
DATA SCIENCE IN INDUSTRIAL 4.0 APPLICATIONS

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Abstract-

Industry 4.0 is a shift from the past industry shape. Mechanization is because of innovation including electrical energy. Changes happen and prompt paperless and human less, yet these progressions require arrangement both in the modern world and in other supporting universes. Data is an alternate side of innovation. Data includes a wide range of ideas from the modern world, despite the fact that either data of the modern world include a similar innovation. In particular, data the board is not quite the same as industry the executives. This paper audits incorporated administration in light of data science, a science those concentrates on the conduct of data. Accordingly, joining requires data organizing ventures from Industry 4.0 and organizing data for Industry 4.0.

Keywords: *Industry 4.0, Data Science*

INTRODUCTION

Industry 4.0 is a period of the computerization of the creation of labor and products, which has prompted fundamental changes in numerous areas and parts of human existence. The presence of different comforts of data innovation has prompted modern robotization covering movements of every sort of production. Aside from the physical-digital framework (CPS) the web of things (IoT) makes it conceivable to make savvy industrial facilities the utilization of sensors, mechanical technology, and PCs bit by bit makes paperless and humanless. From one viewpoint, the utilization of human work is diminishing, however then again, it requires gifted laborers with innovation to fill the fields of work that unexpectedly show up. The utilization of innovation to control and screen producing consequently creates data. Not a couple of the devices being referred to expect that data as criticism in AI to have the option to foresee which modern frameworks are running. In any case, data can't be handled naturally by a PC machine. It needs finishing stages, beginning from data demonstrating to data the actual board. On the Industry 4.0 side, authority of data innovation is at the center of supporting exercises and expanding execution. On the human side, understanding data is important for dominating data innovation this functioning paper depicts Industry 4.0 from a data science outlook.

Basic Concept

Data, from all sides, has driven the development of innovation, particularly data innovation, going from easy to perplexing and refined the innovation incorporates exercises connected with info, cycle, and result, perceiving the communication between the shipper and recipient of data. The innovation is at the focal point of the Industrial insurgency 4.0, among the advancements are CPS Internet of Things, Augmented reality, Digital Twins, Deep Learning, Edge Computing, Artificial Intelligence, Robotic,

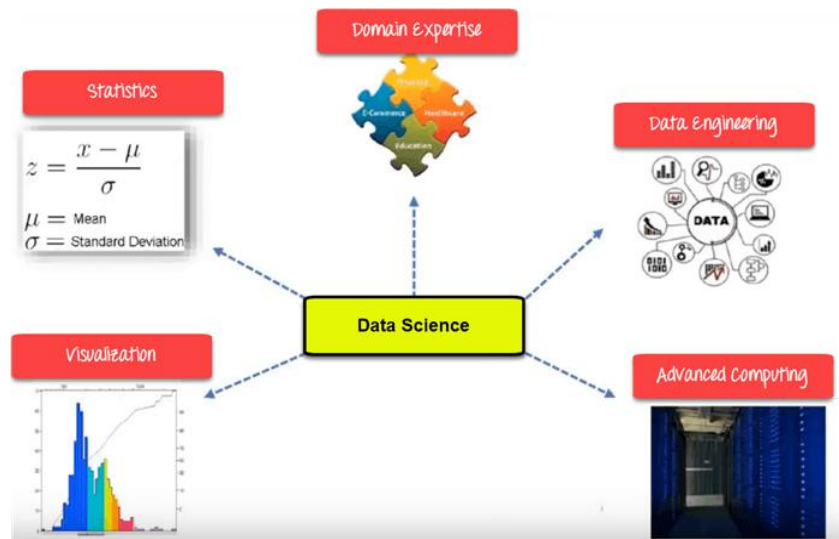
Machine to Machine Learning, Big Data Analysis, Cloud Computing, Mobile Internet, and so forth. This innovation plans to deliver a savvy modern framework. In any case, the industry has been around for quite a while, since the steam motor was designed, and has involved different logical fields. The area of science concerns normal assets and HR, specifically arithmetic, physical science, stock, improvement, gadgets, arranging, upkeep, business, financial aspects, showcasing, and others, both hypothesis, and execution. A few related logical fields like financial matters, business, arranging, upkeep, advertising, and different areas of execution require change, and a portion of the essential ideas should be re-state again. As per designing, modern frameworks work following the basic innovation and procedures. Enormous machines work precisely, albeit controlled electronically, as in mechanical technology in the car gathering industry, where the developments precisely completed with high accuracy. All machines require energy, and it is given by the energy supply machine, while energy guideline is brought out through control sensors to save the necessities of every creation machine. Following PC evaluations and estimation results by Computer-Aided Design (CAD) each robot machine, for instance, in a processing plant, has its not entirely set in stone. Every robot, in any case, can make mistakes when support doesn't match the age of the machine. Besides, mathematically every robot connected with programming requires changes when the machine is a refreshed rendition. Moreover, every machine requires learning, with the goal that creation isn't just expanded however more productive and ideal. It happens when those machines and advances are upheld by data. Each machine requires numerous boundaries to work. Boundaries that require suitable data, for the most part data require displaying as well as normalization. All of this is a data science business.

