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A CONCEPTUAL STUDY ON BIG DATA APPLICATIONS FOR BUSINESS INTEGRATION; A TECHNO-BUSINESS LEADERSHIP PERSPECTIVE

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Abstract: Big data analytics is a trending practice that many companies are adopting. The analytics process includes the deployment and use of big data analytics tools, that improves operational efficiency, drive new revenue and gain competitive advantages over business rivals. The descriptive analytics focuses on describing something that has already happened, as well as suggesting its root causes. Descriptive analytics, which remains the lion's share of the analysis performed, typically hinges on basic querying, reporting and visualization of historical data. Alternatively, more complex predictive and prescriptive modeling can help companies anticipate business opportunities and make decisions that affect profits in areas such as targeting marketing campaigns, reducing customer churn and avoiding equipment failures. With predictive analytics, historical data sets are mined for patterns indicative of future situations and behaviors, while prescriptive analytics subsumes the results of predictive analytics to suggest actions that will best take advantage of the predicted scenarios.

Keywords; Big Data; Analytics; Descriptive; Applications; Business Integration

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Methodology: Analytical Review with secondary data.

Objectives:

(i) To gain knowledge on the basic knowledge on big data analytics and its applications in real life.

(ii) To gain insight on the latest developments in the big data analytics around the world compared to India

(iii) To evaluate the applications of Big Data in Business Applications.

Literature Review:

Structured Analytics In structured analytics, large quantity of data is generated from business and scientific research fields. These data is managed by RDBMS, Data warehousing, OLAP and BPM. Data grown by various research area like Privacy preserving data mining, E-commerce.

Text Analytics In Text analytics, Text is one of the most common forms of storing the information and it includes Email communication, documents, and Social media contents. Text analytics also known as Text mining, refers to the process of extracting useful information from large text. Text mining system is based on text representation and Natural Language Processing (NLP) with emphasis on the latter [2].

Web Analytics The aim of Web analytics is to retrieve, extract the information from Web Pages. Web Analytics also called Web mining.

Multimedia Analytics Recently multimedia data, including images, audio, and video has grown at a tremendous rate. Multimedia analytics refers to extract interesting knowledge and semantics captured in multimedia data. Multimedia analytics covers many subjects like Audio Summarization, Multimedia annotation, Multimedia indexing and retrieval.

Mobile Analytics Mobile data traffic increased 885PBs Per Month at the end of 2012. Vast volume of application and data leads to mobile analytics. Mobile analytics involves RFID, mobile phones, Sensors etc.

Technique for Analyzing Big Data There are many techniques that can be used to analyze datasets. Some techniques are machine learning. From this techniques, analyze new combination of datasets..

A/B Testing A technique in which control group compared with various test groups in order to determine what changes will improve a given variable for example- Reponse rate of marketing.
Classification; A technique in which to identify the categories of new datasets and assign into predefined classes for exampleclassification of mushroom as edible or poisonous[4]. It is used for data mining.

Crowd Sourcing; A technique in which collecting data submitted by large group of people or community i.e. crowd. It is usually through network media such as web.

Data Mining; A technique in which extracts patterns of data from large datasets of combinations from statistics and machine learning.

Introduction:
Big data can be understood as data sets that are too big and complex, and the traditional methods as well as process application software that are traditional cannot be applied or inadequate to deal with them. The challenges with big data are varied and complex. The challenge starts with the capturing, storage and analysis, with much more complexity in search, sharing and transfer, visualization, querying, updating and information privacy with the data source is also posing challenge. The term was coined by John Mashey in 1990, and making it popular, and followed by a definition in the year 2016 defines "Big data represents the information assets characterized by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value". It was further added with a definition in 2018 that "Big data is where parallel computing tools are needed to handle data", and notes, "This represents a distinct and clearly defined change in the computer science used, via parallel programming theories, and losses of some of the guarantees and capabilities made by codd's relational model". (Wikipedia). **The advanced analytics market**; The market for advanced

analytics tools has evolved over time, and are available as per capability and ease of use. For example, IBM, Oracle and SAS. Others are Microsoft, Dell, Teradata and SAP.

