Tech-Business Analytics in Secondary Industry Sector

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ABSTRACT

Purpose: *Businesses in all sectors, including the secondary industry, will turn to tech-business analytics as a crucial tool. Tech-Business Analytics' role in the secondary industrial sector is to support companies in making data-driven decisions that optimize their operations, boost productivity, and boost profitability. Businesses may optimize their supply chains by accessing data on suppliers, inventories, logistics, and other aspects to spot inefficiencies and areas for improvement. Organizations can use this information to reduce downtime and boost production to schedule maintenance in advance and predict when machinery and equipment will likely break. Examining data on product flaws, customer complaints, and other aspects can help firms improve their quality control systems by identifying root causes and implementing corrective measures. Studying data on consumer behaviour, industry trends, and other factors can help organizations optimize their sales and marketing activities and find chances for expansion and higher profitability.*

Design/Methodology/Approach: *Businesses can use several processes in the tech-business analytics methodology to help them make decisions based on data in the secondary industry sector. This secondary industry sector can entail enhancing the effectiveness of the supply chain or decreasing equipment downtime. After identifying the issue, the necessary data must be gathered and prepared. Once the data is collected, it must be analyzed using statistical models and other analytical methods. This collected data might entail looking for relationships between multiple variables, spotting trends in consumer behaviour, or predicting outcomes using predictive models.*

Findings/Result: *It is described in the article how tech-business analytics in the secondary industrial sector will have managed the growth itself from its inception to the present. The Tech-Business Analytics technique in the secondary industry sector offers a structured approach to problem-solving using data analysis to assist in better decision-making and improve business outcomes.*

Originality/Value: *Exploring the evolutionary path of business analytics transforms into the advanced realm of technology-driven business analytics within the secondary industry sector. A generic architecture also examines 130 recently published Tech Business Analytics in Secondary Industry sector research projects for technical purposes. Tech-Business Analytics is a new field that applies ICCT-underpinning technologies in Tech-Business Analytics (TBA). TBA is intended to provide businesses with unprecedented opportunities for growth and innovation in secondary industry sectors.*

Paper Type: *Exploratory research.*

Keywords: Business Analytics (BA), ICCT underlying technologies, Tech-Business Analytics, TBA, Secondary industry sector, Production industry, Industry Performance, Data Science, Big Data Analytics, Research gap in Business Analytics, ABCD Analysis.

1. INTRODUCTION :

In today's rapidly evolving business landscape, data-driven decision-making has become the cornerstone of success. The Secondary Industry Sector, which includes manufacturing, construction, and industrial production, is no exception to this transformation. Tech-Business Analytics refers to applying advanced technologies and data analysis techniques to extract valuable insights from vast amounts of data generated within the Secondary Industry. By leveraging cutting-edge tools such as artificial intelligence, machine learning, big data processing, and predictive modeling, businesses in this sector can gain a competitive edge by making informed and strategic decisions. This dynamic field empowers industries to optimize processes, enhance production efficiency, minimize waste, and improve product quality. It enables companies to identify and address operational bottlenecks, predict maintenance needs, and streamline supply chains, ultimately leading to increased profitability and reduced operational costs. Moreover, Tech-Business Analytics is pivotal in driving innovation within the Secondary Industry Sector. By leveraging data-driven insights, businesses can identify new market opportunities, analyze customer preferences, and develop personalized products to cater to the ever-changing demands of consumers. As the volume of data continues to grow exponentially, the importance of Tech-Business Analytics in the Secondary Industries Sector becomes increasingly apparent. This Introduction provides a glimpse into the vast potential of data-driven decision-making and its transformative impact on the future of manufacturing, construction, and industrial production businesses. With Tech-Business Analytics, companies can unlock the true potential of their data, enabling them to thrive and stay ahead in today's data-centric world. The competitive landscape for companies in this sector has significantly changed as a result of Tech-Business Analytics. Tech-Business Analytics analyzes company data using state-of-the-art data analytics methods, machine learning algorithms, and artificial intelligence to produce insights that boost productivity, profitability, and efficiency. In the past, to make business decisions, manual procedures, knowledge, and intuition were in the secondary industrial sector. Yiu, L. M. D. et al. (2020) [1] claim that by examining data on production processes, supply chain management, and other components, inefficiencies can be reduced, and adjustments can be made to increase operational efficiency. According to Hallikas et al. (2021) [2], companies may identify the root causes of issues and implement corrective measures to increase the caliber of their output by analyzing data on product faults and customer complaints. Yu, J. et al. (2019) [3] found that businesses can employ machine learning algorithms to analyze data on machine performance and predict equipment breakdowns to reduce downtime and enhance production. According to Karanci (2018) [4], businesses may develop targeted marketing efforts that are more likely to convert leads into customers, increasing sales and profitability by looking at data on consumer behavior.

2. ABOUT SECONDARY (MANUFACTURING/PRODUCTION) INDUSTRY SECTOR AND ITS IMPORTANCE :

According to Sengupta T. et al. (2018) [5], the secondary industrial sector boosts economic growth by creating jobs, increasing productivity, and fostering innovation. A nation's economy can grow when finished products add value and generate business income. The secondary industry sector significantly contributes to global trade by exporting finished items to other countries. According to Verma S. et al. (2017) [6], the secondary industry sector is crucial to the supply chain as a significant supplier of raw materials and intermediate goods to other industries, such as construction and agriculture. For the economy to run, finished goods are produced by the secondary Industry.

According to Ahmad, A. (2015) [7], technical advancement is influenced by the secondary industrial sector, where businesses constantly seek ways to improve their production processes and products. As a result, innovative concepts and technologies have surfaced, assisting numerous economic and social areas. With the secondary industries sector, the economy as a whole could function. The secondary sector is vital since it is a nation's primary source of wealth. Economists often link this Industry and a nation's wealth. Making is thus playing a more significant role in economic growth and development. The main emphasis is on the acquisition of raw materials from natural resources. The secondary sector will be our main focus today. This sector is the entire economic sector involved in construction and producing a valuable final product. The primary sector supplies raw materials for the goods.

It will analyze the secondary sector's characteristics, pursuits, and utility. Secondary industries require specialized equipment, facilities, and energy to convert raw materials into finished products. The secondary sector is one of the most significant polluters of the environment on a global scale. According to Thake, A.M. (2021) [8], the secondary sector supports primary and secondary education. It is in charge of turning items produced in the primary sector into those produced in the tertiary. Through the sale of local products, foreign businesses export goods to other countries. In the secondary Industry, there are several engineering jobs available. A sizable portion of middle- and upper-class occupations are well-paid in the secondary sector in most industrialized countries. According to Oliva et al. (2019) [9], the secondary sector supports education's primary and secondary sectors. It transforms primary sector output into tertiary sector products. Foreign businesses export goods made locally and sell them abroad. As a result, the secondary Industry has several openings for engineers. The secondary sector offers many well-paying positions in most industrialized countries for the middle and upper classes.

3. EFFECT OF ADVANCES IN TECHNOLOGY IN SECONDARY INDUSTRY SECTOR :

Technology developments, which have led to better output, efficiency, and innovation, have tremendously impacted the secondary industrial sector.
(1) This can perform repetitive tasks and boost production efficiency, examples of automation technologies made possible by technological advancements. Automation also makes businesses work more reliably, promotes safety, and reduces the chance of errors.
(2) Companies can now more easily monitor and control the quality of their products thanks to technological improvements. Automated inspection systems, for instance, can immediately identify weaknesses, allowing businesses to fix issues before they worsen.
(3) The ability to customize items to each customer's unique needs has been made possible by technical breakthroughs. One example is the quick and affordable production of personalized goods using 3D printing technology. Technology improvements have made supply chain management simpler for businesses, allowing them to reduce lead times and improve inventory management. Using technology like RFID (Radio-Frequency Identification), businesses can track things quickly, improving their supply chain visibility.
(4) Thomas, A. (2020) [10] states that a minor detrimental impact on the environment is now achievable for businesses thanks to new technology. Ingenious manufacturing techniques, for instance, can reduce waste and energy use while optimizing resource utilization. Consequently, the secondary industry sector has reaped the benefits of technical improvements, which have raised output, boosted efficiency, and promoted innovation. As businesses continue incorporating new technology, this could predict more significant developments.

3.1 Technology in Secondary Industry Sector:

Businesses in the secondary industrial sector today operate in a very different way, according to Thomas, A. (2020) [10], due to developments in automation and robotics. Welding, painting, and assembly are just a few of the jobs that robots can now do. IoT is a technology that enables software, hardware, and sensors to communicate with one another and exchange data across a network. The secondary industrial sector uses IoT technology to track inventory, monitor and control production operations, and achieve maximum energy efficiency.
The use of augmented reality (AR) and virtual reality (VR) technologies for training, product creation, and simulation is growing in the secondary industrial sector, according to Sumbal, M.S. et al. (2019) [11]. Product development is sped up and made more productive when companies can test and visualize their products before construction.
According to Parihar, A. S. et al. (2021) [12], technical progress and well-being are two distinct but related challenges, respectively, and productivity is not a metric of either. Productivity is based on GDP, a measure of output or production. Instead of raising productivity, technological progress can raise well-being. Data also suggests that long-term organizational adjustments and reorganization of corporate activities are required to adopt new technology. A classic economic sector is the production of raw materials. Industries that heavily rely on technological advancements include computers and electronic communications, both based on information technology.

Furthermore, it's critical to remember that these companies demand workers with sophisticated knowledge and abilities, according to Marshall, A. et al. (2020) [13]. This technical modification has significantly impacted service quality. Modern technology has led to changes in the operational paradigms of most traditional services. The modern economy is no longer referred to as a service economy but instead as a super-industry or third-industrial-revolution economy due to this expansion, which has increased the requirement for factor capital across the service manufacturing process.
According to Bresciani, S. et al. (2021) [14], suppliers must employ more complex productions and assist consumers in decision-making. As a result, to produce and sell goods and services using new technology. The most notable effect of new communication and information technologies is how many services are offered. This is the case, as most services involve data conversion and dissemination. According to a survey, employees who work in the service sector devote 45–80% of their time to sharing and converting.
Homogeneity of services is a side effect of using contemporary communication and information technology to boost productivity. The following strategy is used to create and offer services as efficiently as feasible: the service is codified and standardized. Because of this, manufacturing is widespread, economies of scale are achievable, and marketplaces are global. However, service standardization also makes content simpler. As a result, the market is divided into two categories of services: custom and conventional. To suit the specific needs of specific user groups, personalized services are developed in contrast to the minimal standard services developed for a large clientele. Manufacturing strategies are affected by this.
New technology has made it possible for this to assess data, carry out tasks, and communicate cheaply across long distances. In large groupings, the distribution of administrative responsibility is typical. These are all viable options: working from home, shopping online, and banking online. To access various remote services, homes, and businesses can use Teletext, the internet, and videotext systems. The distance restriction will remain in place even though the quality of telework will increase since teleworkers will still need to travel to corporate offices frequently.
According to Maavak, M. (2020) [15] state, that focused on providing private services. Industrial activity will continue to be crucial to our society in its manifestations. For instance, a more segregated society may have more internationalized markets.
According to Ghosh, A. et al. (2021) [16], the expansion of cooperative and partnership relationships and heightened rivalry occur concurrently. The white-collar and blue-collar sectors have an increasing number of highly qualified employees—an efficient system with multiple business models. Corporate and customer communication is pretty constrained in sectoral systems with hyper-specialized businesses and ultra-sectoral diversity. The utilization of recently externalized and internationalized services is rising, there are more cordial interactions inside organizations, and business ties are improving. This process has already started and will continue unabatedly with the advancement of technology, the economy, and society.
According to Kashive, N. et al. (2020) [17], the Industrial Internet of Things (IIoT) is quickly gaining momentum as it improves connectivity, creates data, and unlocks hitherto untapped potential. It's time to use this information entirely now. Altair understands how to use data to spark creativity, open new avenues, and hasten the transition to intelligent manufacturing.
Chowdhury, L. A. M. et al. (2018) [18], disclose essential details about the product's durability and design or production quality. Manufacturers could improve current products, create new ones that are more reliable, and increase revenue by using this data correctly.
According to Chakraborty, A. et al. (2020) [19], the remainder of this section uses the application of Business Analytics to optimise energy usage as a compelling example. Resource optimization and this application both share some characteristics.
According to Aithal, P. S. (2020) [20], despite extensive research into the elements of an enterprise's information infrastructure, the literature needs a list of the components that make up the Business Analytics ecosystem.

