INDUSTRY 4.0: THE EMERGING FOURTH INDUSTRIAL REVOLUTION ROLE OF BIG DATA ANALYTICS

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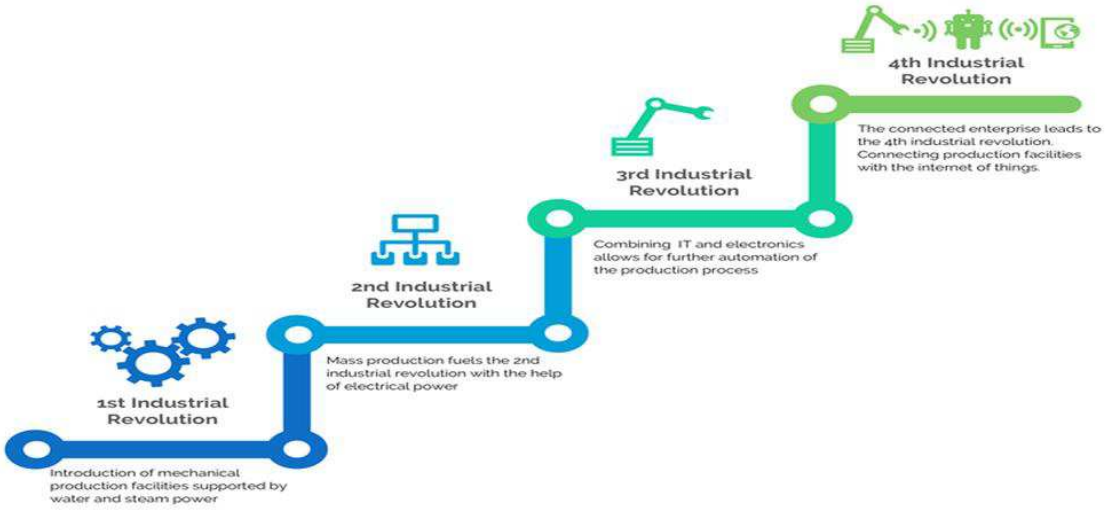
Abstract: Schumpeter's Theory hypothesizes that innovation in business is the major reason for increased investments and business fluctuations. By innovation he means, the changes in the methods of production and transportation, production of a new product, change in the industrial organization, opening up of a new market, etc. The innovation does not mean invention rather it refers to the commercial applications of new technology, new material, new methods and new sources of energy.
He assumed that *change* is the basic element of dynamic process, and those changes come in the form of innovations. Any innovation may consist of:

- The introduction of a new product
- The introduction of a new method of production
- The opening up of a new market
- The conquest of a new source of supply of raw materials or semi manufactured goods
- The carrying out of the new organization of any industry like the creation of a monopoly

Technology has always played a major role in creating the wealth of nations and influencing standards of living and quality of life. It has had such a profound effect on human lives that progress of civilizations is frequently identified by the dominant technology of the age right from Stone Age→ Bronze Age→ Iron Age→ Steam Age→ Electricity Age→ Nuclear Age→ Electronics Age→ Space Age→ Information Age→ Biotech Age.
This paper seeks to look into the emerging Fourth Industrial Revolution under the name Industry 4.0, which collaborates with several innovative technologies by setting up new norms, standards, practices and procedures on the competitive landscape, challenging the industrial sector with the mantra of survival of the fittest.

Introduction: According to Joel Mokyr, a renowned economic historian "*An Industrial Revolution can be considered as a system of macro inventions that generates events that change society in a definitive and pragmatic way, regardless of the supporting scientific basis*".
First Industrial Revolution: First Industrial revolution is the transition from manual labor to steam engine where the mechanical advantage of steam engines was leveraged to lessen the human labor.
Second Industrial Revolution: Advent of electricity into industries marks the second Industrial revolution. Electrical motors and analog systems replaced the steam engine. There was little to no manual labor involved. Mass production assembly lines were introduced during this period.
Third Industrial Revolution: Computers and Electronics in factories and industries made it possible for humans to program the electrified machines and third industrial revolution was born. It eventually paved way for automation.