Other Examples of big data analytics products are Angoss, Predixion, Alteryx, Alpine Data Labs, Pentaho, KNIME and RapidMiner.

Statistical R language and provide predictive and prescriptive modeling capabilities using R's features, or use the software from the open source Weka project.

The scientists, Business executives , Medical Practitioners, advertising companies are now having difficulties with the term big data, and its application as the difficulties that are encountered are generated due to the peculiar characteristics of big data. They are :**4 Vs of Big Data;**

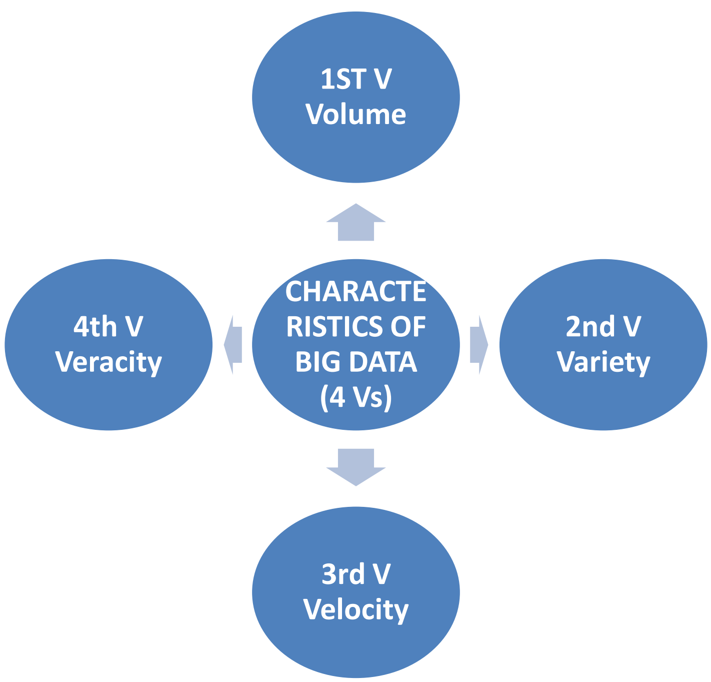

Fig 1: The Characteristics of Big Data (4Vs) : Concept Design and Source: Prof Dr.C.Karthikeyan

1st V= Volume: The enormous amount and at time infinite quantity of generated and stored data at times determines the value and potential insight, and whether it can be considered big data or not. **2nd V= Variety: The variety of data like** text, images, audio, video and in addition completes missing pieces through data fusion. **3rd V=Velocity: This refers to the lightning**

speed at which data generation processes, and meets the challenges of growth and development, including availability in real time. 4th V= Veracity: This refers to the quality of data that it can vary impacting the accuracy of analysis, and impact even on the results and interpretation for decision making.

Objective (i): To gain knowledge on the basic knowledge on big data analytics and its applications in real life.

The processing and data storage in the digital economy and all round the world demands advanced analytics applications. The growing availability of big data platforms and big data analytics tools has enabled environments with predictive and prescriptive analytics applications that have developed to the level of handling massive data volumes originating from a wide variety of sources. The big data analytics tools are software products that support predictive and prescriptive analytics applications running on big data computing platforms -- typically, parallel processing systems based on clusters of commodity servers, scalable distributed storage and technologies such as Hadoop and NoSQL databases.

The tools are designed to enable users to rapidly analyze large amounts of data, often within a real-time window. In addition, big data analytics tools provide the framework for using data mining techniques to analyze data, discover patterns, propose analytical models to recognize and react to identified patterns, and then enhance the performance of business processes by embedding the analytical models within the corresponding operational applications. For example, massive amounts of shipping delivery data, streaming traffic data, streaming weather data and historical vendor performance data can be analyzed to devise a model for optimal selection of shipping subcontractors within geographic regions to limit the risks of late delivery or damaged goods. Big data analytics tools can ingest a wide variety of data types: structured data with defined and consistent fields, such as transaction data stored in relational databases; semi-structured data, such as Web server or mobile application log files; and unstructured data, encompassing things like text files, documents, emails, text messages and social media posts. **National Institute of Standards and Technology [NIST]** said that Big Data in which data volume, velocity and data representation ability to perform effective analysis using traditional relational approaches