3.2 Effect of ICCT Underlying Technologies including Business Analytics in Manufacturing/Production Industry:

Information communication and computing technology (ICCT), particularly business analytics, has dramatically impacted the manufacturing and production industries.

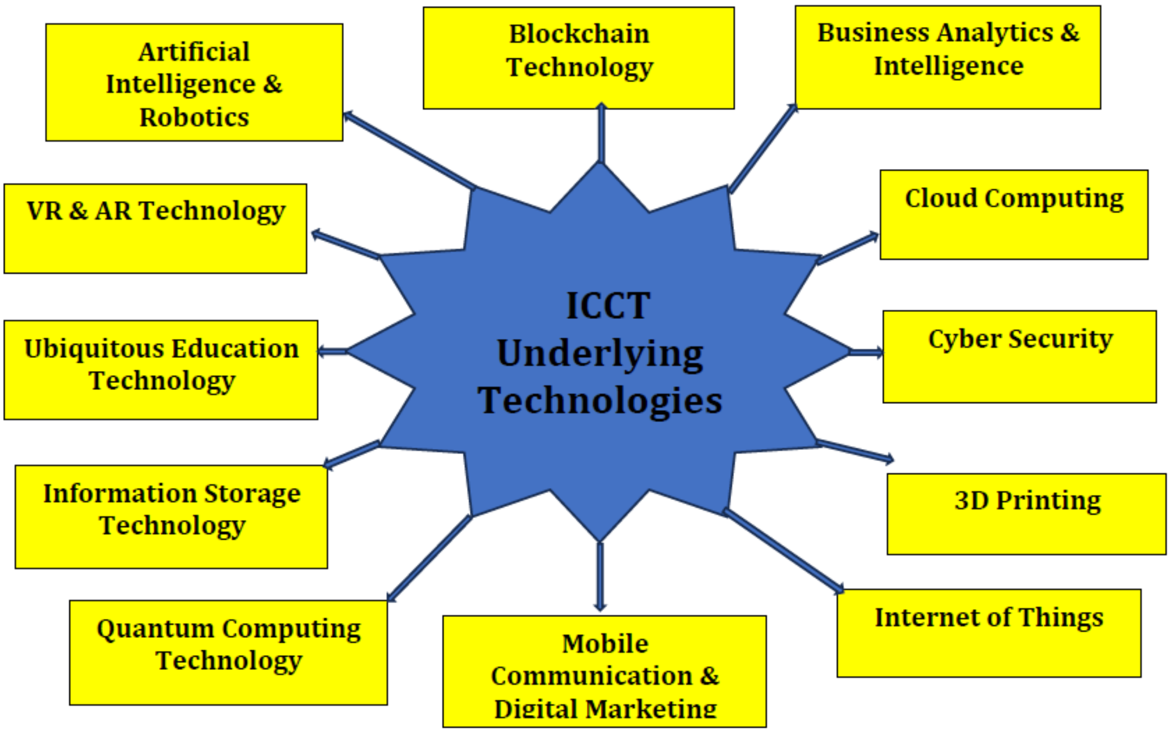

Fig. 1: Block diagram representing ICCT Underlying Technologies [20]

Industries have been revolutionized, and human experiences have been enhanced by investigating ICCT-underpinning technologies [20 -32]. ICCT's foundational technologies (figure 1) cover several important domains, including:

Organizations need help surviving and expanding in the twenty-first century because of several difficulties and uncertainties they must face when conducting business, according to Aithal, P. S. (2023) [20]. For a business to be sustained over the long term, it must keep its current clientele and draw in new ones. To do this, it must employ various tactics for delighting, educating, and satisfying its current clientele and techniques for generating a voluminous demand for luring in new clients through developing business value. Finding ways to provide value to the business to keep its current clients and draw in new ones is a problem for all decision-makers.

Aithal, P. S. (2018) [21] claims that Information Communication and Computation Technology (ICCT) and Nanotechnology (NT) are two recently identified Universal technologies of the 21st century that are anticipated to significantly contribute to the development of society by addressing the fundamental needs, forward-thinking wants, and aspirational desires of people. In this paper, the potential applications of ICCT and the ten key emerging technologies that underpin it—artificial intelligence, big data & business analytics, cloud computing, digital marketing, 3D Printing, Internet of things, online ubiquitous education, optical computing, storage technology, and virtual & augmented reality—are explored.

The rising patterns of applications of the ICCT above underlying technologies in the society's primary, secondary, tertiary, and quaternary industry sectors are examined, assessed, and projected using a newly constructed predictive analysis model, according to Aithal, P. S. (2019) [22]. From the perspectives of many stakeholders, the advantages, benefits, limits, and disadvantages of such technologies are discovered and analyzed to satisfy human wants to lead luxurious and comfortable lifestyles.

According to Aithal, P. S., et al. (2015) [23], the potential technological advancements of the twenty-first century that will have a significant impact on how people live their lives include: (1) Nanotechnology-based human life comfort; (2) High speed computation through optical computers; (3) Embedded Intelligence; and (4) HIV Antivirus. (5) Pseudo Senses - Existence perception in virtual reality and created environments, Off-Planet Production in Microgravity, (7) Protein Maps, which reveal the number of living organisms' active genes that code for proteins; (8) Customised Kids, which

tailor children's physical and mental development; (9), the creation of Chameleon Chips, reconfigurable photonic circuits based on the concept of optical solitons, (10), the control of gravity to enable flying cars (11), the possibility of eternal life through nanotechnology and stem cell research (12), fractal models for fragmented geometry shapes (13), and (13), universal access to space.
Information Communication and Computation Technology (ICCT) and Nanotechnology (NT) are two recently identified Universal technologies of the 21st century, according to Aithal, P. S. (2019) [24]. These technologies are anticipated to significantly contribute to the development of society by addressing the fundamental needs, forward-thinking wants, and aspirational desires of people.
Aithal, P. S., et al. (2019).[25] claim that Information Communication and Computation Technology (ICCT), also known as Digital Technology, is regarded as a general-purpose universal technology because of its capacity to address a wide range of issues in human society related to fundamental needs, cutting-edge wants, and aspirational desires. At the beginning of this chapter, we listed several quality characteristics of digital services and several notable published works in digital service innovation.
The complex nature of brick-and-mortar lifestyle retailing, both from the supply-side and demand side, is due to the sheer vast number of unique designs, products, brands, and categories the retailer must offer in their stores as part of their product assortment. This is added with limitation in terms of the opportunity for the store to retain customers for a more extended period simply because of increasing competition from online retailers, according to Ganesh, H. R. et al. (2020) [26]. Most lifestyle merchants in India think they have implemented the most recent ICCT tools and solutions and are producing accurate results that can be interpreted and used to inform decisions.
The influence of information communication and computation technology (ICCT) is growing daily among many communities worldwide for learning about numerous concerns, challenges, and solutions, according to Revathi, R., et al. (2019). [27]. The rise of ICCT has transformed many facets of society, and it is now helping to address issues about peoples' fundamental requirements, as well as their future aspirations and advanced demands. Every business and society is significantly impacted by the importance of and use of information, communication, and computing technologies. This study attempted to ascertain the impact of ICCT on different industrial sectors, including primary, secondary, and tertiary levels.
According to P. S. Aithal et al. (2018). [28], technology is used in various ways to address society's many complex problems. Some technologies have developed and broadened their branches into numerous fields and industries of practice, earning the title of "General-Purpose Technologies." General Purpose Technologies (GPT) is characterized by pervasiveness, where they have the potential for technical advancements, and innovation complementarities, where the productivity of research and development in related industries rises due to creative applications made possible by such general-purpose technologies. Because of this, as general-purpose technologies developed, they spread throughout the economy and eventually led to generalized productivity improvements.
Technology is a tool to tackle numerous societal difficulties for a comfortable life-leading process, claims Aithal P. S., et al. (2020) [29]. Technology has advanced steadily since the beginning of time, and various generations have been created. These generations have greatly influenced society and changed how people live and how comfortable they are. In this essay, we have provided a thorough overview of the history of technological advancement and its impact on civil society. The technology generations of the twenty-first century are named, and their significance in societal change and comfortability for the daily lives of humans is examined.
Aithal, P. S. et al. (2022) [30] claim that Technology makes it possible to execute various techniques for resolving environmental issues. Nanotechnology (NT) and information, communication, and computation technology (ICCT) are two new, emerging general-purpose technologies with the potential to creatively and effectively address a wide range of societal issues. These technological advancements promise to manage the earth's ecological and natural environment to support resilient living things. This went into great detail to analyze how the ICCT's underlying technologies contribute to preserving the planet's sustainable living systems.
According to Aithal, P. S., et al. (2019) [31], it has been seen that some technologies have developed and spread their branches to numerous fields and industries of practice, leading to their designation as general-purpose technologies. These all-purpose technologies are recognized and used in numerous industries to conduct business and address or mitigate industry-specific issues. It has been noted that

during the past few years, two general-purpose technologies—Nanotechnology (NT) and Information Communication and Computation Technology (ICCT)—have grown more quickly than the rest of the general-purpose technologies and produced a large number of underlying sub-technologies. These two technologies are further referred to as "Universal Technologies" because they can address issues relating to society's basic requirements, cutting-edge ambitions, and aspirational desires of people. ICCT and nanotechnology have paved the way for widespread solutions to various production and service industry issues by providing autonomous mobility, stability, and sustainability.

Information Communication and Computation Technology (ICCT) is a 21st-century name for Information Communication Technology (ICT), according to Aithal, P. S., et al. (2020) [32]. It encompasses about twelve underlying emerging technologies and a broader definition of advancements in computer science technologies. The Universal Technology System is constructed from components such as ICCT and Nanotechnologies. These 12 underlying technologies include 3D Printing, the Internet of Things, information storage technology, mobile business technology, online education technology, quantum computing, virtual and augmented reality, blockchain technology, data science and business intelligence, cloud computing, cybersecurity, and forensic science. Therefore, these ICCT-underpinning technologies are regarded as emerging technologies of the 21st century and are anticipated to transform the existing human generation into a tech generation by altering the current solutions for various challenges in industry and society.

(1) AI & Robotics Technology: Artificial Intelligence (AI) and Robotics represent the forefront of technological advancement. These fields involve creating intelligent machines capable of mimicking human-like cognitive functions, enhancing automation, and revolutionizing various industries, from manufacturing to healthcare.

(2) Blockchain Technology: A decentralized and tamper-proof digital ledger, Blockchain transforms how data is stored, shared, and secured. It has paved the way for cryptocurrencies and revolutionized industries by enabling transparent and immutable record-keeping.

(3) Business Analytics Technology: In the era of data-driven decision-making, Business Analytics, and intelligence play a crucial role. These technologies leverage data analysis and visualization tools to extract meaningful insights, aiding businesses in making informed and strategic choices.

(4) Cloud Computing Technology: Cloud technology has revolutionized storing and accessing data and services. Offering scalability, cost-effectiveness, and flexibility, Cloud Computing allows businesses and individuals to access resources and applications over the Internet.