Why Data Science?

Here, are significant advantages of using Data Analytics Technology:

1. Data is the oil for the present world. With the right tools, advances, calculations, we can utilize data and convert it into a particular business advantage.
2. Data Science can assist you with identifying misrepresentation utilizing progressed machine learning calculations.
3. It assists you with forestalling any huge financial misfortunes.
4. Allows building insight capacity in machines.
5. You can perform opinion examination to measure customer brand faithfulness.
6. It empowers you to take better and quicker choices.
7. Helps you to prescribe the right product to the right customer to improve your business.

Data Science Components



Statistics:

Insights are the most basic unit in Data science. It is the strategy or science of gathering and dissecting mathematical data in huge amounts to get valuable experiences.

Visualization:

Perception method assists you with getting to tremendous measures of data in straightforward and edible visuals.

Domain expert

Is an individual who is an expert in a specific region or theme. The term area master is habitually utilized in master frameworks software advancement, and there the term generally alludes to the space other than the software area. A space master is an individual with unique information or abilities in a specific area of try (for example a bookkeeper is a specialist in the space of bookkeeping). The advancement of bookkeeping software requires information in two distinct spaces: bookkeeping and software.

Data Engineer

A data engineer is a laborer whose essential work liabilities include planning data for insightful or functional employments. The particular undertakings dealt with by data designers can shift from one association to another however regularly incorporate structure data pipelines to arrange data from various source frameworks; coordinating, merging and purifying data; and organizing it for use in individual investigation applications.

Deep Learning:

Profound Learning technique is new machine learning research where the calculation chooses the examination model to follow.

Applications of Data science

Internet Search:

Google search use Data science technology to look through a particular outcome inside a negligible portion of a second.

Recommendation Systems:

To make a suggestion framework Model, "recommended companions" on Facebook or proposed recordings" on YouTube, everything is finished with the assistance of Data Science.

Image & Speech Recognition:

Discourse perceives framework like Siri, Google right hand, Alexa runs on the strategy of Data science. In addition, Facebook perceives your companion when you transfer a photograph with them, with the assistance of Data Science.

Gaming world:

EA Sports, Sony, Nintendo, are utilizing Data science technology. This upgrades your gaming experience. Games are currently evolved utilizing Machine Learning technique. It can refresh itself when you move to more significant levels.

Online Price Comparison:

PriceRunner, Jungle, Shopzilla work on the Data science mechanism. Here, data is fetched from the relevant websites using APIs.

Prerequisites for Data Science

Here are some of the technical concepts you should know about before starting to learn what is data science.

Machine Learning

Machine learning is the backbone of data science. Data Scientists need to have a solid grasp of ML in addition to basic knowledge of statistics.

Modeling

Mathematical models enable you to make quick calculations and predictions based on what you already know about the data. Modeling is also a part of Machine Learning and involves identifying which algorithm is the most suitable to solve a given problem and how to train these models.

Statistics

Statistics are at the core of data science. A sturdy handle on statistics can help you extract more intelligence and obtain more meaningful results.

Programming

Some level of programming is required to execute a successful data science project. The most common programming languages are Python, and R. Python is especially popular because it's easy to learn, and it supports multiple libraries for data science and ML.