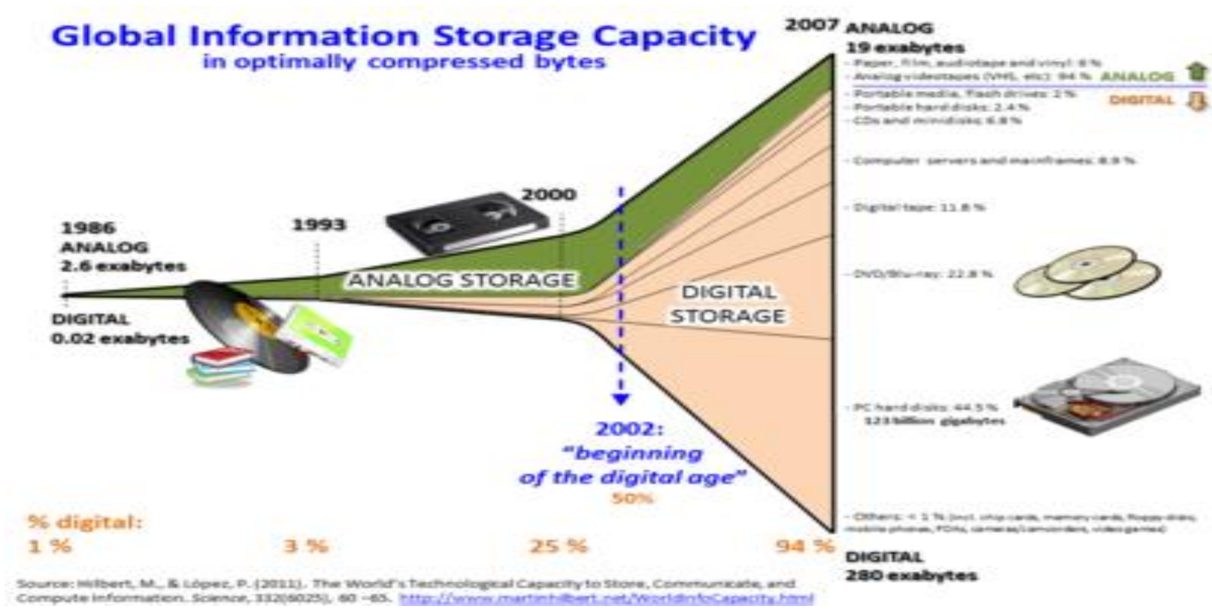

Fig: 2: The Global Information Storage Capacity: Source: Wikipedia.org

An IDC Reports predicts that from **2005 to 2020**, the global data volume will grow by a factor of 300, from 130 Exabyte's to 40,000 Exabyte's, representing a double growth every two years. **IBM estimates** that everyday 2.5 quintillion bytes of data are created out of which 90% of the data in the world today has created in the last two years. It is observed that social networking sites like Facebook have 750 Million users, Mobile Phones becoming best way to get data on people from different aspect, the huge amount of data that mobile carrier can process to improve our daily life.

Paulo Boldi, One of the authors says "Big Data does not need big machines, it needs big intelligence" . There are two types of Big Data Structured Data These data can be easily analyzed. It is in numerical form, figures, and transaction data etc.

The real time applications of Big Data:

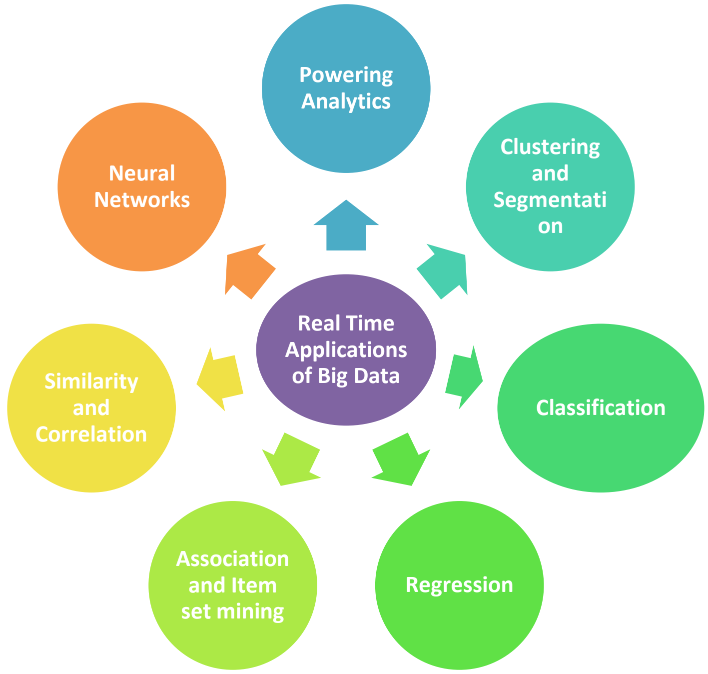

Fig: 3: Real time applications: Graphical design and Concept: Prof Dr.C.Karthikeyan

Powering analytics: Inside big data and advanced analytics tools the advanced analytics algorithms and models run on big data platforms such as Hadoop or specialty high-performance analytics systems. Easy to use structured and unstructured data from multiple sources and the capability of scaling data incorporated into analytical models. Their analytical models can be or already are integrated with data visualization and presentation tools. They can easily be integrated with other technologies.

Clustering and segmentation: the process which divides a large collection of entities into smaller groups that exhibit some (potentially unanticipated) similarities. An example is analyzing a collection of customers to differentiate smaller segments for targeted marketing.

Classification, a process of organizing data into predefined classes based on attributes that are either pre-selected by an analyst or identified as a result of a clustering model. An example is using the segmentation model to determine into which segment a new customer would be categorized.

Regression, a process to discover relationships among a dependent variable and one or more independent variables, and helps determine how the dependent variable's values change in relation to the independent variable values. An example is using geographic location, mean income, average summer temperature and square footage to predict the future value of a property.

Association and item set mining, which looks for statistically relevant relationships among variables in a large data set. For example, this could help direct call-center representatives to offer specific incentives based on the caller's customer segment, duration of relationship and type of complaint.

Similarity and correlation, which is used to inform undirected clustering algorithms. Similarity-scoring algorithms can be used to determine the similarity of entities placed in a candidate cluster.

Neural networks, which are used in undirected analysis for machine learning based on adaptive weighting and approximation.

Objective; (ii): To understand the conceptual base of Big Data and its Tools.

In every business organization, the only way to survive and move forward is by looking to explore and devise new predictive models, or embed these models within their business processes, and still at times move on the overall impact that these tools will have on the business. In other words, organizations that are adopting big data analytics need to accommodate a variety of user types. The data scientist, who likely performs more complex analyses involving more complex data types and is familiar with how underlying models are designed and implemented to assess inherent dependencies or biases.

The business analyst, who is likely a more casual user looking to use the tools for proactive data discovery or visualization of existing information, as well as some predictive analytics. The business manager, who is looking to understand the models and conclusions. IT developers, who support all the prior categories of users. All of these roles would typically work together in the model development lifecycle. The data scientist subjects a swath of big data sets to the undirected analyses provided, and looks for any patterns that would be of business interest. After engaging the business analyst to review how the models work and evaluate how each of those discovered models or patterns could potentially positively affect the business, the business manager and IT teams are brought in to embed or integrate the models into business processes or devise new processes around the models.From a market perspective, though, it's interesting to consider the types of businesses that are embracing big data analytics. Many of the early users of big data technologies were Internet companies (e.g., Google, Yahoo, Facebook, LinkedIn and Netflix) or analytics services providers. Each of these companies relied on operational and analytical applications requiring fast-flowing streams of data to ingest, process, analyze, and then feed the results back to continuously improve performance.

As the need for data expand among companies in more mainstream industries, big data analytics has found a place in a more general corporate population. In the past, the cost factors for a large-scale analytics platform would have limited the adoption to only the very largest businesses. However, the availability of utility-style hosted big data platforms (such as those available via Amazon Web Services) and the ability to instantiate big data platforms such as Hadoop on-premises without a large investment have reduced the barrier to entry. In addition, open data sets and accessibility to *fire hose* data feeds from social media channels provide the raw material for larger-scale data analyses when blended with internal data sets. Larger businesses may still opt for high-end big data analytics tools, but lower-cost alternatives deployed on cost-effective platforms enable small and medium-size businesses to evaluate and launch big data analytics programs and achieve the desired business improvement results.