(5) Cyber Security Technology: Cyber Security has become paramount with the growing digital landscape. It encompasses technologies and practices to protect systems, networks, and data from cyber threats and attacks.

(6) 3D Printing Technology: Also known as Additive Manufacturing, 3D Printing enables the creation of three-dimensional objects from digital designs. This Technology is transforming manufacturing processes, healthcare, and even architecture.

(7) IoT (Internet of Things) Technology: IoT refers to the interconnection of everyday objects through the Internet, enabling them to collect and exchange data. It revolutionizes industries such as home automation, healthcare, and transportation.

(8) Mobile Communication & Marketing Technology: As mobile devices have become an integral part of daily life, mobile communication, and marketing technology drive targeted and personalized advertising, enhancing consumer experiences and engagement.

(9) Quantum Computing Technology: Quantum Computing harnesses the principles of quantum mechanics to process information exponentially faster than classical computers. It holds the potential to tackle complex problems in fields like cryptography, drug discovery, and climate modeling.

(10) Information Storage Technology: With the explosive growth of data, efficient Information Storage Technology has become vital. Innovations in this domain cater to scalable and secure data storage solutions.

(11) Ubiquitous Education Technology: Transforming the education landscape, Ubiquitous Education Technology encompasses e-learning platforms, interactive content, and personalized learning experiences, making education accessible to learners worldwide.

(12) Virtual & Augmented Reality: Virtual Reality (VR) and Augmented Reality (AR) merge the digital world with reality, creating immersive experiences. These technologies have found applications in gaming, training simulations, and various industries for visualization and interaction.

The ICCT's exploration and research in these underlying technologies foster a technologically advanced society, driving progress and reshaping the future across diverse domains.

3.2.1 Artificial Intelligence & Robotics and BA in Production Industry:

According to Zhan Y. et al. (2018) [33], humans, the only creatures capable of doing it, used to perform every aspect of production manually. It was a long, tedious process that needed to be science because individuals can make mistakes and get exhausted. Building primary automated machines that could only complete one specific duty at a time was the next logical step after this. These robots were still limited in their abilities, even though it was an improvement over individuals performing the same task continuously. Since each of these machines is built and programmed to carry out a particular task, numerous machines would need to operate independently to accomplish the same task. Artificial intelligence and machine learning are the following significant developments in how we approach the industrial sector.

3.2.2 Big Data and BA in Production Industry:

Because industrial earnings groaningly depend on maximizing the value of assets, performance improvements can lead to considerable productivity improvements, even if they only boost margins. Similarly, a decrease in asset breakdowns can reduce inefficiencies and halt losses. Because of these factors, manufacturers emphasize maintenance and continually enhance asset performance. These data may be of great value to manufacturers, but many are surprised by their sheer volume. To learn things that will improve their performance, they can collect, clean up, and comprehend machine data.

3.2.3 Blockchain Technology and BA in Production Industry:

Manufacturing is typically dispersed throughout the world to take advantage of the durability of anyone crucial connection can put the operation as a whole to the test because enterprises are tied closely together by ample, global supply and demand chains, according to Van Oorschot, J.A. et al. (2020) [34]. Blockchain provides reliable data sharing and process automation across organizational and governmental boundaries.

3.2.4 Cloud Computing Technology and BA in Production Industry:

The promise of a wide range of benefits has sparked interest in the business, and IT worlds in the next-generation cloud computing architecture. Gartner estimates that the cloud market will be valued at more than $148.8 billion by 2014. Despite this, cloud computing is still alien to many individuals.

3.2.5 Cyber Security & Forensic Science and BA in Production Industry:

Zhang Z. et al. (2014) [35] claim that a branch of cybersecurity known as "digital forensics" or "digital forensic science" is tasked with recovering and investigating data from digital devices and cybercrimes. "Digital forensics," formerly only used to describe computer forensics, is increasingly used to analyze all devices holding digital data.

3.2.6 Digital Marketing and Business and BA in Production Industry:

In 2018, 86% of manufacturing marketers who participated in a survey used content marketing, according to Virtanen, J. (1988) [36]. Knowing that only 22% of content creators believed their company was "advanced" or "mature" in this area is in your best interest. According to this report from the Content Marketing Institute, if you still need to, you still have time to utilize the benefits of content marketing. There is a wide variety of forms available for content marketing.

3.2.7 3D Printing and BA in Production Industry:

3D printing can help your business with prototyping and small-batch manufacturing. Additional applications include design, biological devices, and mechanical components. You need to ensure that your supply chain and products are of high quality to prevent unlawful 3D printing. Working only with applicants with credentials and experience relevant to your 3D printing pursuits is another important rule.

3.2.8 The Internet of Things (IoT) and BA in Production Industry:

Verhoef E.T. et al. (2002) [37] state that (IoT) envisions a seamless connection between the natural world and the internet. This is good since it opens the door to developing robust manufacturing services and applications. Numerous academics are currently conducting active studies on the topics in this discipline.

3.2.9 Data Storage and BA in Production Industry:

Even though business analytics techniques have been successfully applied in various specialist applications to improve specific business units, it is evident from the literature that a holistic enterprise strategy is necessary.

3.2.10 Quantum Computers and BA in Production Industry:
Applying quantum computing may have limitless potential across various industries, including manufacturing. Increased strength-to-weight ratios in materials, more efficient synthetic and catalytic processes, and very energy-dense batteries could all be made possible by quantum computing.
3.2.11 Online Education and BA in Production Industry:
Due to its simplicity in scaling, online learning is widely employed in Indian schools, universities, and even businesses, according to Duc T. A. (2007) [38]. The Indian government now permits colleges to provide online degrees, which may restructure the nation's educational system.
3.2.12 VR & AR and BA in Production Industry:
According to Ren, as digitization advances, consumers reportedly lose awareness of their actual physical surroundings. W. (2003) [39]. However, they are submerged in virtual reality, perhaps with VR glasses. Users can now navigate a virtual environment and view movies or photos from a confined, 360-degree perspective. An increasing number of applications have been created due to improved graphics cards, camera quality, and quicker, more potent computers. These programs include training simulators, VR games that reflect reality more realistically than ever, and product configurators for brand-new cars.

4. REVIEW BASED RELATED RESEARCH WORK :

This is a review-based description of all ICCT underlying technology within the production industry that should come under the secondary industry sector and be compared with tech business analytics from Table 1 to Table 13.

Table 1: Business analytics in Production Industry

S. No.	Area	Issue	Outcome	Reference
1	An investigation into business intelligence and operational capacity in high-tech companies.	The importance of BI systems is determined by the quantity and sophistication of the technology used by the high-tech organization.	Knowing the surrounding factors makes it more likely for a business to reap additional benefits from implementing BI solutions.	Zeng, D. Z. (2009). [40]
2	As procurement moves more and more online	The current study advances our grasp of this subject by examining how data analytics and data analytics competence influence the development and accomplishment of digital supply chains.	Data analytics' importance and role in the development and success of the digital supply chain are made abundantly evident.	Brulhart, M. (2009). [41]
3	Is there a connection between the occupational community and corporate internal control? As an example, take high-tech CFOs.	By merging occupational communities (OCs) and upper echelons theory, the study examines how shared morals and behavioral standards from many sources affect executive decision-making.	As a result, a fresh viewpoint on CFO judgment is offered, emphasizing the importance of OCs among higher echelons.	Connolly E. et al. (2010). [42]
4	Review of Turkish	By merging multiple sorts of data, researchers function as curators and co-create.	Professionals are expected to take risks, move quickly as leaders, and actively	Wang, Z. et al. (2006). [43]

	Market Research	People's perspectives on market research have altered due to the new job; This is expected to actively participate in advancing their profession by taking chances and rushing.	contribute to the progress of their specialty.	
5	Using big data analytics wisely	In addition to academic implications for scholars interested in BDA adoption in developing countries.	The relationship between the technological, organizational, and environment.	Liang X. et al. (2007). [44]
6	How Knowledge Management Systems Can Help You Retain	The study's uses may also be expanded by introducing it into new research disciplines and geographical areas.	According to the study, supply chain integration can lead to a more organized production process and a more sustainable economy, society, and environment.	Xi Y. et al. (2012). [45]
7	The Maltese ICCT sector	This study looked at how foreign workers contribute to the ICT sector, where there is a greater need for skilled workers due to the unsustainable growth of the ICT sector.	ICT is among the sectors of the Maltese economy that is expanding the quickest. Labor issues could obstruct economic expansion if they are not resolved. ICT graduates per year need to be increased.	Pei L. (2018). [46]
8	Brazil's business sectors	The study's main contribution is the sectoral innovation standard classification of companies representing Brazil's major economic sectors.	The development of a conceptual model is the main theoretical contribution.	Qiyun F. et al. (2015). [47]
9	Differentiation in the marketplace is made possible by digital technology convergence and synthesis.	One suggested strategy for enabling creative and effective workflows is when management disciplines, technologies, and applications converge and blend as digital technology is more closely tied to company operations.	New opportunities and risks, new business models, and distinctive growth strategies for firms result from the technical union of developing technology and digital tactics.	Zhang K. et al. (2019). [48]
10	One example of a big data application	The findings demonstrate the factors the oil and gas sector should consider while implementing and utilizing big data.	Implementing knowledge obtained from big data is crucial.	Wu Y. et al. (2012). [49]

Table 2: ICCT in Production industry

S. No.	Area	Issue	Outcome	Reference
1.	The acceptance of new working practices is	The format consists of 79–99 working persons involved in various jobs, including the manufacturing sector.	IT is acceptability is influenced by the behavioural intention variable, which in turn is influenced by moderator	Qu W. et al. (2016). [50]

	influenced by culture.		variables like age and gender that influence users' behavioural intention, such as profitability of usage, usability, and mental standards.	
2.	It is significant to observe how China manages its IT human resources.	More than 400 of the 5,600 executives who took part in the survey came from China, and they came from 18 different multinational industries. This study on the availability of IT talent in China was built on the perspectives of more than 400 Chinese CEOs.	By China's particular market conditions. MNEs also need help to retain employees due to various factors, including the fact that other companies, usually Western MNEs, lure workers with more lucrative salaries.	Wang Q. et al. (2013). [51]
3.	The bubble's dark undercurrents are visible in the panoptic view of the data stream.	One of the most crucial conclusions was that the significant data sector is undergoing a trillion-dollar market bubble. There will be significant effects on societal stability and global access to the internet.	Big data must move from a bubble to a panoptic phase by potentiating numerous changing processes.	Tongbin Z et al. (2016). [52]
4.	According to the study, patterns, and developments in IoT have potential use in the building industry.	These details could be utilized to pinpoint the main impetuses of adopting digital and IoT technology.	Draw attention to the information gaps in the current studies, particularly a more thorough assessment of the organizational changes needed to support the usage of the IoT, economic analyses, and obstacles to broader adoption.	Chen J. et al. (2016). [53]
5.	Crowdsourcing is used to get information on employee opinions for company branding.	This is to look at how social media may assist any company in developing a more desirable employer brand. In these reviews, there is a lot of information about employer branding.	The study found that businesses can use information from crowdsourced polls on workplace branding to gauge their desirability as an employer. They can use cutting-edge data analytics techniques like sentiment analysis and text visualization to create intelligence-based employer branding initiatives.	Wu. Huang C.Z. et al. (2019). [54]
6.	Information about how intellectual capital works	Using descriptive statistics and multiple regression approaches, it was determined how IC efficiency affected financial	This might adhere to the study's findings. Repercussions for daily life Managers, corporate owners, and regulators	Yangjun R. et al. (2019). [55]

		performance. Annual reports' secondary data are used in this study.	must connect IC with performance management in conditions of globalized competition to sustain the competitive advantage.	
7.	Big Data Analytics in Healthcare: India's Development and Challenges	BDAs have been researched and found to benefit the health field in wealthy nations, offering a wide range of long-term treatments for the most prevalent and persistent disorders.	It has demonstrated how BDAs could bring about gradual reforms in the Indian healthcare sector while outlining the current circumstances and any arising issues.	Bin J. et al. (2015). [56]
8.	The importance of AI-based transformation initiatives	The implications of artificial intelligence on organizational performance, particularly regarding the financial value of AI-based transformation efforts.	Artificial Intelligence can fully realize its promise thanks to its capacity to enhance the impacts of automation, information, and change and recognize, anticipate, and interact with people.	Zeng X. (2011). [57]
9.	Evidence and new Chinese trends offer credibility to a proposed paradigm for rapid creation in data-driven scenarios.	This document makes six suggestions for leveraging data analytics and information and communication technologies (ICTs) to foster creativity.	It generated six suggestions for how ICTs, in particular, and data analytics could assist for research.	Zhang J. et al. (2004). [58]
10.	Use of technology in the housing sector	Three objectives have been set for this investigation. A taxonomy of advancements in housing is required to begin.	This summarizes the data on innovation uptake in the housing sector.	Xie, L. (2010). [59]

Innovative uses of ICCT can develop new sales channels, product features, and ways to differentiate items. ICCT may also increase productivity, reduce expenses, and improve the framework for risk management and strategic decision-making. These discoveries ought to improve corporate performance.