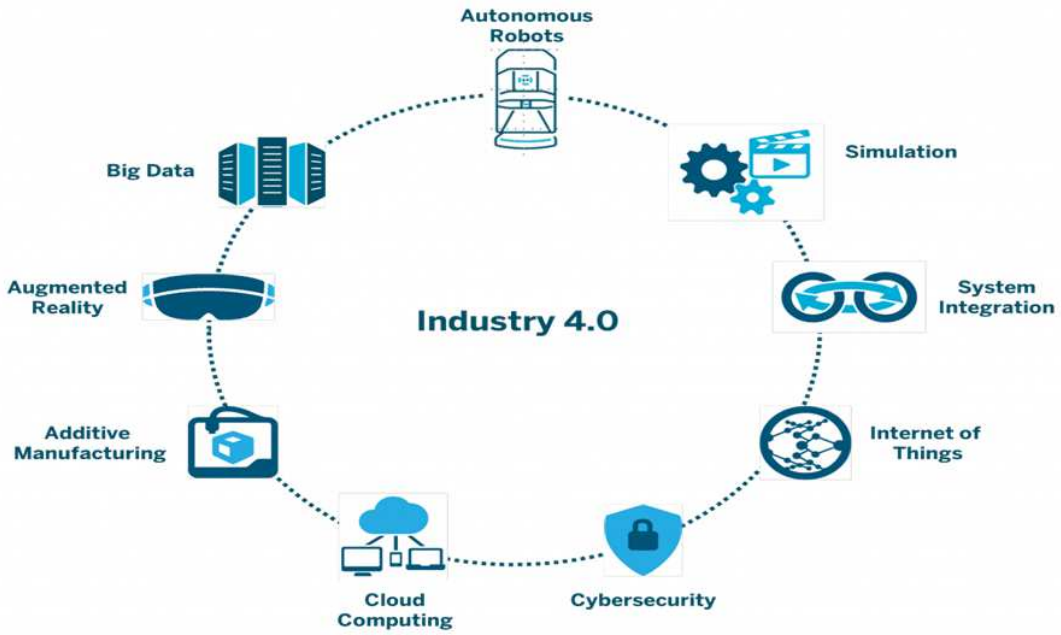
All the three Industrial Revolutions that the world has seen comply with the above definition.



Fourth Industrial Revolution—Industry 4.0: Industry 4.0 is the fancy name given to the **fourth Industrial revolution**. Americans prefer to call this concept- **smart factory** and Europeans call it- Industry 4.0 (Germans came up with the term).

A Cyber physical system plays a vital role in Industry 4.0 and is changing the face of the industry. It again is a fancy name for the physical systems with electronics embedded in them for making them intelligent.

Industry 4.0 is the process of embedding intelligence and connectedness in manufacturing and supply chain to provide satisfying products and services". Dirk Salma, the director of business development at Bosch Software Innovation GmbH said "*It's not only the things that we manufacture become more and more intelligent and connected but it's also that the manufacturing process itself can really leverage these technologies and concepts in Industry 4.0*" in his keynote address at NEXT Conference.



Source: https://www.advancedmobilegroup.com/blog/rfids-role-in-industry-4.0

The **nine technologies** that are transforming industrial production under industry 4.0 are:
1. Big Data Analytics
2. Autonomous Robots:
3. Internet of Things:
4. Horizontal and Vertical System Integration
5. The Cloud
6. Cyber Security
7. Simulation
8. Additive Manufacturing
9. Augmented Reality

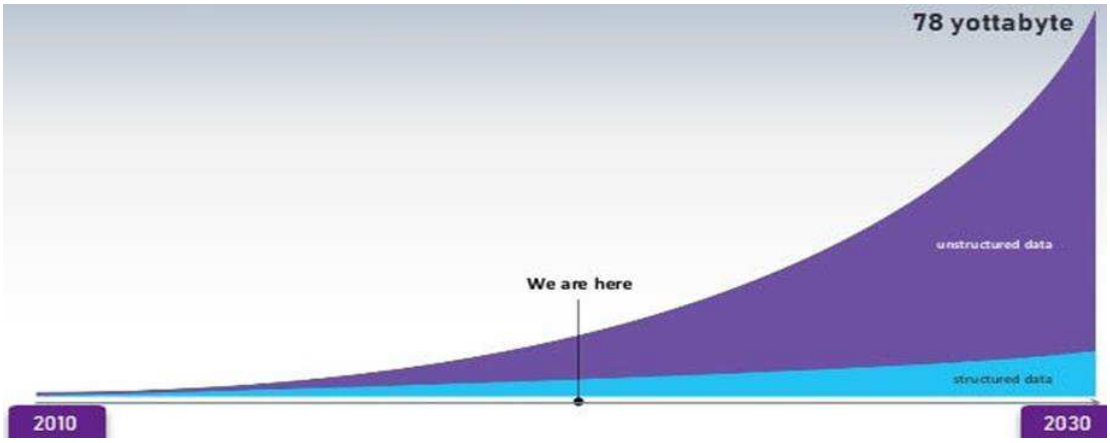
Big Data Analytics:

It has been observed that the cumulative rate of generating data during last two years has far exceed3ed the rate during the last century.
Society is on the cusp of a tremendous wave of innovations, productivity and growth as well as new modes of competition and value capture—all driven by Big Data

The process of converting large amounts of unstructured raw data, retrieved from different sources to a data product useful for organizations forms the core of Big Data Analytics. Today, many organizations are collecting, storing, and analyzing massive amounts of data. This data is commonly referred to as "big data" because of its volume, the velocity with which it arrives, and the variety of forms it takes. Big data is creating a new generation of decision support data management. Businesses are recognizing the potential value of this data and are putting the technologies, people, and processes in place to capitalize on the opportunities. A key to deriving value from big data is the use of analytics. Collecting and storing big data creates little value; it is only data infrastructure at this point. It must be analyzed and the results used by decision makers and organizational processes in order to generate value.

Data analytics, once an IT application is now penetrating into manufacturing and supply chain industry. Power of data analytics and pattern recognition can be harnessed in the manufacturing industry to reduce downtime and wastages. Data can be collected at different levels of manufacturing process and their manufacturing data can then be retrieved and comprehensively evaluated to arrive at a pattern. Process involving those patterns can be redesigned and re-evaluated to reduce wastage and increase productivity. Predictive maintenance can be carried out based on the data collected. This is cost-efficient and safer than the conventional routine maintenance method.

Big Data: Big Data is also **data** but with a **huge size**. Big Data is a term used to describe a collection of data that is huge in size and yet growing exponentially with time.



UNIT	ABBREVIATION	STORAGE
Bit	B	Binary Digit, Single 1 or 0
Nibble	-	4 bits
Byte/Octet	B	8 bits
Kilobyte	KB	1024 bytes
Megabyte	MB	1024 KB
Gigabyte	GB	1024 MB
Terabyte	TB	1024 GB
Petabyte	PB	1024 TB
Exabyte	EB	1024 PB
Zettabyte	ZB	1024 EB
Yottabyte	YB	1024 ZB

Storage units (www.byte-notes.com

In short, such data is so large and complex that none of the traditional data management tools are able to store it or process it efficiently.

Characteristics of Big Data:

- ***Volume*** – The name Big Data itself is related to a size which is enormous. Size of data plays a very crucial role in determining value out of data. Also, whether a particular data can actually be considered as a Big Data or not, is dependent upon the volume of data. Hence, '**Volume**' is one characteristic which needs to be considered while dealing with Big Data.
- ***Variety*** – The next aspect of Big Data is its **variety**. Variety refers to heterogeneous sources and the nature of data, both structured and unstructured. During earlier days, spreadsheets and databases were the only sources of data considered by most of the applications. Nowadays, data in the form of emails, photos, videos, monitoring devices, PDFs, audio, etc. are also being considered in the analysis applications. This variety of unstructured data poses certain issues for storage, mining and analyzing data.
- ***Velocity*** – The term '**velocity**' refers to the speed of generation of data. How fast the data is generated and processed to meet the demands, determines real potential in the data. Big Data Velocity deals with the speed at which data flows in from sources like business processes, application logs, networks, and social media sites, sensors, Mobile devices, etc. The flow of data is massive and continuous.
- ***Variability*** – This refers to the inconsistency which can be shown by the data at times, thus hampering the process of being able to handle and manage the data effectively.

Examples of Big Data

- The **New York Stock Exchange** generates about ***one terabyte*** of new trade data per day.
- The statistic shows that ***500+terabytes*** of new data get ingested into the databases of social media site **Facebook**, every day. This data is mainly generated in terms of photo and video uploads, message exchanges, putting comments etc.
- A single Jet engine can generate 10+terabytes of data in 30 minutes of flight time. With many thousand flights per day, generation of data reaches up to many Petabytes.

Who's using Analytics?