Databases

A capable data scientist needs to understand how databases work, how to manage them, and how to extract data from them.

TOOLS AND PROGRAMMING LANGUAGES USED FOR DATA SCIENCE

There are bunches of programming dialects created as of not long ago, and new ones are being fostered each year. Which are the programming dialects for the most part utilized in the space of data science? O'Reilly Media is a distributor organization of PC technology themes. In their Data Science Salary Survey 2017 around 800 respondents were posed inquiries about compensation, industry, group, programming tools and data advancements. Concerning the prominence of programming dialects, SQL showed the greatest divide utilization between the respondents (>60%), the second Python with >60% share, third R with >50% share, then, at that point, Bash >30% share, JavaScript, Java, Scala and Visual Basic having all >10% share. [3] Similarly to O'Reilly's overview, one more ongoing review led by Kaggle in 2018 additionally showed Python, R and SQL on the first spot on the lists. Kaggle is an internet based local area of data researchers and machine students having more than 1,000,000 enlisted clients. Kaggle was established by Goldboom and Hamner in 2010, and it is likely generally popular for its machine learning contests. In 2017 Kaggle was gained by Google LLC. Kaggle's Machine Learning and Data Science Survey 2018 planned to investigate characteristics of specialists working with data and patterns in the field of machine learning in various enterprises. The data from 23,859 usable reactions was distributed and a review data challenge with prizes was set out. One of the contending data stories by Rochette [4] is referred to here. See Table 1 for the highest point of the programming dialects when the respondents were posed a various decision inquiry how programming dialects treat use. Table 2 shows the first spot on the list when posed a solitary decision inquiry how explicit programming language treat utilize most frequently.

Table 1: What programming languages do you use? Number of respondents per the top ten programming language when multiple choices. Source: Rochette [4].

Rank	Language	# respondents
1	Python	15711
2	SQL	8267
3	R	6685
4	C/C++	4383
5	Java	3999
6	JavaScript/Typescript	3249
7	Bash	2708
8	MATLAB	2652
9	C#/.NET	1670
10	Visual Basic/VBA	1274

Table 2: What specific programming language do you use most often? Number of respondents per the top nine programming language when a single choice. Source: Rochette [4].

Rank	Language	# respondents
1	Python	8180
2	R	2046
3	SQL	1211
4	Java	903
5	C/C++	739
6	C#/.NET	432
7	JavaScript/Typescript	408
8	MATLAB	355
9	SAS/STATA	228

Future prediction on growth of data science in market.

Objective

- [1] To comprehend the industry 4.0 idea and its verifiable foundation.
- [2] To distinguish the critical innovation in Industry 4.0.
- [3] Study On Data Science In Industrial 4.0

Future prediction on growth of data science in market

Peruse the most recent experiences and measurements about the data science industry. Learn about the kinds of occupations and pay rates accessible, as well as gauges for the fate of this developing area. The COVID-19 pandemic has shown us numerous things. This worldwide emergency has implied that specialists across many disciplines have needed to resolve issues and propose arrangements. One region that has been essential to comprehension and estimating the pandemic is that of data science. We investigate why this field is so crucial for our everyday lives and what's on the horizon for data science. As well as investigating the current scene in the industry, we'll likewise investigate what drives development and where the positions are. We'll inspect the different courses into data science and the compensations on offer.

The current landscape in the data science industry

Basically, the field of data science centers around dissecting data to give experiences and afterward utilizing calculations and machine learning to settle on informed choices and predictions. In our current reality where we're each creating more data than any other time in recent memory, it's fundamental that we comprehend and deal with the ramifications of this data.

What is the data science industry's global market value?

There are a few reports we can check out to get a proportion of the worldwide worth of the data science industry. As per Grand View Research, in 2019, the worldwide data science stage market size was esteemed at \$3.93 billion. Different data from Statista shows that in 2021, the worldwide huge data market is anticipated to be valued at \$64 billion. With regards to data examination, one more key area of data science, research shows that North America represented the biggest portion of the overall industry in 2019, with a market worth of simply more than \$10 billion. Europe was the second-biggest market in 2019, esteemed at around \$6.43 billion.

What is the data science jobs market like?