Table 3: Artificial Intelligence and Robotics in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	Artificial intelligence, machine learning, and deep learning in contemporary robotics	Robots are becoming more productive, safe, and intelligent thanks to the contributions of Artificial intelligence, machine learning, and deep learning.	Thanks to integrating AI, ML, and DL into advanced robotics systems, this may now be examined and changed in various applications to boost productivity in advanced robotic businesses.	Soori, M., et al. (2023). [60]
2.	Knowledge of AI's possible	To cultivate better crops, control pests, monitor soil	The most effective AI-based crop health	Javaid, M., et al. (2023). [61]

	applications in the agricultural sector	and growth conditions, and analyze data for farmers, artificial intelligence (AI) technology is being employed in agriculture.	strategies involve hyperspectral imaging and 3D laser scanning. For analysis, these sensors that are powered by AI gather more detailed information about the health of the crops.	
3.	A platform for modifying and improving production systems through the use of digital twins and modular AI	Artificial intelligence and digital twins could improve the productivity, reactivity, and robustness of industrial systems. However, traditional digital twin solutions are usually restricted to improving isolated, static systems when optimizing a specific process.	Artificial intelligence, used to optimize production lines and make decisions, offers a framework for various manufacturing applications.	Mo, F., et al. (2023). [62]
4.	The Banking Sector and Artificial Intelligence	management institutions, given the technological advancements of today, which involve automating practically all processes from start to finish. Banks are missing out on the chance to modernize some of their business models, freeing people from repetitive work, preventing fraud, enabling better decisions, and reducing losses because they are out of step with current trends and times.	Banks interact daily with many clients while still using antiquated Institutions that can improve overall performance and human dependency while increasing profits thanks to automation. In short, Artificial Intelligence-powered Virtual Assistants improve the efficiency of business processes across all business sectors, but especially in the banking sector, making them quick, dependable, and not dependent on humans.	Umamaheswari, S., et al. (2023). [63]
5.	Modern analysis of wire arc additive manufacturing's applications for artificial intelligence research	For the fabrication of medium to significant metal components with high value-added for numerous industries, including the aerospace and maritime industry, a recent development. The typical WAAM method isn't widely used in the manufacturing industries.	It explores how to apply fresh AI techniques and how to improve AI techniques. It is anticipated that through AI approaches and the results of this systematic research.	He, F., et al. (2023). [64]
6.	Artificial Intelligence's Increasing Contribution to Collaborative Robots for Industrial Use	Close collaboration is made possible by collaborative robots (cobots), which allow direct human-to-robot interaction without the usual obstacles. Industrial robots and people used to	Costs can be reduced, customer satisfaction can be increased, and they can adapt quickly. They are determining the current and prospective future functions of artificial	Borboni, A., et al. (2023). [65]

		be separated by fences while they worked.	intelligence in commercial robots.	
7.	Customer perceptions of service production and service operations' resilience	Artificial intelligence is used more frequently in service sector operations. Production systems and operations management academics have yet to investigate the preference of service customers for AI-powered service operations.	Customer interactions with mechanical AI have an asymmetrical effect on customer satisfaction with service operations.	Mariani, M. M., et al. (2023). [66]
8.	An intelligent production management system for resources that conserve energy based on data mining	The intelligent production management system is constructed using data mining and energy-efficient artificial intelligence resources.	The optimal workstation assembly plan highlights the intelligent elements of the production control system for clever manufacturing and is displayed on the system's front end.	Guo, Y., et al. (2023). [67]
9.	A Review on Industry 4.0 Design.	AI is gaining popularity due to its success in resolving particularly challenging issues in industrial chemistry and chemical engineering.	The use of AI in automated synthesis, route planning for synthetic materials, and research of structure-function relationships. The difficulties and prospects for AI in producing chemical products are discussed in the final section.	He, C., et al. (2023). [68]
10.	AI-based software methods for improving the trajectories of mobile robotic platforms	Various control strategies for robots' autonomous navigation have been developed during Industry 4.0.	The DQN functions in a simulated environment because of the randomness, which resulted in better autonomous learning performance than previous control approaches.	Escobar-Naranjo, J., et al. (2023). [69]

Table 4: Blockchain in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	The use of blockchain technology to create a transparent and consumer-trust-based food sector of the future	well-being, and transparency will govern the food industry's trends. Inaccurate and deceptive assertions are a current problem that undermines customer confidence.	Blockchain have the potential to fundamentally alter how business operations and processes are carried out across all sectors, including the public ones, with the correct amount of time and effort. This article examines how the Blockchain can help the food industry become future-ready, enabling	Singh, V., et al. (2023). [70]

			customers to check product claims and guard against food fraud.	
2.	The analysis demonstrates promises about sustainability, health, and Applying Blockchain Technology to Food Supply.	Food supply chains are heterogeneous, diverse, collaborative, and widely scattered regarding the product, method, and destination.	In the food supply chain, blockchain can be utilized to enable traceability, origin monitoring, transparency, and low environmental impact. It also aids in achieving the UN's sustainable development objectives.	Chandan, A., et al. (2023). [71]
3.	Blockchain technology offers opportunities for the Chinese industrial hemp industry.	This significant cash crop can help reduce poverty and raise farmers' incomes. However, the safe expansion of the industrial hemp sector needs to be improved by risks associated with drug loss and public policy.	The feasibility study recommends creating a consortium blockchain comprising market players, financial institutions, and anti-drug organizations to solve the industrial hemp sector issues.	Liu, H., et al. (2023). [72]
4.	How can the retail sector choose the optimum replenishment plan using blockchain technology as support?	Product correctness and supply chain management transparency are two significant problems that practitioners must deal with. Data storage via blockchain is highly safe and reliable. If reliability is poor, it is imperative to incorporate radio frequency identification. By increasing product visibility for the appropriate replenishment plan, radio frequency identification can enhance SCM.	This can boost profits by 40% if holding costs are higher. Even though the lowering rate is relatively sluggish, the detrimental impact of misplacement is lessened with rising demand. Only if there is such a significant demand that it can lessen the impact of misplacement may the decision to forgo radio frequency identification be successful.	Saxena, N., et al. (2023). [73]
5.	Pharma supply chain industry solution using blockchain	Modern pharmaceutical supply chains are intricate, including producers, suppliers, and customers on various continents. The movement and sale of medicinal items that are sold online are now markedly opaque. The absence of openness, a lack of trust in teamwork, and a reluctance to share data can be significant obstacles for this international industry.	Smart contracts also govern interactions between vendors and customers by keeping track of IoT containers containing prescription drugs and thoroughly informing customers. Our intelligent contracts manage unique situations, including consumer reimbursements, in case contract terms are broken to guarantee the secure delivery of medications.	Abdallah, S., et al. (2023). [74]

6.	When should remanufacturing platforms employ blockchain for platform operations?	Blockchain technology is now being used in many industries. Currently, one of its uses is remanufacturing. The business uses blockchain technology to save the data on discarded products before producing new ones.	For social welfare, coordination between the producer, online platform, and the third-party company is conceivable in the market or resale mode.	Xu, X., et al. (2023). [75]
7.	We are incorporating Industry 4.0's next-generation environment with IoT, ML, and blockchain technology.	The concept of "Industry 4.0" is revolutionizing many different industries and sectors worldwide. Through methodical adaptation and the use of cutting-edge engineering tools from the next generation, Industry 4.0 serves as a technical accelerator for increased growth.	Due to Industry 4.0's quicker adoption, authors have tried to describe every associated concept and explore a prospective roadmap, specifically focusing on its implications in the current market.	Shrivastava, A., et al. (2023). [76]
8.	Blockchain and federated learning are used in FusionFedBlock to protect privacy in Industry 5.0.	Modern technology, including the Internet of Things (IoT), is required for application in the industrial setting. The sector can collect, transfer, and evaluate large amounts of data utilizing state-of-the-art technologies. When employed with industrial infrastructures, IoT still has various issues, including centralized control, privacy protection, latency, and security.	By miners in Blockchain networks, this global model is validated. Federated learning ensures privacy protection among the many divisions and sectors it covers.	Singh, S. K., et al. (2023). [77]
9.	Relationship analysis between the evaluation of the circular economy	This is done to compare the relative influence of blockchain technology on various metrics. A general study strategy is offered for contrasting blockchain capabilities with CE performance evaluation.	It is crucial to research and evaluates practises in this area; much more analysis is required to advance CE.	Kouhizadeh, M., et al. (2023). [78]
10.	Supply chains for producing textiles that use blockchain storage and sharing Internet of Things data.	The distribution of goods globally and how makers exchange value are being reinvented. As an illustration, IoT technology aids in gathering, storing, processing, and improving the effectiveness of operational data. However, the information systems used in textile production	Blockchain-based computing has several benefits, including quick scaling, distant data storage, and service delivery in a dynamic context.	Pal, K. (2023). [79]

		based on IoT technology and its supply chain are highly susceptible to security, privacy, and trust problems.		