Recent advancements in technology have increased the potential of analytics. More data, better and cheaper storage options, stronger computational power, distributed and shared processing capabilities, and more algorithms make it easier to apply analytics to large problems and derive answers from data – in every industry.

Manufacturing: Manufacturing and logistics companies are leaders in digital transformation. The use of robotics and automation are streamlining the supply chain. And whereas some industries struggle to generate value from IoT, manufacturers are adept at using sensor data to expose product flaws and optimize heavy machinery maintenance.

Banking: Banks worldwide are transforming to attract and retain customers. From AI-driven chat bots to advanced fraud detection, financial institutions are implementing new digital technologies to stave off disruptors and form new digital pathways between customers and the business.

Health Care: Digital transformation is accelerating improvements in areas such as diagnostics, care and monitoring. Look no further than AI being used to improve cancer detection. Digital tools bring the promise of more precise diagnoses and better targeting of treatments with predictive models. Simply put, we're living longer, healthier lives through the use of technology.

Energy: Better forecasting technology helps energy companies save millions. It also helps provide more consistent power for energy-starved nations. Sensors on turbines help utilities squeeze value from existing machinery and proactively address mechanical issues before machines fail.

Communications: Plummeting revenues have pushed many telcos to take a more aggressive approach to transformation. This includes creating new, innovative services and mining data to improve the customer experience. Expect strong investments in digital transformation projects as telecoms look for new growth opportunities.

Government: The public sector is increasingly using technology to improve the lives of citizens. With a plethora of big data at their disposal, governments have ample opportunity to further cut costs and drive revenue. The key is change management and fostering a culture of innovation.

Insurance: Commonly limited by legacy technology, insurers are investing in cloud infrastructure to support the adoption of new technologies and agile processes. In many cases, business units within companies are driving digital transformation – serving as proofs of concept for embedding digital technologies elsewhere in the business.

Manufacturers today seek to achieve true business intelligence through collecting, analyzing, and sharing data across all key functional domains. In this architecture, production systems are not only more efficient but can also respond in a timely manner to changing business needs, including signals from partners and customers. What follows are some selected real-life examples of how the Industry 4.0 big data vision can bring measurable value to manufacturers:

- **Merging quality and production data to improve production quality**: A semiconductor manufacturer began correlating single-chip data captured in the testing phase at the end of the production process with process data collected earlier in the process. The manufacturer could then identify faulty chips early on and greatly improve the quality of the production process.
- **Empowered customers**: The automotive industry is enthusiastically embracing Industry 4.0 in order to cost-effectively meet consumer expectations for more affordable and digitally connected cars. Among the many use cases of the big data that will be generated by connected cars is the seamless exchange of data with the manufacturer. In addition to improving after-sale service for the individual car-owner, the aggregated information on car performance can be used to improve quality processes and future designs.
- **Reduced downtime**: Applicable to many industrial sectors, Industry 4.0 big data analytics can uncover patterns that predict machine or process failures before they occur. Machine supervisors will be able to assess process or machine performance in real time and, in many cases, prevent unplanned downtime.

Conclusion: According to Wikipedia, analytics is "the discovery and communication of meaningful patterns in data." Where the real story with analytics lies, however, is in what we can do with it. Think in terms of Possibilities, Opportunities and Discoveries. Made possible by technological advancements in analytics that was never even dreamed of not so very long ago, within our lifetime. Big data will be vital to the fourth industrial revolution. In fact, some go as far as to say big data is Industry 4.0. Others look at it as an equation in which artificial intelligence plus big data equals the fourth industrial revolution.

Big Data Analytics (BDA) is a powerhouse for organizations of 21st century seeking immediate value from their data. With BDA the manufacturers as well as retailers can discover insights from their data and make sense of it all. Identify what's working and fix what isn't. Make more intelligent decisions. And drive relevant change**.** In manufacturing, improvements and efficiencies in the analysis of big data are expected to bring billions of dollars to the industry over the next five years.

Throughout history, industrial revolutions have often been judged by their impact on the production and manufacturing of goods and products. That's no different with the looming Industry 4.0, but it will affect many other industries as well. Industry 4.0 is paving the way for widespread big data analytics. The ROI for manufacturers is already compelling in terms of improved operational efficiency, enhanced quality, and faster response times to ever-changing market signals. Hence, the manufacturers need these solutions to integrate seamlessly with existing enterprise systems in order to align production and quality processes with their core business objectives.

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