Big data analytics benefits; the direct and indirect benefits are new revenue opportunities, more effective marketing, better customer service, improved operational efficiency and competitive advantages over rivals. Big data analytics applications enable data scientists, predictive modelers, statisticians and other analytics professionals to analyze growing volumes of structured transaction data, plus other forms of data that are often left untapped by conventional business intelligence (BI) and analytics programs. That encompasses a mix of semi-structured and unstructured data -- for example, internet click stream data, web server logs, social media content, text from customer emails and survey responses, mobile-phone call-detail records and machine data captured by sensors connected to the internet of things.

On a broad scale, data analytics technologies and techniques provide a means of analyzing data sets and drawing conclusions about them to help organizations make informed business decisions. BI queries answer basic questions about business operations and performance. Big data analytics is a form of advanced analytics, which involves complex applications with elements such as predictive models, statistical algorithms and what-if analyses powered by high-performance analytics systems.

Objective: (iii): To understand the applications of Big Data in Business Applications.

Practical Benefits of Big Data Analytics; Big Data can help companies achieve real results by by doing predictive modeling and data analysis. Information technology (IT) executives have attempted to figure out how they can use the four 'V's of big data – volume, variety, veracity and velocity. Effective Marketing Decisions with Big Data Analytics; Big Data Analytics leverages the four 'V's and delivers detailed insights for executing better decisions. Take an example of a marketer who can predict the customer registration pattern with the help of big data analytics. With detailed analytics, the decision maker can analyze when the customers have registered the most and also know which marketing campaigns has resulted in increased registrations. Apart from marketing, there are many business functions that can add value by leveraging the power of Big Data Analytics.

Achieving Financial Efficiency: Cloud based analytics and Hadoop are the two main big data technologies that can help in saving costs. Critics try to draw comparisons between the conventional architectures like data-warehouses and big data. These comparisons are hard since not only are the two technologies different, but are also varying in their costs. Almost all firms use big data services to complement already existent architectures.Instead of using a warehouse to store and process large data quantities, Hadoop is used and data moves to enterprise warehouses for other applications. Wells Fargo and Citi have adopted Hadoop along with their current analytics storage and processing capabilities. It is possible that cloud and Hadoop will continue to lend a helping hand to firms wanting to manage big data. **Informed Decision Making:** The aim of analytics is to speed up the decision making process for businesses. Companies want the ability to make better and faster decisions by implementing big data.

Hadoop and in-memory analytics help companies improve on the decisions already made and increase the pace of making functional decisions. **Introducing New Products & Services:** Big data analytics also enables organizations in creating new products and services for consumers. While e-commerce companies use analytics to design new offerings, off the grid companies such as GE are cashing in now. GE is using big data analytics to invest in new service models for their industrial products. On the other hand, Verizon Wireless uses its mobile device data to sell information about user actions, backgrounds and frequency of their presence in certain locations.
Better Data Visualization: In today's times, executives need to present Business Intelligence – BI data in an easy-to-understand format that makes use of charts, graphs and slide decks. Due to the large volumes of data created, Big data analytics tools offer data in a simplified form for users to query and manipulate. Paying enough attention to usability or UX is equally necessary. Managers and employees in decision-making positions need information to infographics, tables and dashboards. The adoption and subsequent ROI increases when end-users analyze, view and benefit from it quickly. Thus, big data analytics helps organizations to take better and cost-effective decisions that accentuate the effectiveness of their business strategies and ultimately boost the bottom-line.