Table 5: Cloud Computing in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	A green cloud? Energy efficiency and cloud computing: an empirical analysis	The technology's rapid, widespread adoption during the past ten years has generated discussions on cloud computing's environmental effects.	As shown by examining firm-level survey data, SaaS promotes energy-efficient production, enhancing operations.	Park, J. et al. (2023). [80]
2.	An examination of the environmental, financial, and Social advantages	This is to discuss the benefits of cloud computing for the environment, including its ability to use less energy, produce fewer carbon emissions, and possibly include renewable energy sources.	To fully realize its potential, further study, and policy action are required. This is because cloud computing has the potential to play a significant role in fostering sustainable development.	Yenugula, M., et al. (2023). [81]
3.	Governing Through Infrastructure Control: Cloud Computing and Artificial Intelligence	Digital data is crucial to how societies, organizations, and persons are observed, comprehended, and managed. States and governments have used numerical data to monitor and administer their borders and populations.	As evidenced by their infrastructure forays into education, Amazon, Google, and Microsoft now hold the position of state-like corporations with the social, technical, economic, and visionary power to influence how institutions, people, and entire systems are measured, evaluated, rated, predicted, controlled, and governed.	Williamson, B. (2023). [82]
4.	In the direction of a secure cloud architecture for smart industrial IoT based on blockchain and SDN	Several significant new technologies have been the focus of recent research.	The traits used in experimental evaluations of our SDN and BC-based implementation's effectiveness.	Rahman, A., et al. (2023). [83]
5.	Observation Based on the Cloud to Follow the Digital Thread	A list of critical technologies is provided to help people understand the digital thread concept. Using the chosen technology as a foundation,	Additionally, the design offers a cloud-based observation that blends enterprise products (like SAP products) with cloud infrastructure (like	Daase, C., et al. (2023). [84]

		cutting-edge options for digital threads are investigated. The research project also provides a high-level architecture for realizing the digital thread by the finished technological analysis.	Google Cloud). Based on the work undertaken to conclude the research conducted here, a forecast is given regarding anticipated future developments.	
6.	A social platform called Nurilo uses cloud computing and blockchain to sell and buy framework products.	A delivery chain is a network of organizations, individuals, tasks, information, and resources used to move. Most industries, including healthcare, economics, food, and education, centrally administer statistical systems.	Blockchain's potential could be used to change the features of the supply chain that affect efficient execution. This can improve the simplicity of financial transactions, increase the adaptability of system operation, and enable handling robotization.	Kumar, A., et al. (2023). [85]
7.	Smallholder farmers in Sub-Saharan Africa are utilizing big data and cloud computing.	Information processing in numerous economic areas, including agriculture, has made cloud computing and big data technologies increasingly popular.	The lack of access to and processing information and farmers' resistance to implementing modern farming techniques and digital technologies are the leading causes of Africa's agriculture productivity problems.	Mupaikwa, E. (2023). [86]
8.	A social analysis of Industry 4.0 technology in connection to goals for sustainable development	This will build an evaluation framework after identifying the SDGs connected to I4.0.	The findings provide a starting point to assist order investments in different technologies based on the SDGs. We identify logical steps that can help invest in and plan for adopting I4.0T to achieve SDGs more effectively.	Bai, C., et al. (2023). [87]
9.	Industry 4.0 implementation in Indian banks	Digitalization and intelligence are needed to improve the state of the earth.	The study aims better to understand banks' challenges in the digital age. We are putting customers first while adjusting to the digital age in banks.	Gupta, R. (2023). [88]
10.	They are integrating blockchain, ML, and the next-generation environment of Industry 4.0.	The concept of "Industry 4.0" is revolutionizing many different industries and sectors worldwide. Through methodical adaptation and cutting-edge engineering tools from the next generation, Industry 4.0 is a technical accelerator for increased	Because this technology is being adopted more quickly than in the past, authors have worked hard to clarify every concept associated with Industry 4.0 and examine a potential roadmap, paying close attention to how it will	Shrivastava, A., et al. (2023). [89]

		growth—the Internet of Things, blockchain, and AI.	affect the market in the present.	

Table 6: Forensic Technology & Cyber Security in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	Bibliometric examination of studies on cyber forensics and security	Cybersecurity has become one of the most significant issues with the development of internet-based technology, goods, services, and networks. If cybersecurity is a kind of prevention, then cyber forensics is a treatment. In terms of digital security, both are crucial pillars.	Cybersecurity and forensics are shown here, including the authors, organizations, nations, keywords, sources, and documents with the most vital international collaboration connection strengths. Present are also the most recent trends, unexplored subjects, and future directions.	Sharma, D., et al. (2023). [90]
2.	A global framework for memory forensics for programmable logic controllers	This automates physical operations in essential infrastructure and numerous other industries and manufacturing sectors. Cybersecurity was not considered when PLCs were being developed, and they were initially totally cut off from the Internet.	In the event of a cyberattack or system failure, the Python memory profile implementation can assist in reducing the time and effort needed for human investigation.	Awad, R. A., et al. (2023). [91]
3.	Do ChatGPT and Deepfake Algorithms Put the Cybersecurity Sector at Risk?	Cybersecurity has become a primary global concern in this digital age. Hackers employ deepfake algorithms and the development of Massive Language Models (MLMs) like ChatGPT to produce codeless fake content that spreads online dangers. Natural language processing and deep fake algorithms make up the technology frequently used in movies, pictures, and the film business. The capacity to tell actual photos from fraudulent ones is in jeopardy since the technology uses machine learning to change real photographs and movies using neural networks.	Technology threatens cybersecurity because it makes it easier for thieves to commit crimes like vishing and business email compromises that are difficult to detect. This study provides a detailed description of the various neural networks that facilitate the creation of deep-learning algorithms while considering both social and technological implications.	Dash, B., et al. (2023). [92]
4.	Cybersecurity Concerns in the FinTech Sector:	With examples from the Indian financial industry, this will examine privacy, information security, and	Digital payment fraud prevention strategies are provided.	Pachare, S. M., et al. (2023). [93]

	Problems, Challenges, and Solutions	cyber security. A fundamental framework for cyber security is addressed in the chapter, along with an iterative procedure that considers actions.		
5.	Was the crime committed by the AI system, according to the discipline of AI forensics?	Artificial intelligence (AI) is becoming increasingly autonomous and making choices that influence our daily lives. Their actions may lead to accidents, injuries, or, more generally, legal violations.	This aims to concentrate on grey box analysis and AI that may be "malicious by design." Convolutional neural networks were used in our study to highlight problems and suggest solutions for identifying harmful AI.	Schneider, J., et al. (2023). [94]
6.	Framework for digital forensic preparation for 3D printing using material extrusion	Critical parts for cars, planes, and other vehicles are increasingly printed in industry. Cyberattacks on the printed object are encouraged by the potential for severe damage to the system and the environment if a 3D-printed element (like a turbine blade) fails while it is in use.	A post-incident inquiry is made more accessible by forensically-ready printing equipment.	Rais, M. H., et al. (2023). [95]
7.	Techniques and Issues in Machine Learning for Cybersecurity	Using cybersecurity data to identify patterns or insights regarding security events and creating the appropriate data-driven models is the key to automating and intelligently constructing a security system. The use of data to examine real-world events is known as data science. The names of numerous scientific methodologies, machine learning procedures, and systems also refer to it	Increasing performance and periodically updating the training dataset are essential to include new phishing techniques. These activities will improve the detection of phishing.	Bharadiya, J. (2023). [96]
8.	An IoT forensic concept based on blockchain is called BLOFF. Blockchain, the Internet of Things, and Security: Research Anthology	IoT is an intriguing technology for consumers and attackers because of its many benefits. The tools and technology are available to hackers now allow them to carry out millions of complex attacks.	Further, the vast bulk of the evidence used by forensic investigators comes from service providers, which raises the possibility of corrupted evidence. The authors proposed an IoT forensic method based on blockchain that would address this problem by barring the use of tampered logs as proof.	Agbedanu, P., et al. (2023). [97]

9.	I am using forensically sound risk management to combat insider attacks.	Insider cyberattacks are hard to thwart with traditional security methods. Such attackers usually exploit lawful access to the system for malicious purposes, or an external attacker may pose as an insider or use other cunning methods to get access and bypass security measures. Software solutions that support the inevitable forensic investigation and are forensically equipped could solve this problem.	To determine the necessary forensic preparation for insider assaults, the FR-ISSRM risk management technique is proposed. When the requirements are implemented, they help improve security posture overall while reliably identifying the attack's root cause, perpetrator, and damage. Three instances involving common insider attacks are used to illustrate the method.	Daubner, L., et al. (2023). [98]
10.	A small nation-state's remapping of cybersecurity skills	As all industrial sectors continue to become more digital, cybersecurity (CS) significantly impacts the general public's well-being. A sufficient number of CS experts with the necessary skills are required for information system security. A critical component of the strategy for workforce development is a cyber-competency map..	Two semi-structured qualitative field professional interviews are used to present and validate the competence map.	Bukauskas, L., et al. (2023). [99]

Table 7: Digital Marketing and Business in Pthe roduction Industry

S. No.	Area	Issue	Outcome	Reference
1.	The Financial and Sustainability Performance During the COVID-19	MSMEs' financial and sustainability success is impacted by the e-commerce platforms they use and the digital marketing tactics they employ. MSMEs had to learn and use a variety of business-sustaining practices.	Our findings add to the body of work already available on technology adoption. This study has various lessons for managers and decision-makers of small firms, who can discover how important it is to work.	Gao, J., et al. (2023). [100]
2.	Digital advertising to its full potential as an online marketing technique. Digital Entrepreneurial Start-up	To increase consumer interest in purchasing, this study will examine the best strategies for using Internet advertising.	Digital marketing is the most significant medium because it is the most efficient way to advertise and may dramatically enhance sales volume.	Wuisan, D. S., et al. (2023). [101]

3.	Determinants, Research Perspectives, and Evolutions	The marketing strategy must be changed, especially the brand management paradigm.	Internal branding and outside customer impression directly affect the firm's success. The link between brand and market orientation currently exhibits synergy instead of mutual substitution.	Li, S., et al. (2023). [102]
4.	The APIAT Trade Fair's MYPES for the footwear industry.	This study, which employed a quantitative research technique and a correlational research design, sought to understand how digital marketing affected MYPES's entrepreneurship in the footwear industry at the APIAT trade show.	Normative, referential, conceptual, and philosophical frameworks have a less substantial impact on entrepreneurship than the framework. The conceptual framework is another area that is greatly influenced by entrepreneurship.	Castillo, S. A. P. (2023). [103]
5.	Following the COVID-19 era, marketing plans for the United Arab Emirates' tourism sector are needed.	The effect of the COVID-19 pandemic on the tourism industry in the UAE will be studied through a theme assessment. It focuses on using transformative tactics by tourism-related businesses to resurrect the industry.	This is subject to both supply-side and demand-side disruptions. As part of designing tourism products, it also considers the most critical socioeconomic issues.	Seshadri, U., et al. (2023). [104]
6.	The Development of the Travel and Tourism Sector: From Digital Marketing to the Metaverse Network	This is being suggested as a result of this change and would take the shape of a substitute tourist type that would allow people who live in different countries to visit the same or different countries in the virtual world.	The conceptual framework for digital tourism marketing and the metaverse network, which the department provided, is expected to support the industry and upcoming scholarly research.	Garda, B. (2023). [105]
7.	Training in Digital Marketing to Boost Village-Owned Businesses' (BUMDes) Competitiveness in the South Buton Regency	Since the Internet has been widely used, digital marketing has grown exponentially. The affordability of cell phones contributes to this degree of use. However, it is only sometimes understood that business people, such as firms controlled by villages, employ digital marketing (BUMDes).	The social media platforms used for digital marketing include those owned by BUMD's employees and those built mainly for the company—product sales at BUMDes.	Lawelai, H., et al. (2023). [106]
8.	Energy Use, Climate Change, and Sustainability	Today, the word "sustainability" permeates all economic sectors, but it	Climate change includes an assessment of potential environmental harms brought on by the	Thangam, D., et al. (2023). [107]

	Affected by Digital Marketing Practises	is especially prevalent in business.	practice, reasons why digital marketing companies need a sustainable business strategy, and upcoming efforts required to ensure a sustainable environment.	
9.	Artificial intelligence and digital technologies are advancing and changing digital marketing and branding, and the metaverse universe is also experiencing these changes.	The customers don't need to leave their houses to interact with items in an augmented reality environment. In-store encounters can become actual in the Metaverse.	Businesses must be prepared to compete in digital and virtual environments as part of the digital transformation process if they want to succeed in a world that is becoming increasingly competitive.	Nalbant, K. G., et al. (2023). [108]
10.	Artificial Intelligence and the Metaverse in Marketing: Digital Transformation 4.0. Eduzone	The main objective of the fashion sector's digital transformation was to attain sustainability by utilizing a variety of digital tools. A new virtual reality environment called the metaverse, which was just created, has expanded the possibilities for digital clothing.	Studies on the metaverse and artificial intelligence have been conducted in several academic disciplines, including literature, art, music, and education. Two of the most important modern technologies are artificial intelligence and the metaverse.	Rathore, B. (2023). [109]

