of the past and can focus their attention on the present, rather than on reconciling different views of the past. Characterized by the use of key performance indicators, descriptive analytics drills down into data to uncover details such as the frequency of events, the cost of operations and the root cause of failures. The most common type of analytics used by organizations, it typically displays information within a report or dashboard view. Solutions can be automated to issue alerts when potential problems arise that fit data patterns the solution has discovered.[3]

IV. PREDICTIVE ANALYTICS

Predictive analytics provides answers that move beyond using historical data as the principal basis for decisions. Instead, it helps managers anticipate likely scenarios. So they can plan ahead, rather than reacting to what has already happened. Predictive analytics uses the understanding of the past to make “predictions” about the future. It is applied both in real-time to affect the operational process (ex: real-time

retention actions via chat messages or real-time identification of suspicious transactions) or in batch (target new customers on Web site or direct mail to drive cross-sell/up-sell, predict churn etc.). These predictions are made by examining data about the past, detecting patterns or relationships in this data and then extrapolating these relationships forward in time. In order to do this, a variety of techniques are used, such as machine learning, data mining, modelling and game theory. Predictive analytics can be used in all departments, from predicting customer behavior in sales and marketing, to forecasting demand for operations or determining risk profiles for finance. A very well-known application of predictive analytics is credit scoring used by financial services to determine the likelihood of customers making future credit payments on time. Determining such a risk profile requires a vast amount of data, including pubic and social data.

Predictive analytics can be classified into six categories:[8]

- **Data mining**: What data is correlated with other data?
- **Pattern recognition and alerts**: When should I take action to correct or adjust a process or piece of equipment?
- **Monte-Carlo simulation**: What could happen?
- **Forecasting**: What if these trends continue?
- **Root cause analysis**: Why did something happen?
- **Predictive modeling**: What will happen next if?

The Using descriptive data accumulated over time, predictive analytics utilizes models for predicting events. However, it does not recommend actions. Predictive capabilities such a forecasting and simulation provide enhanced insight that managers can use to make more informed decisions. Characterized by the use of trends of time-series data and correlations to identify patterns, predictive analytics applies advanced statistical analysis and data mining-as well as sophisticated mathematics to validate assumptions and test hypotheses-to provide a solid, data-base foundation that can raise manager's confidence in conclusions. In the cloud era, there are many tools available for organizations to predict future outcomes. With predictive analytics it is important to have as much data as possible. More data means better predictions.

Performing predictive analytics is not difficult when you understand the data required by your business and have a tool that easily supports predictive modeling. One should first understand how to use the predictive analytics process and then learn how to leverage analytic procedures into the process. The steps in the predictive analytics process are:

1. Business understanding
2. Data understanding
3. Data preparation
4. Modeling
5. Evaluation
6. Deployment.

Each step is iterative and can be revisited as needed. As with almost all computer technologies, data is the core of the processing efforts. In figure 2 a graphical representation of the industry standard process that analyst follow when implementing predictive analytics.[9]

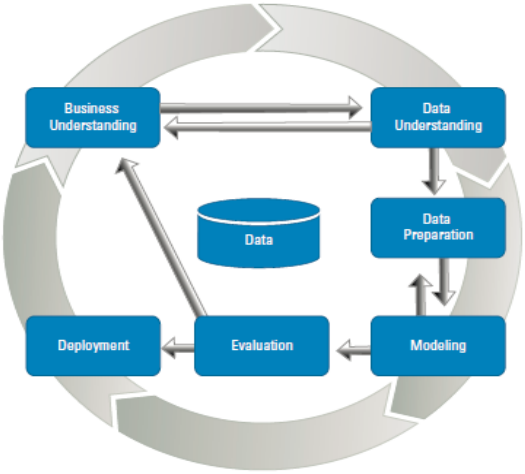

Figure 2 – Predictive analytics processes

V. PRESCRIPTIVE ANALYTICS

Once the past is understood and predictions can be made about what might happen in the future, it is then time to think about what the best response or action will be, given the limited resources of the enterprise. This is the area of prescriptive analytics. Prescriptive analytics is the final stage in understanding business, but it is still in its infancy. In this year's Hype Cycle of Emerging Technologies by Gartner, prescriptive analytics was mentioned as an "Innovation Trigger" that takes another 5-10 years to reach the plateau of productivity. Prescriptive analytics not only foresees what will happen and when it will happen, but also why it will happen and provides recommendations how to act upon it in order to take advantage of the predictions. It uses a combination of many different techniques and tools such as mathematical sciences, business rule algorithms, machine learning and computational modelling techniques as well as many different data sets ranging from historical and transactional data to public and social data sets. Prescriptive analytics tries to see what the effect of future decisions will be in order to adjust the decisions before they are actually made. This will improve decision-making a lot as future outcomes are taken into consideration in the prediction.[8][6]

Prescriptive analytics explores a set of possible actions and suggests actions based on descriptive and predictive analysis of complex data. Prescriptive analytics solutions can provide a reliable path to an optimal solution for business needs or resolution of operational problems. Prescriptive analytics take uncertainty into account and recommends ways to mitigate the risks that can result from it. Its ability to not only examine potential outcomes but also make recommendations helps managers make decisions when the data environment is too large or complex to be understood without the help of technology.[3]

Given the adoption rate of smart devices, cloud computing, SaaS business and consumer models, there's never been a time when more is known about the behaviors and habit of customers, employee, patients and stakeholders. Big data is an outcome of an ever increasing wired and online populous, driven by continual advancements in computing and data warehouse technology and capacity. Enterprise and organizations of all type and scale have reached a level of data breadth and volume where decision makers can leverage advanced data analysis to maximize their economic, competitive and market effectiveness. Big data is the answer to the question of how to improve future business decisions and the enabling factor is advanced analytics.[10]

Prescriptive analytics requires a predictive model with two additional components: actionable data and a feedback system that tracks the outcome produced by the action taken. Since a prescriptive model is able to predict the possible consequences based on different choice of action, it can also recommend the best course of action for any pre-specified outcome.[2]

Figure 3 below provides an overview of different analytics.