The job of a data researcher is one of the most sought after positions in both the UK and the US. The job showed up on LinkedIn's 2020 Emerging Job Report in the two nations, including at number 3 in the US and number 7 in the UK. In the US, the job saw a 37% yearly development. The report likewise features that 'data researchers might be enlarging liabilities customarily finished by analysts as certain enterprises, similar to protection, gear up for the future.' Data from IT Jobs Watch shows that, in the a half year to March 2021, there were 2,273 super durable data science occupations posted in the UK, down from 3,162 in a similar period the earlier year. A comparable pattern was found in the US, where work postings for data researchers showed up level somewhere in the range of 2019 and 2020. In any case, this plunge could undoubtedly be clarified by the effect of the COVID-19 pandemic. Different data from 2020 shows that there was a lack of around 250,000 experts with security and data science abilities, showing an unmistakable interest for those with the right abilities.

Industry 4.0

With the open doors gave by creating technology to the advantage of individuals, it is seen that there are movements to digital conditions in numerous areas from money to instruction, and from wellbeing to somewhere safe and secure as far as propensities and business processes. Shopping on digital stages, the utilization of web banking, the recording of actual archives on PCs, the utilization of email rather than mail, the choice of understudies' courses, the declaration of test results, and the sharing of talk notes through administration data frameworks can be generally displayed as instances of the present circumstance. This is alluded to as digitization or digital transformation. Digital transformation is a cycle that outcomes in separation in the fields of endeavors like items, hierarchical designs, and computerization processes with the joining of digital advances into plans of action Digital transformation is the profound and fast transformation of business exercises, cycles, capabilities, and models by utilizing the progressions and open doors achieved by digital advances to completely fortify the effects of these innovations on society in a key and need way. The possible advantages of digitization are huge, particularly as far as deals or usefulness increments and developments in esteem creation. One of the areas where digital transformation shows its impact is industry. The industry has arrived at the current day by going through various periods along with the frameworks created by the states of the day and remembered for the creation interaction. These periods are known as the primary, second, third, and fourth modern insurgencies. The frameworks that influence the transformation can be considered steam-controlled mechanical frameworks, electrical energy-fueled frameworks, PC based mechanization frameworks, lastly, insightful frameworks that can speak with one another through the web and settle all alone. Globalization has lifted worldwide lines and it has prompted a change in the opposition to an alternate aspect in all areas. Expanded item and interaction intricacy, variable market attributes, abbreviated item, market, technology, and advancement cycles are a portion of the difficulties in the serious climate.

In this regard, different techniques that are inventive and increment usefulness are created and different speculation proposition are assessed to get by under intense cutthroat circumstances. The reason for surveying reserve funds through different venture choices or settling on essential choices is to create more income later on. For this situation, one of the significant focuses is to give the best yield least gamble. Then again, The improvement of data and correspondence innovations and the expanding significance of data stand out enough to be noticed of nations to make new drives

particularly in the field of industry. Additionally, the benefits and weaknesses of molding systems and ventures around changing social propensities, information and new advances have begun to be examined. Particularly with the joining of web and sensor technology to existing creation frameworks, another creation model has been proposed. This model, which is alluded to as Industry 4.0, was set out in 2011 by a proposition document submitted to the German government by a functioning gathering under the bearing of Robert Bosch GmbH and Henning Kagermann. With the last report declared at the Hannover Fair in Germany in 2013, it has turned into a subject of interest on the world plan.

Factors that speed up the progress to Industry 4.0 incorporate expanded measure of put away data, expanded registering force of PCs, worked on scientific and business knowledge arrangements, further developed connection points in human-machine association, and the simplicity of changing digital rules into the actual world (Baur and Wee, 2015). Despite the fact that it is by all accounts the improvement of modernized assembling frameworks that prompted the third modern unrest with new innovations, Industry 4.0 depends on an organization model that incorporates the computerization of significant worth chain components as well as the reconciliation of these apparatuses with consistent correspondence and ongoing elements. Toward this path, Industry 4.0 has an idea formed around the ideas of cyber physical frameworks, web of things and administrations, remote correspondence, modern web, astute creation and cloud-based creation. Industry 4.0 is a model related with data trade in light of availability between new advancements from one perspective, and with computerization then again. To put it all the more plainly, it is a creation model in which a genuine plant has coordinated portrayal in a virtual climate, where machines, robots and individuals can speak with one another through the web and canny machines (robots) can oversee themselves by examining the data, which is gathered from various sources with the assistance of sensors, in choice frameworks. Thusly, adaptable and quick arrangements can be created and assets are utilized all the more proficiently. The Industry 4.0 model can be summed up as follows:

1. Forming intelligent factories with a modular structure consisting of sensors that can detect the environment and intelligent robots carrying out production activities,
2. Creating a cyber-physical system in which a virtual object of every object in physical structure is created and communication between objects and people is provided via the internet,
3. Recording the data flowing into the system,
4. Obtaining high quality and efficient production with less error by processing this big data.

With the new creation framework proposed inside the extent of Industry 4.0, a higher creation robotization level is designated by advancing creation the executives and with the creation security and preparing of representatives Industry, 4.0 expects to make plants savvy enough as far as flexibility, asset proficiency and further developed coordination of market interest processes The advantages of Industry 4.0 with the subjects on the utilization of inactive data, creation time and personalization are fortifying this model In request to make Industry 4.0 more significant, the elements of new innovations utilized for this creation model and their parts in the framework should be known. In this specific situation, the main parts of Industry 4.0 are clarified beneath.

Cyber-Physical Systems (CPS): This is a fundamental piece of the Industry 4.0 model. Digital Physical Systems are the reconciliation of actual cycles with the virtual cycles and actual cycles are checked and controlled through implanted PCs, sensors, different programming and organizations these two frameworks impart over the cyberphysical framework and in this manner work

simultaneously with one another. The capacity of these frameworks to collaborate with the actual world and extend their abilities through figuring, correspondence, and control is essential to future innovative advances.

Internet of Things (IoT): Communication later on won't just be between individuals. Likewise, admittance to data won't just be mentioned by individuals. For the benefit of individuals, machines will attempt to speak with different machines and gather data (Tan and Wang, 2010). This communication will occur through the web. Web of things whose engineering is actually founded on data communication instruments, principally RFID, intends to work with the trading of data between all articles characterized on the organization (M. Wu, Lu, Ling, Sun, and Du, 2010). As such, all objects (human or machine) characterized in the digital actual framework will involve the web of things for communication.

Savvy Factory: The adjustment of the nearby association and communication between items, apparatus, transport frameworks and individuals through different advances referenced above additionally shows an adjustment of the current creation rationale (Hofmann and Rüschi, 2017). The manufacturing plants of things to come will be significantly more than a framework where creation assets are interconnected and where they consequently trade data. As indicated by this, an adequately smart framework will arise that can foresee the issues that might emerge and decide the expected upkeep times, control the creation interaction and deal with the machines (Qin, Liu, and Grosvenor, 2016). With shrewd manufacturing plants, the point is to understand an adaptable and versatile wise creation process that can adjust rapidly to change, depends on robotization, deals with the machine by lessening human intercession and utilization assets productively.

Cloud Computing: Rather than meeting their equipment, framework, and programming needs inside the system of the assets in the endeavor on account of hindrances as far as cost, adaptability, the intricacy of foundation, and capacity of data, organizations give these necessities from outside. Distributed computing is an adaptable and economical technology that offers types of assistance including foundation, programming, equipment, stages, and other data technology framework assets when required. Clients can utilize the administrations gave to them as indicated by application necessities and in view of admittance to PC and capacity frameworks (Zhou, Liu, and Zhou, 2015).

Methodology

Inside the extent of the review, research was completed on the assessment of articles through deliberate audit. The article choice was made on the Web of Science (WOS) database.

The still up in the air as indicated by the record status of the diary, the quantity of references got by the articles and the watchwords which had not set in stone.

Articles distributed between 2013-2019 were looked through utilizing the WOS database. Since the idea of industry 4.0 became official starting at 2013, 2013 was picked as the beginning of distribution date. - "

"Industry 4.0 and data" catchphrases were utilized for article search. Catchphrases were looked in subjects of the articles.

The articles chose for assessment were distributed in diaries filed by Social Sciences Citation Index (SSCI), Sciences Citation Index Expanded (SCI-Expanded), Arts and Humanities Citation Index (A&HCI), Book Citation Index-Science (BKCI - S), Book Citation Index-Social Sciences and Humanities (BKCI-SSH) and Emerging Sources Citation Index (ESCI).