Table 8: 3D Printing in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	Challenges and possibilities for the construction industry with 3D printing using cementitious materials	Both conventional and non-conventional materials have been analyzed, many of which are alkali-activated materials (geopolymers).	Results from the development and research phases are encouraging and are anticipated to become an industrial reality soon. The key issues and potential solutions for using additive manufacturing are discussed in this study.	Robayo-Salazar, R., et al. (2023). [110]
2.	Agri-food processing waste streams can be valued using a 3D printing method.	Food-processing waste streams are becoming increasingly recognized as a topic of study and commercial interest due to mounting evidence of their importance for resource recovery.	This highlights the technology's main benefits and how it might be used for food printing applications.	Yoha, K. S., et al. (2023). [111]

3.	Analyzing the financial and environmental consequences of supply networks utilizing 3D printing technology	The tire business is one of many that the 3D printing technology is expected to transform. The fundamental reason is that tires are a large product requiring intensive transportation and inventory management procedures.	3D printing technology may provide a 9–10% reduction in the chain's carbon emissions. Future distribution and manufacturing of tires may be cleaner as a result. Extensive sensitivity analysis is also undertaken to comprehend how model outputs change with altering input parameters.	Shahpasand, R., et al. (2023). [112]
4.	Recent developments and potential in polylactic acid 3D printing	A type of polymer known as "bio-based polymers" is produced by living things, albeit only a small number of these are now known and used commercially. They have not seen widespread application due to inadequate mechanical strength and financial limitations. Instead, they have been a strong contender for biological applications.	This study evaluated PLA's chemical composition, production processes, standard features, and market environment. This review focuses on 3DP processes that use PLA filaments in extrusion-based 3DP technology. Several recent articles have highlighted products made of PLA using 3D printing.	Joseph, T. M., et al. (2023). [113]
5.	As examples of modular product architecture for sustainable, flexible manufacturing in Industry 4.0,	Modular products are adaptable to changing requirements and maximize resource use. In this study, a method was suggested and applied to two goods, a 3D printer and an electric toothbrush, with a modular architecture, several product variations, and customizability to help develop adaptable, sustainable manufacturing systems.	The factory must be modified or reorganized to accommodate the modular design as it evolves. To establish the connections between goods and processes for a flexible, sustainable manufacturing system.	Habib, T., et al. (2023). [114]
6.	Designing a 3D-printed emergency mechanical ventilator for crises with advanced manufacturing techniques	For the industry to handle such events and increase resource conservation and avert shortages, increased collaboration efficiency is required. Technology advancements in additive manufacturing are poised to alter how goods are created fundamentally. They can support the earth's fight against catastrophe from	Another thing that was assessed was a mix of production technologies. When a high volume of output is needed, the adjustments made it possible to cast (injection mold) the pieces optimally, which sped up production rather than printing each part individually.	Kalkanis, K., et al. (2023). [115]

		material and use perspectives.		
7.	What impact does 3D printing have on residential construction project success using structural equation modeling?	Applying 3D printing to construction could improve the project's overall result. However, Malaysia's home building industry typically uses traditional techniques, which could improve the environment, public health, and public safety.	Malaysian officials may view the outcomes of using 3D printing in home construction as a cutting-edge strategy for advancing environmental sustainability, public health, and safety.	Waqar, A., et al. (2023). [116]
8.	In light of the scope and context of the 3D printing revolution, supply chain management, and operations should be re-evaluated.	For at least three decades, people have predicted that 3D printing will revolutionize additive manufacturing.	This document lists variables on three levels for a company to gain from the use of additive manufacturing.	Beltagui, A., et al. (2023). [117]
9.	Personalized Medicine with Magistral Compounding and 3D Printing	Pharmacy practice has traditionally included the use of magisterial compounding. A rise in medicinal compounding could help to meet the rising need for individualized medication therapies on a global scale. The new, adaptable 3D printing technology might advance this procedure even further.	Relevant Dutch stakeholders, including those from boards and ministries of health, trade associations, and various pharmacies, participated in semi-structured interviews. Participants were found using deliberate sampling. Using content analysis, the key topics were found.	Beer, N., et al. (2023). [118]
10.	Identifying Obstacles to the Development of a Local Medical Supply Chain Ecosystem Supported by 3-D Printing	Separating the areas is necessary to build a local supply chain, and this process results in a new business model due to alliances made with local partners and clients. The factory buys raw materials, components, and preassembled components in local supply chains from regional vendors. Then, it sells the finished goods to consumers in the region by lowering inventory and transportation costs and switching the manufacturing process from manufacture-to-stock to make-on-demand.	The necessity for a change in company strategy, strong stakeholder participation, and rapid backing from the local government has been identified as the main forces behind developing 3DP-enabled localized supply chain ecosystems.	Kamble, S., & et al. (2023). [119]

Table 9 : The Internet of Things (IoT) in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	Analysis of Internet of Things (IoT) security concerns and solutions	The scenarios necessitate intelligent devices; it is necessary to consider how the dynamics of protection will change due to the various demands of these practical applications. This study includes an introduction and thoroughly describes the connections between the main security requirements, implementations, and network safety.	By looking at a few recent studies in the IoT field, it is possible to exhibit and talk about fresh IoT ideas from the scientific, educational, and industrial sectors regarding specific facts.	Rekha, S., et al. (2023). [120]
2.	Big data analytics problems arise when the Industrial Internet of Things (IIoT)	The sharp rise in IoT-connected devices and the exponential rise in data consumption is a clear indication of how significant data growth and IoT growth are interwoven.	We are building intelligent IIoT systems in an industrial 4.0 environment while addressing the challenges given by BDA.	Qi, Q., et al. (2023). [121]
3.	IoT applications in the construction sector have undergone a thorough investigation that reveals new aspects.	IoT has been rapidly adopted in many industries in this digital age, but its use in the construction sector is still only slightly prevalent. Construction 4.0 safety is integrated with IoT devices to create a framework that effectively supports applications that increase operational and construction efficiency.	With the aid of this study, construction managers will be better ready to spot issues, and experts will be better able to evaluate the potential for IoT hybridization within the context of Construction 4.0.	Khurshid, K., et al. (2023). [122]
4.	Utilizing the Industrial Internet of Things, blockchain, and artificial intelligence to assist small and medium-sized businesses in their move to the digital economy	Automating SME transaction execution grows increasingly difficult as more SME stakeholders connect, access, trade, add, and edit transactional executions. SMEs demand high levels of efficiency, stable manufacturing, excellent financial management, privacy, and security, among other things.	The goal is to use artificial neural networks with ML-based AI to manage and optimize the daily volume of SME transactions.	Khan, A. A., et al. (2023). [123]
5.	To support the industry, build a smart factory based on IoT and cyber-	As Industry 4.0, which stands for the digital transformation of manufacturing and uses cutting-edge intelligent and potent technology, arises, society, business, and other	The creation of an intelligent cyber-physical system using essential industrial, computer, informational, and communication	Ryalat, M., et al. (2023). [124]

	physical systems. 4.0.	industrial sectors are strongly influenced.	technologies, built on the ground-breaking brilliant factory architecture of Industry 4.0.	
6.	The role of supply chain transparency as a mediator.	The alleged connections between operational performance (OP), supply chain visibility (SCV), big data analytics (BDA), and the Internet of Things (IoT) in Jordan's pharmaceutical manufacturing sector. The conceptual model linked to SCV's indirect impacts is also investigated in this research.	The study's results demonstrate a favorable and statistically significant association between the IoT and BDA on SCV and OP. A statistically significant correlation existed between the SCV and OP. In addition, it was demonstrated that SCV mediates the connection between IoT, BDA, and OP.	Al-Khatib, A. W. (2023).[125]
7.	Blockchain and Internet of Things (IoT) technology help pharmaceutical supply chains remain resilient in the post-pandemic era.	Blockchain and the Internet of Things (IoT) help to solve complex, interrelated problems by increasing the flexibility, visibility, and transparency of PSC activities in the IT sector.	It is creating a PSC management paradigm with a hospital-specific focus that incorporates blockchain and IoT.	Chen, X., et al. (2023). [126]
8.	Workers' Opinions on the Olive Oil Industry's Performance Improvement Potential with the Internet of Things	Systematic and distributed, the world's food supply is now. A rise in business productivity is predicted due to information technology adoption and reasonable use.	The approach's development used decision trees and self-organizing map (SOM) clustering. Respondents who know how to incorporate new technology into the sector were surveyed for the data. The outcomes showed that olive oil companies' performance was greatly enhanced by implementing IoT.	Alsayat, A., et al. (2023). [127]
9.	Aspects of the Industrial Internet of Things (IIoT), including benefits, needs, and challenges.	This is altering how businesses operate and how we live our lives. Only a third of the estimated 75 billion devices online by 2025 will likely include tablets, PCs, smartphones, and wearable technology.	Shortly, human communication will significantly improve thanks to the "Internet of Things" (IoT).	Banafa, A. (2023). [128]
10.	Using IoT-enabled devices, healthcare help is provided to	IoT could lead to disruptive medical innovation. Searching for research articles on the COVID-19 pandemic and IoT in healthcare allows one to	The focus of IoT in the field of medicine is on providing proper treatment for a variety of COVID-19	Mukati, N., et al. (2023). [129]

	COVID-19 patients.	investigate the viability of this technology. Professionals may solve connected issues with this literature-based research and stop the COVID-19 pandemic.	circumstances. Lowering risks and improving overall performance makes the surgeon's job easier. Using this technology, physicians can quickly spot changes in COVID-19's vital characteristics.	

Table 10: Data Storage in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	Industry 4.0 refers to how medical manufacturing companies are utilizing technology.	These are extensively used by businesses wanting to grow to enhance their reputation and offerings. Additionally, there is automation using trustworthy server storage and databases.	In the age of digital transformation, information systems are crucial for assuring the technical integration of all business operations, particularly management-related ones.	Guadalupe Mori, V. H., et al. (2023). [130]
2.	Cost analysis for the temple's manufacture	The data on business operational activities at Tempe Agro-industry UD Mawar Sari were studied and reported using a quantitative descriptive approach in this Field Work practice. This practice was primarily focused on those activities related to production costs, such as raw material costs, labor costs, and overhead costs.	According to the findings, the Tempe Agro-industry UD Mawar Sari produced a temple at the cost of Rp. 420,775,433.3, which included Rp. Three hundred forty-two million sixty thousand for raw materials and Rp. 31,559,200 for labor.	Sinta, I., et al. (2023). [131]
3.	Blockchain and federated learning are used in FusionFedBlock to protect privacy in Industry 5.0.	Industries are going through considerable changes in the digital world, or "Industry 5.0.".	Federated learning enables privacy protection due to the multiple departments and defined areas. The cloud layer's Distributed Hash Table (DHT) offers decentralized, safe storage.	Singh, S. K., et al. (2023). [132]
4.	Real-time optimization is made possible by Industry 4.0 technologies.	Based on recent developments, this examines the component- and system-level technologies needed to achieve ROOPVC. The paper explicitly covers the two critical components of ROOPVC: modeling, simulation, optimization, and DT technology.	The main conclusions of this review point to ROOPVC as being suitable for deployment on any size field, offering more stable output while allowing significant carbon savings, and swiftly installing thanks to its modular (microservices) architecture.	Singh, H., et al. (2023). [133]
5.	Driving force behind the	Natural disasters such as abrupt climate changes,	A service unit's performance is compared to comparable	Li, X., et al. (2023). [134]

	development of the low-carbon sectors in the digital economy. Technology and Assessments for Sustainable Energy	earthquakes, typhoons, storms, and snowstorms have become more common in recent years, posing a severe threat to human life and advancement. Many nations worldwide strive for a development that strikes a balance between economic growth and the preservation of the environment. The most popular option among them is the low-carbon economy, which all nations on Earth support.	units offering the same service to maximize efficiency.	
6.	Industrial 4.0's use of data visualization is one of the newest mechanical and industrial engineering trends..	Manufacturing industries are concentrating on enhancing their production in every way due to the escalating market rivalry. The manufacturing industry's procedures may deviate with time. Therefore, effective process monitoring aids in understanding how the process is developing and forecasts the direction that existing operations and practices will take.	Before adopting SPC improvement and quality assurance in assembly lines, trend analysis can be utilized as a first research. Using statistical and process control techniques, we can use the deviation in the processes that are being watched to enhance the process.	Nair, V. R., et al. (2023). [135]
7.	Modern IoT and machine learning decision support systems for Industry 4.0 shift from knowledge-based to big data analytic methodology.	Most cutting-edge ML techniques for PdM anticipate the remaining valuable lifetimes of the components using run-to-failure data and a variety of condition monitoring data, including vibrations, currents, temperature, and others.	The suggested DSS's main pillars, in particular, are data collection, feature extraction, predictive modeling, cloud storage, and data analysis.	Rosati, R., et al. (2023). [136]
8.	Construction Industry's Production Chains Offer Opportunities for Inter-Company Collaboration on Transparency and Data Value.	In Germany, the building industry receives a sizable portion of every euro spent. Despite being one of Germany's leading economic activities, construction is mainly overlooked in the public's image of its economy because it typically involves small and medium-sized businesses building in specific regions.	This is sometimes criticized for needing to be more active in adopting new technologies, which can buck this trend. Existing obstacles must be lessened, and knowledge gaps must be filled.	Brell-Cokcan, S., et al. (2023). [137]