The metamorphosis of Big Data Analytics in Business Applications;

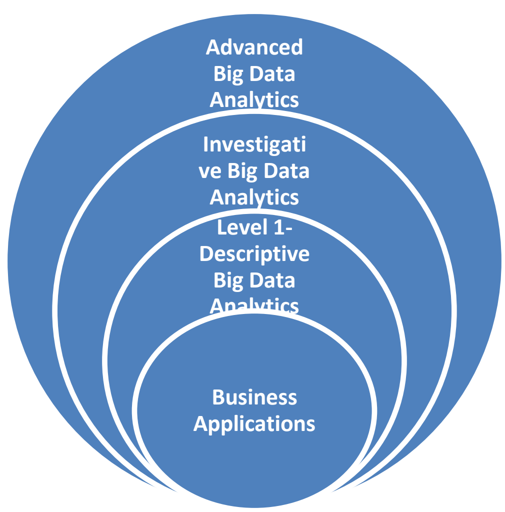

Fig:4: The levels of Business Applications and its Advancements: Graphic Design and Concept:Prof Dr.C.Karthikeyan

Level 1 – Descriptive Big Data Analytics; This is the first benefit of big data analytics: They consolidate all of your data, including internal and external data, structured data (files and databases) and text (including all details and history) in a single location. Through dynamic interactions with your production applications (ERP, CRM, Marketing automation, etc.), they transform all heterogeneous and usually widely-distributed data into automatically updated and directly accessible information that provides a complete view of reality. Thousands of data and all the details can be combined to form a complete perspective. Through this you will gain both a global, consolidated view and an in-depth, detailed close-up, thus providing a full description of your data.

Level 2 – Investigative Big Data Analytics; Big Data Analytics Applications let you carry out various and complex investigations. The next step is using big data analytics application to investigate new potentiality or models that are currently hidden in your data. By using dynamic visualization tools and discovery engines, you can look into all historical information in depth. You can focus on any specific user profile or product component, and verify their characteristics – as well as identify the impact of any element in your overall results. For instance, a risk manager can check if and how a meteorological or geographical situation is having an impact on incident figures.

Level 3 – Advanced Big Data Analytics Applications provide you with in-depth understanding of your data. All of the descriptive information captured through big data provides you with access to advanced analytics capabilities that transform all data into models and patterns. You will gain a new understanding of your customers' behavior and their journey across multiple platforms. This allows you to identify new segmentations of your population (customers or patients, based on the reality of all interactions) by identifying relationships between data which normally would have been separated.

Level 4 – Adaptive Big Data Analytics; Big Data Analytics Applications are more than just tools: they continuously adapt to your business context, thus letting you solve new and unexpected challenges in unique and creative ways. One of the main benefits of an adaptive big data analytics is its ability to integrate the perspective of any business user, and easily and quickly create new patterns and models to fit with any business concern. Moreover, their links with performance and optimization initiatives provides you with a unique value.

Level 5 – Predictive Big Data Analytics; Big Data predictive analytics applications move you a step ahead, allowing you to see into the future.Predictive analysis utilizes statistical modeling and data mining techniques to analyze all existing data (including historical data) in order to identify sequential pattern repetitions. Because they can extrapolate data that you do not have, they provide you with the ability to envision trends and predict what might happen in the future.

Level 6 – Prescriptive Big Data Analytics; Ultimately, prescriptive analytics applications provide you with the ability to make decisions and take action.A prescriptive approach is the next step towards **closed- loop analysis**. Because it allows you to extrapolate data from a specific situation, it gives you the ability to explore multiple options for the future.This is the ultimate benefit of prescriptive analytics applications: they bring together simulations of multiple scenarios that enable decision-makers to decide on actions based on tangible information.

Cost effective solutions:

Banking and Securities: Top investment and retail banks industry include utilise big data for securities fraud early warning, tick analytics, card fraud detection, archival of audit trails, enterprise credit risk reporting, trade visibility, customer data transformation, social analytics for trading, IT operations analytics, and IT policy compliance analytics, among others.