"Exceptionally Cited in the Field" and "Hot Papers in Field" choices were chosen and all articles were recorded in the WOS Database.

The quantity of articles was restricted to 30. In this way, just the initial 30 articles were chosen for assessment.

A primer assessment was performed for 30 articles. With the end goal of the review, just 20 articles met the target of this review. Because of the fundamental assessment these 20 articles were chosen for point by point assessment.

The chose articles were analyzed as far as broad exploration subject, application area, applied techniques and obtained general outcomes. All articles were summed up under these terms.

Preventive analysis

Contingent upon the profundity of examination and data types, data investigation procedures are ordered into three levels: Descriptive examination gives data concerning what has been accomplished and subsequently assists with getting what has occurred. Prescient investigation gives models to foresee what could will occur. It stately depends on Data Mining, AI and profound learning strategies which gives factual models. A typical method is relapse investigation, which predicts the upsides of a few related factors. Prescriptive investigation assists with picking the best arrangement among a few possible answers for guide what will occur later on.

Preventive maintenance

The stage has not yet been tried at the third step of the Industry 4.0 advancement way, prior introduced. Works are being done toward this path and one of the constraints distinguished is the continuous control of frameworks that will require a data investigation and control framework at the edge level rather than cloud level. Other work is additionally underway to coordinate models for predictive maintenance.

Supply chain optimization etc

In this segment, we will attempt to respond to three primary inquiries regarding the utilization of BD in SCM. These inquiries would i say i are: in what areas of SC, BD is being produced? (ii) In what areas of SC, BDA is being applied? (iii) And what models and strategies of BDA are applied in SCM? Store network or extended enterprise can be characterized as a mix of various and autonomous administrations like Marketing, Procurement, Warehouse Management and Transportation. This large number of administrations are interlinked and associated with every others, straightforwardly or by implication, by sharing data; material, monetary stream SCM data frameworks are answerable for making and keeping up with the connection of these associations. All the more definitively among makers and providers as well as between their accomplices, to work on their organizations, from obtainment of natural substances to extreme end client conveyance of the end result. Inside the time of

Industry 4.0, the enterprises have admittance to a colossal assortment of trend setting innovations like sensors, IoT, cell phones, online interpersonal organizations, and so on Furthermore they take on an assortment of Information and Communication Technologies for Supply Chain Management (for example RFID, Enterprise Resource Planning (ERP), IoT, and so on) to gather, oversee and store their data. Subsequently, the Supply Chains become increasingly mind boggling. This Complexity is related with the heterogeneous material and data streams between inventory network accomplices. Customarily, these streams are coordinated consecutively from provider to client. Today, data streams don't follow this straight direction. Data streams rather now resemble a concurrent and continuous trade or even shared, particularly through electronic trades between all production network accomplices or through cooperative stages some vital qualities of this intricacy are: Number of parts, Diversity, Interdependency, Dynamicity, and Uncertainty.

Conclusion

Having valuable data is vital for undertakings to comprehend their cutthroat climate and their situation in this climate, to assess their interior activities accurately, and to settle on the fundamental vital choices with least blunders. Understanding the present circumstance, foundations and associations have ceaselessly attempted to record a wide range of data they can acquire. Accordingly, other than assets like work, materials, and gear, data has been among the significant sources. Such an increment in the significance of data has brought about nonstop data assortment from every conceivable source. Creating data advancements and expanding assumptions prompted the recording of data with an alternate design and an expansion in volume. This brought about a huge volume of data sets that are hard to adapt to and the idea of huge data was advanced. Also, the industry has now entered another transformation cycle which is called Industry 4.0. The fundamental rationale of Industry 4.0 depends on the portrayal and communication of individuals, machines, robots, and any remaining actual parts in the creation framework through digital actual frameworks and the web of articles. Inside this design, data will be created both by sensors and during the communication cycle with the web of items. Consequently, inside the extent of Industry 4.0, data and surprisingly huge data become one of the significant parts. Savvy plants designated at Industry 4.0 and effective self-choice frameworks must be acquired by handling this data and creating exact information.

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