9.	A description of the sequestration and storage of products related to subsurface energy.	The energy supply chain's capacity for reserves, resiliency, and security are all improved by storing energy-related things in subsurface geology. Energy-related products can be sequestered to offer long-term isolation from the environment and, in the case of CO2, a decrease in air emissions.	The continuous energy transition towards net-zero or low-carbon economies can be made more sustainable by considering broader factors, including life cycle analysis, ecological, social, and governance (ESG) impact, and effective stakeholder involvement. These factors can also lower project uncertainties and costs.	Schultz, R. A., et al. (2023). [138]
10.	Opportunities and Difficulties in Using Industry 4.0 and Sensors in Product Design	The operational efficiency, organizational capacity to monitor and regulate activities, cost savings, and product quality have all significantly increased due to the interconnected systems and processes.	The systematic literature review with bibliometric analysis (SLBA) method is used to research and synthesize data on how Industry 4.0 and sensors might aid product creation.	Rosário, A. T., et al. (2023). [139]

Table 11: Quantum Computers in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	Quantum computing is driving innovation in the healthcare sector for sustainability in COVID-19.	Even simple medical concerns can become difficult due to conventional medical procedures, and the healthcare business is home to various stakeholders.	Healthcare, pharmaceutical, and hospital organizations and patients can solve issues precisely and quickly using quantum computing.	Gupta, S., et al. (2023). [140]
2.	A summary of the significant issues with quantum communications and computation.	Quantum computing's power keeps expanding. As a result, there have been many research papers and other publications about race.	Four significant issues are structured into the essential components of a quantum internet, and each is carefully examined.	Yang, Z., et al. (2023). [141]
3.	Applications of quantum computing in medicine and health at the moment	Hardware and software developments for quantum computing have been astounding over the past few years. Regarding the effects of quantum computing on science and society, the emphasis has switched from "if" to "when/how." The 2020s have been termed the "quantum decade." In the years to come, it is anticipated that the first manufacturing solutions	Particularly in recent medical research, quantum machine learning (QML) has quickly developed and proven to be competitive with traditional benchmarks. Quantum support vector classifiers and quantum neural networks, for example, have been trained using a variety of clinical and real-world data sets. This covers investigations into developing novel molecular entities as	Flöther, F. F. (2023). [142]

		that have value for both science and business will become available. Although it is debatable whether or not medicine and quantum theory have been connected since Schrödinger's cat, there has recently been a rush of quantum-related activities and experiments in the medical profession, including topics in healthcare and the life sciences.	therapeutic candidates, diagnosing based on the classification of medical images, predicting patient persistence, predicting treatment effectiveness, and customizing radiation.	
4.	Quantum Computing and IS Potential of Emerging Technologies	Emerging technologies are significant because they have a great deal of potential to affect the information systems (IS) community. As there currently needs to be more understanding regarding the adoption, use, and effects of new technologies during their early stages, the IS discipline has not been able to be a leader in the research and teaching of emerging technologies.	With the assistance of academics from various fields, IS researchers thoroughly examine emerging technologies. In our view, IS researchers can participate in the scholarly study of emerging technologies and integrate those technologies into the IS curriculum.	Chipidza, W., et al. (2023). [143]
5.	Multiple-Knapsack Problems and Quantum Computing	Numerous industrial settings involve optimization issues, and multi-knapsack optimization is one such ongoing challenge that many businesses deal with regularly. With the potential to provide better and quicker solutions for particular types of problems, quantum computing has created a new paradigm for computationally demanding activities. By examining some of the most renowned and cutting-edge quantum algorithms employing various quantum software and hardware tools, this paper analyzes quantum computing approaches for multi-knapsack situations.	The ramifications of our findings about applying quantum optimisation in the future for industrial applications. Our findings underline the need for additional and better quantum optimisation techniques, particularly for multi-knapsack situations and better quantum hardware.	Awasthi, A., et al. (2023). [144]
6.	We are enhancing the	Its high oxygen content and intricate chemical makeup	The results suggested that Fe and Zn could alter	Li, C., et al. (2023). [145]

	yield of bio-aromatics in bio-oil made from bamboo residues.	prevent pyrolysis bio-oil from being used as a liquid fuel.	HZSM-5's high acidity and pore size distribution.	
7.	The Taxonomy, Review, and Challenges of Modern Quantum Computing	The limitations and drawbacks of quantum computing applications are now on the market, and to identify potential future research areas in this exciting field, quantum computing aims to create a thorough understanding of these applications.	The knowledge gap between physicists and non-physicists is closed by detailing the conceptual and notational distinctions between quantum and traditional computing.	Singh, J., et al. (2023). [146]
8.	Tools to ensure that economic systems are managed according to Industries 3.0, 4.0, and 5.0.	The concept of the following three key categories—the 3.0, 4.0, and 5.0 industrial revolutions—and the transition implementation mechanism are being developed for the phase transition to a new socioeconomic formation.	The emergence of internet-of-things technologies, the growth of cyber-physical systems, and the miniaturization of financial assets. The standards of the information group.	Melnyk, L. H., et al. (2023). [147]
9.	They are utilizing quantum computers to study the material characteristics at restricted temperatures.	Even though current quantum algorithms for calculating the thermal properties of these systems incur high computational costs because they either prepare the entire thermal state on the quantum computer or they must sample a large number of pure states from a distribution that grows with system size, quantum computers can successfully simulate quantum many-body systems.	The algorithm's efficiency in calculating the thermal characteristics of quantum materials has been demonstrated. This method is projected to permit finite temperature examinations of critical quantum materials on short-term quantum computers due to its rising accuracy with system size and adaptability in implementation.	Powers, C., et al. (2023). [148]
10.	Logistic transport optimization via adiabatic quantum computing	The foundation and backbone of current global trade is a robust and healthy supply chain, where logistics play a crucial role in creating and supplying the essential commodities and assets that sustain civilizations and economies. The importance of logistics and the need for fine-tuning transport functions to maintain the supply chain has increased	The Travelling Salesman Problem is a well-known optimization issue, and the Vehicle Routing Problem is a variant. Our goal is to approach the vehicle optimization problem from the last-mile logistic scenario application from the perspectives of classical and quantum techniques and offer a hybrid solution that includes both approaches.	Sales, J. F. A., et al. (2023). [149]

		due to the world's current geopolitical and hygienic issues. Taking on transport optimization benefits both business and society because the challenge will only become more prominent.		

Table 12: Online Education in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	Digitalization of career education in times of crisis	Rapid technological advancement and adoption across all economic sectors are necessary for enhancing the standard of vocational training. Digital technologies, on the other hand, allow for the diversification of training approaches to the needs produced by various conditions.	Because computers now run most modern machinery, digital technologies influence all manufacturing processes and operations in the service industry. Digital technology is used to operate and base contemporary military weaponry. Therefore, a high level of digital literacy is necessary for employment in contemporary sectors and services, which poses a problem for the vocational education system.	Kovalchuk, V. I., et al. (2023). [150]
2.	Based on IOT and mobile wireless communication networks, online education in engineering colleges is improved.	Engineering is a profession that demands a lot of critical thought, technical expertise, and intuition. Due to the existence of sufficient and practical frameworks and procedures for student assessment, the caliber of graduates from engineering faculties is rapidly declining.	The proposed system is being implemented using a Python simulation tool, and performance benchmarks have also been evaluated. According to the study's findings, the proposed conceptual model surpassed the ones already in place in terms of enhancing the online learning process.	Kadhim, J. Q., et al. (2023). [151]
3.	Evaluating important institutional aspects of Industry 4.0 for educational reform	Educational institutions must rethink education and emphasize building human capability in light of the fourth industrial revolution.	According to the poll, the top institutional facilitators and barriers are attitudes hostile to changing education for Industry 4.0, which are national programs mainly targeted in this direction—the results from the Delphi exercise help to create a national strategy for education reform.	AlMalki, H. A., et al. (2023). [152]
4.	University-based software firm that creates graduates with	It can be challenging to provide authentic learning opportunities, and there are discrepancies between what students have learned in	Answers are provided based on 15 semi-structured interviews with SDA alums. Working with the software of production quality and	Tenhunen, S., et al. (2023). [153]

	industrial experience.	school and what employers expect them to know once they graduate. In an internal software startup run by a university called Software Development Academy (SDA), we offer a novel approach to teaching skills relevant to the industry to address this difficulty.	handling various duties were deemed the most crucial aspects of SDA since they provided students with a strong foundation of future-ready skills.	
5.	Effects of COVID-19 on Education	The COVID-19 sickness, which is highly contagious, has been dubbed a pandemic by the WHO. Now that the disease is hitting India, a developing country. The only preventive measure everyone can implement is social isolation since COVID-19, also known as the coronavirus, is a disease that passes from person to person.	The government has implemented a national lockdown as a means of separating individuals. But how will this shutdown likely affect various parts of our nation? This essay examines how COVID-19 has affected India's educational system.	Kaur, M. (2023). [154]
6.	Is it ready for this new teaching and learning approach?	Since March 2020, instruction has been provided online. Students missed out on campus life. As a result, teamwork was minimized, fieldwork, industrial tours, and community service were overlooked, and most importantly, the learning outcomes could have been better.	The consequences of these modifications must be thoroughly considered because they might affect the caliber of graduates. This study will examine how the COVID-19 epidemic has affected the educational system and highlight some workable solutions that the academic community and HEI top management may want to consider to mitigate the negative consequences of current practices.	Othman, A. K, et al. (2023). [155]
7.	Gender characteristics: Implications for online cross-cultural learning. The Future of Online Education: A Research Anthology on Distance Learning	The populations of higher education have changed in terms of demographics. Online education now has a predominantly female student body. While yet distinct, genders are similar in physiology and psychology.	It can address how biological, environmental, and technological factors influence gender disparities in behavior and learning. Online learning strategies are offered to help students with their requirements and obstacles. Finally, the chapter offers ideas for further study on gender issues that cut across cultures in the context of online learning.	Chuang, S., et al. (2023). [156]
8.	Using Industry 4.0 Technologies	Because of the COVID-19 pandemic, the higher education industry has been	Institutions of higher learning are implementing technology from Industry 4.0	Aderibigbe, J. K. (2023). [157]

	to Advance Education 4.0 and Practical Hybrid E-Training for Successful Post-Epidemic Higher Education	pushed to use hybrid pedagogical practices rather than conventional in-person teaching and learning methods. The transition from traditional classrooms to online teaching and learning environments has started at nearly all higher education institutions.	(I4.0). This move is a component of the Education 4.0 (EDUC4) higher education development for the twenty-first century. In light of this, this chapter addresses ways to support EDUC4 for effective higher education during an epidemic.	
9.	A call for educational reform and the effects of Industry 4.0 on the workplace. The Frontier of Chinese Education Reform and Development	Industry 4.0 is the subject of intense discussion among worldwide academics and professionals. But up until now, the prospects, underlying technology, and applications have only been conceptually described by worldwide research institutions.	The development of primary education that is ability-oriented, the reformation of vocational education teaching methods, and the reformation of higher education.	Yang, J. (2023). [158]
10.	Effective methods for enhancing soils' ecological condition. Technological advancements, intellectual education, and cutting-edge digital tools	Industries' effects on soils and how to safeguard them. At the same time, details about how to effectively use the land near industrial sectors are provided.	Information on the efficient use of land near industrial areas is provided.	Turgunovich, J. B., et al. (2023). [159]