The Securities Exchange Commission (SEC) is using big data to monitor financial market activity. They are currently using network analytics and natural language processors to catch illegal trading activity in the financial markets.Retail traders, Big banks, hedge funds and other so-called ‘big boys’ in the financial markets use big data for trade analytics used in high frequency trading, pre-trade decision-support analytics, sentiment measurement, Predictive Analytics etc. This industry also heavily relies on big data for risk analytics including; anti-money laundering, demand enterprise risk management, "Know Your Customer", and fraud mitigation.*Big Data providers specific* *to this industry* include: 1010data, Panopticon Software, Streambase Systems, Nice Actimize and Quartet FS

Communications, Media and Entertainment; Consumers expect rich media on-demand in different formats and in a variety of devices, some big data challenges in the communications, media and entertainment industry include: Collecting, analyzing, and utilizing consumer insights, Leveraging mobile and social media content, Understanding patterns of real-time, media content usage, Organizations in this industry simultaneously analyze customer data along with behavioral data to create detailed customer profiles that can be used to:

Healthcare Providers; The healthcare sector has access to huge amounts of data but has been plagued by failures in utilizing the data to curb the cost of rising healthcare and by inefficient systems that stifle faster and better healthcare benefits across the board.This is mainly due to the fact that electronic data is unavailable, inadequate, or unusable. Additionally, the healthcare databases that hold health-related information have made it difficult to link data that can show patterns useful in the medical field. Other challenges related to big data include: the exclusion of patients from the decision making process, and the use of data from different readily available sensors.

Education; From a technical point of view, a major challenge in the education industry is to incorporate big data from different sources and vendors and to utilize it on platforms that were not designed for the varying data. From a practical point of view, staff and institutions have to learn the new data management and analysis tools.

Manufacturing and Natural Resources; Increasing demand for natural resources including oil, agricultural products, minerals, gas, metals, and so on has led to an increase in the volume, complexity, and velocity of data that is a challenge to handle.Similarly, large volumes of data from the manufacturing industry are untapped. The underutilization of this information prevents improved quality of products, energy efficiency, reliability, and better profit margins. In the natural resources industry, big data allows for predictive modeling to support decision making that has been utilized to ingest and integrate large amounts of data from geospatial data, graphical data, text and temporal data.

Government; In governments the biggest challenges are the integration and interoperability of big data across different government departments and affiliated organizations.In public services, big data has a very wide range of applications including: energy exploration, financial market analysis, fraud detection, health related research and environmental protection. Big data is being used in the analysis of large amounts of social disability claims, made to the Social Security Administration (SSA), that arrive in the form of unstructured data. The analytics are used to process medical information rapidly and efficiently for faster decision making and to detect suspicious or fraudulent claims.The Food and Drug Administration (FDA) is using big data to detect and study patterns of food-related illnesses and diseases. This allows for faster response which has led to faster treatment and less death.The Department of Homeland Security uses big data for several different use cases. Big data is analyzed from different government agencies and is used to protect the country.

Insurance; Lack of personalized services, lack of personalized pricing and the lack of targeted services to new segments and to specific market segments are some of the main challenges. In a survey conducted by Marketforce challenges identified by professionals in the insurance industry include underutilization of data gathered by loss adjusters and a hunger for better insight.Big data has been used in the industry to provide customer insights for transparent and simpler products, by analyzing and predicting customer behavior through data derived from social media, GPS-enabled devices and CCTV footage. The big data also allows for better customer retention from insurance companies.When it comes to claims management, predictive analytics from big data has been used to offer faster service since massive amounts of data can be analyzed especially in the underwriting stage. Fraud detection has also been enhanced.Through massive data from digital channels and social media, real-time monitoring of claims throughout the claims cycle has been used to provide insights.*Big Data Providers in this industry include*: Sprint, Qualcomm, Octo Telematics, The Climate Corp.

Retail and Whole sale trade; From traditional brick and mortar retailers and wholesalers to current day e-commerce traders, the industry has gathered a lot of data over time. This data, derived from customer loyalty cards, POS scanners, RFID etc. is not being used enough to improve customer experiences on the whole. Any changes and improvements made have been quite slow.Big data from customer loyalty data, POS, store inventory, local demographics data continues to be gathered by retail and wholesale stores.

Transportation; Governments use of big data: traffic control, route planning, intelligent transport systems, congestion management (by predicting traffic conditions). Private sector use of big data in transport: revenue management, technological enhancements, logistics and for competitive advantage (by consolidating shipments and optimizing freight movement). Individual use of big data includes: route planning to save on fuel and time, for travel arrangements in tourism etc.