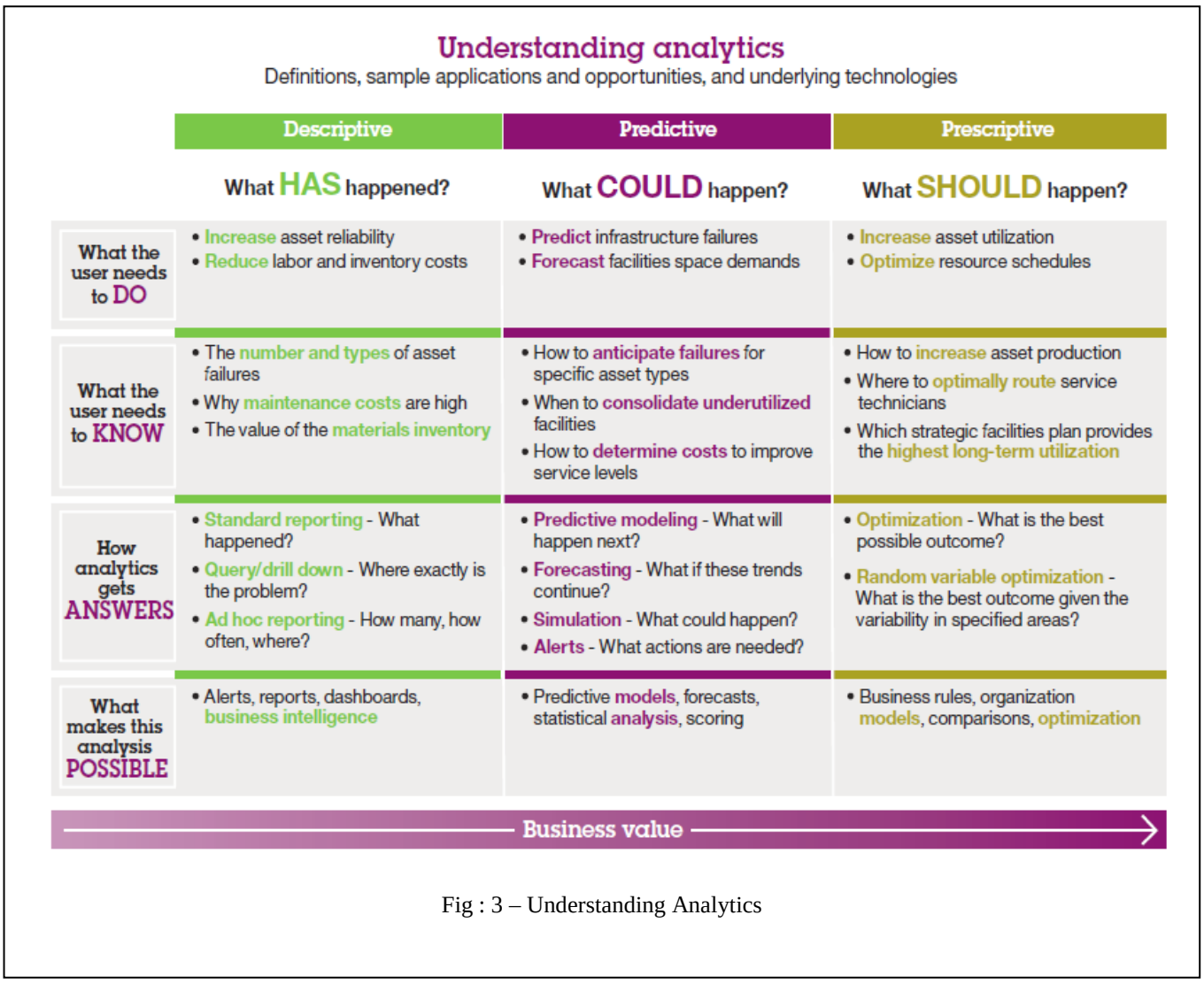

Fig : 3 – Understanding Analytics

VI. CONCLUSION

Analytics are used by the organizations to increase quality of service, operating costs reduction and increase return on assets. The risks of failure can be mitigated by analytics. It helps to find failure patterns and detection of minor anomalies. Early issue Identification helps organizations to deploy maintenance resources cost-effectively. This will improve levels of customer service and maximize equipment uptime. Counter to conventional thinking that organizations evolve from Descriptive to Predictive to Prescriptive analytics, all three kinds of analytics need to be done in the correct combination to enable the holistic creation of insights. Different business problems required different levels of all three kinds of analytics. The goal of business analytics is the fast resolution of business problems and enable better decisions.

Integration of Business Intelligence technology with cloud computing and Big data are the new trends in the analytics. Although there are concerns if this hype lives up to the expected real value preposition, a new research[11] reported by Saugatuck Technology states that cloud based BI and analytics will be among the fasted growing options

within the coming years. The augmentation of Business intelligence with Cloud will compound the growth rate by almost 84% annually in the next two years. If we hold this estimate true, then the Business analytics market will be touching $50 billion mark by 2016.

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