Energy and Utilities; In utility companies the use of big data also allows for better asset and workforce management which is useful for recognizing errors and correcting them as soon as possible before complete failure is experienced.

Findings and Conclusion;

While the ability to capture and store vast amounts of data has grown at an unprecedented rate, the technical capacity to aggregate and analyze these disparate volumes of information is only just now catching up. Evolving technology has brought data analysis out of IT backrooms, and extended the potential of using data-driven results into every facet of an organization. However, while advances in software and hardware have enabled the age of big data, technology is not the only consideration. Companies need to take a holistic view that recognizes that success is built upon the integration of people, process, technology and data; this means being able to incorporate data into their business routines, their strategy and their daily operations. Organizations must understand what insights they need in order to make good strategic and operational decisions. The first part of the challenge is sorting through all of the available data to identify trends and correlations that will drive beneficial changes in business behavior. The next step is enriching this organizational information with that from sources outside the enterprise; this will include familiar big data sources, such as those created and stored online. In a business environment that constantly and rapidly changes, future prediction becomes more important than the simple visualization of historical or current perspectives. For effective future prediction, data analysis using statistical and predictive modeling techniques may be applied to enhance and support the organization's business strategy. The collection and aggregation of big data, and other information from outside the enterprise, enables the business to develop their own analytic capacity and capability, which for many years has only been available to a few larger organizations.

Big data; Changing the way businesses compete and operate Analytics can identify innovative opportunities in key processes, functions and roles. It creates a catalyst for innovation and change — and by challenging the status quo, it can help to create new possibilities for the business and its customers. Sophisticated techniques can allow companies to discover root causes, analyze microsegments of their markets, transform processes and make accurate predictions about future events or customers' propensity to buy, churn or engage. It is no longer enough for companies to simply understand current process or operations with a view on improving what already exists, when there is now the capacity to question if a process is relevant to the business, or whether there is a new way of solving a particular issue. The key driver for innovation within organizations is to constantly challenge existing practices rather than consistently accept the same. Most organizations have complex and fragmented architecture landscapes that make the cohesive collation and dissemination of data difficult. New analytic solutions are playing an important role in enabling an effective Intelligent Enterprise (IE). An IE helps to create a single view across your organization by utilizing a combination of standard reporting and data visualization. Data from multiple source systems is cleansed, normalized and collated. External feeds can be gathered from the latest research, best practice guidelines, benchmarks and other online repositories. Use of enhanced visualization techniques, benchmarking indexes and dashboards can inform management and consumers via smartphones, laptops, tablets, etc., in-house or remotely All companies need to start thinking about collecting and using relevant big data. Data-driven decisions can reduce inefficiency between the business, legal and IT, optimize existing information assets and address disconnects between different functions of an organization. However, it is worth noting that the best data and the most advanced analytical tools and techniques mean nothing if they are not being leveraged by people who are asking the right questions. Big data, emerging storage technology platforms and the latest analytical algorithms are enablers to business success, not a guarantee of it. Big data can be a powerful way to identify opportunities, but when combined with traditional organizational information the volumes of data collected can be vast and traditional storage methods can be prohibitively expensive and do not necessarily scale effectively. Big data is changing the way businesses compete and operate, and organizational information is typically historical, incomplete and inaccurate. For a forward-looking perspective (using statistical and predictive modeling) it needs to be enriched with external information. Big data drivers The benefits and risks of big data While there is no doubt that the big data revolution has created substantial benefits to businesses and consumers alike, there are commensurate risks that go along with using big data. The need to secure sensitive data, to protect private information and to manage data quality, exists whether data sets are big or small. However, the specific properties of big data (volume, variety, velocity, veracity) create new types of risks that necessitate a comprehensive strategy to enable a company to utilize big data while avoiding the pitfalls. This should be done in a prioritized fashion so that companies can start to realize the benefits of big data in step with managing the risks. The following pages look at the possibilities and risks associated with big data and give examples of how big data is being leveraged to solve some of the complex issues businesses face today. We identify traditional and new risks and considerations for the seven key steps to success: governance, management, architecture, usage, quality, security and privacy.

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