Table 13: Virtual and Augmented Reality in Production Industry

S. No.	Area	Issue	Outcome	Reference
1.	Using augmented reality, a cutting-edge study on digital twins helped industries shift their focus from products to people.	The promise of digital twins (DT) and augmented reality (AR) has recently started to take shape, sparking an increase in academic and industry research interest. The chance for operators to participate in the future excites AR.	As part of the futuristic transformation of human-centric businesses, this study also promotes product design, robotics-related work, cyber-physical interaction, and human ergonomics.	Yin, Y., et al. (2023). [160]
2.	Guidance for product assembly and maintenance/repair from an augmented reality perspective	Product diversity is constrained by barriers to pre- and post-manufacturing stakeholder stakeholders' knowledge transfer. Augmented reality (AR), a recent innovation, can provide	The substantial challenges, like evaluating human movement and environmental experiences using tracking and rendering techniques, are expected to increase the technology's adaptability.	Eswaran, M., et al. (2023). [161]

		great adaptation and independence.		
3.	An investigation of data management and visualization methods using BIM and augmented or virtual reality to monitor the structural health	Most public infrastructure in use today is no longer needed for its original purpose. This circumstance has led to the requirement for more extensive inspections and continuing infrastructure monitoring to ensure structural integrity.	The goal and distinctiveness of this review study originate from the fact that, in contrast to SHM's diagnostic and prognostic methods, relatively little systematic assessment of the most recent data management and visualization tools has been done. Each subtopic explores state-of-the-art data management and visualization methods.	Sadhu, A., et al. (2023). [162]
4.	Applications for human-robot interaction that use virtual, mixed, and augmented reality using game engines	The primary papers in this study cover solutions for Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), which let users interact with real robotic platforms by extending their perception of reality through technology.	The publications are extensively utilized, easily accessible, current, and relevant. We performed a seven-year search of critical robotics databases for articles published between 2015 and 2022.	Coronado, E., et al. (2023). [163]
5.	Using dynamic digital models and augmented reality to lower occupational risks in industrial settings requires a human-centered conceptual approach.	By integrating augmented reality (AR) and dynamic digital models (DDM), training will be improved, and occupational dangers will be reduced in workplace settings.	The experts who participated in the discussion contend that the technology still needs to be ready, even though it is highly intriguing and would be very helpful in practice to reduce occupational risks.	Gualtieri, L., et al. (2023). [164]
6.	In the clothing industry, virtual and augmented reality	The research aims to use network visualization and bibliometric tools to synthesize the literature on augmented reality and virtual reality in the garment business.	Future augmented and virtual reality-related work in the garment sector will use the study as a springboard. Practitioners will also be taught everything there is to know about this scientific field.	Goel, P., et al. (2023). [165]
7.	It's necessary to consider trust in augmented reality apps and the purpose of shopping at online and offline locations to understand how mobile augmented	The question is whether elements of expectancy-value judgments (EVJ) of uses and gratifications, such as novelty, fashion/status, sociability, and relaxation, influenced trust in augmented reality (AR) apps, whether trust in AR apps influenced	To what extent EVJs of use and gratification of trusted AR apps depends on various factors, including novelty, status, and fashion. The EVJs' socialism of uses and gratifications damaged people's faith in AR applications. Users'	Kang, J. Y. M., et al. (2023). [166]

	reality is digitally changing the retail industry.	usage intention towards AR apps and online/offline store patronage intention, and whether the moderating effect of consumer self-determination affected these outcomes.	autonomy regulated the influence of users' trust in augmented reality applications on usage intention towards augmented reality apps and intention to shop at online and offline stores.	
8.	The viability of an augmented reality-based digitalization paradigm for architecture education in building construction	In response to emerging technologies in the era of digital transformations, the digitalization model (DM) for building construction courses has been developed.	The main conclusions are choosing the right digital tools, specifying the workflow and steps depending on the stages of a construction project, and determining how to define specific details successfully.	Seyman Guray, T., et al. (2023). [167]
9.	Using industrial augmented reality to display ergonomic evaluation data in a sophisticated manner	A fresh situation where the operator is an essential part of the industrial ecosystem is brought about by the shift to the 4.0 industrial paradigm.	The software tool uses a cheap D-RGB camera (Kinect v2) and an Augmented Reality (AR) visualization system based on Microsoft HoloLens 2 to monitor the human body.	Evangelista, A. et al. (2023). [168]
10.	Setting up augmented reality users: examining YouTube advertising to comprehend market expectations.	These promotional videos try to position AR technology and potential users by exhibiting techno-euphoric claims and hypothetical use scenarios with a situational and grounded theory analysis of the movie.	In construction operations, it is discovered that there are gaps between expectations and foreseen requirements. The results of our study may also help develop applications for AR that are socially resilient and provide a more comprehensive understanding of workplaces.	Wortmeier, A. K., et al. (2023). [169]

5. OBJECTIVES BASED ON REVIEW:

(1) To determine technology's role in the secondary industry sector.
(2) To organize the existing position of ICCT-UT in secondary industries.
(3) To create the idea of tech-business analytics in the secondary industries sector.
(4) To evaluate the tech-business analytics model in the secondary industries sector.
(5) The ABCD analytical paradigm will analyze the Pros, Cons, and Cons of Tech-Business Analytics in the Secondary Industries Sector.
(6) To investigate how tech-business analytics are used and how it affects secondary industrial sector productivity.

6. METHODOLOGY :

6.1 Primary Data:

Primary data refers to information that you gather on your own. The longer the data-gathering process, the more control you have over where the data comes from and how it is used. Primary data is original data collected for a specific research study or investigation. This data is gathered directly from sources such as individuals, organizations, or natural phenomena to address the research objectives and answer specific research questions. Primary data collection involves various research methods and techniques, considered the most accurate and relevant information for a particular study.

6.2 Secondary Data:

Secondary data refers to information collected by someone else or for a different purpose and is subsequently used by researchers for their studies. This data is typically gathered from existing sources, such as previous research studies, government reports, surveys, databases, academic publications, and other publicly available records. Unlike primary data, collected first-hand by researchers for their specific research objectives, secondary data has already been processed, analyzed, and made available.
Research scholars and Google search engines are the primary sources of this data. White papers, market studies, trade publications, newspapers, and websites can all be used to disseminate information. Although secondary data is simple, you need help to control how it was obtained or managed. Furthermore, the competitors will have easy access to the information they discover. Checking out competitors' websites is a fantastic place to start market research. Annual reports and other investor presentations by publicly traded companies can show how a reputable business performs in your preferred industry. Focus groups and online surveys can be beneficial for market research on technology. After determining their needs, develop detailed personas for your target audiences. These profiles will aid the marketing strategy and product creation.

7. CONCEPT OF TECH-BUSINESS ANALYTICS IN SECONDARY INDUSTRY SECTOR :

In the secondary industrial sector, TBA refers to applying cutting-edge technologies like automation, IoT, AI/ML, and data analytics to enhance corporate operations and decision-making procedures. Data must be gathered from many sources and analyzed to produce insights that might aid firms in streamlining their operations, lowering costs, increasing efficiency, and boosting profitability.

Tech-business analytics for secondary sectors involves the stages listed below:
(1) Sensors, machinery, industrial processes, and supply chain activities are just a few sources from which businesses gather data.
(2) To find patterns, trends, and insights, data is examined utilizing state-of-the-art technologies such as AI/ML and data analytics.
(3) Employing the information from data analysis, firms can decide how to manage their operations best, increase efficiency, and reduce costs.
(4) To identify areas that require improvement, businesses must continuously gather and evaluate data as part of the tech-business analytics process. The idea of tech-business analytics in the secondary industrial sector is becoming increasingly important as businesses battle to preserve their competitiveness in a market that is changing swiftly. Utilizing cutting-edge data collection and analysis technologies, businesses can learn more about their operations and make data-driven decisions that can boost productivity, enhance quality control, and increase profitability.
The TBA in the primary industrial sector, according to Kumar, S. et al. (2023) [170], is to organize the effectiveness and sustainability of agricultural extraction activities. As a result of the primary sector's reliance on resources and environmental factors, TBA can assist companies operating in this sector in making data-driven decisions that will improve operations and lessen their environmental impact. By accessing information from weather sensors, soil sensors, and other sources, TBA, for instance, can aid agricultural enterprises in optimizing their crop yields. Firms can use predictive analytics to foresee weather patterns and modify their planting plans and crop management techniques accordingly. Increased crop yields, better use of resources, and less negative influence on the environment can all result from this. Similarly, TBA's analysis of data from sensors, drones, and other sources can assist enterprises engaged in exploiting natural resources in streamlining their operations. Technology has grown in importance as a tool for resolving social and economic issues in contemporary society, according to Aithal, P. S. et al. (2023) [171]. The values of goods and services in virtually every industry and business practice have been revolutionized by information, communication, and computation technology (ICCT). In this chapter, we've discussed how ICCT's Tech-Business Analytics, which combines big data analytics with its underpinning technologies, may be used to generate business intelligence in higher education. Twelve different forms of TBAs are

proposed and analyzed, and their separate components and subset technologies are listed, along with potential applications for each type of tech-business analytics.
A new type of business analytics that can be used to solve semi-structured and unstructured problems of various industry sectors, such as primary, secondary, tertiary, and quaternary industry sectors, has been developed, according to Kumar et al. (2023) [172]. Tech-business analytics (TBA) is the name of the latest study. This study aims to gain a deeper understanding of the concept of TBA and how it affects an organization's innovation outcomes.
By Kumar, S., et al. (2022).[173], technology, in particular the intersections of artificial intelligence (AI), big data, and the Internet of Things (IoT), is advancing its capacity to help organizations produce better results with fewer resources. Utilizing technology, a business may produce a product faster and with fewer employees. Concerns with needs-based, want-based, sociocultural, and phantasmagorical desires are covered in this section. The use of technology to advance business in society has a promising future. People's struggles are examined here, and prospective future developments are considered. The effects of technology on society have been discussed, along with various technology generations, business models, and strategies. Business and ICCT technology have been examined, as well as the controversy surrounding nanotechnology and the model for technology adoption.
Kumar, S., et al. (2020) [174] state that this study explores the developing fields of data analytics and decision prediction using information gathered from various systems employing Internet of Things technology. The Internet of Things (IoT) is a grouping of interconnected computing devices, mechanical and digital machinery, items, animals, or people given unique identifiers and the capacity to send data over a network without human-to-human or human-to-computer interaction. Processing the vast and ongoing data created should have the specific goal of future prediction, as well as an explanation of the issue utilizing another high-tech system and model.
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As stated by Kumar, S., et al. (2020) [173], this study analyses the developing fields of data analytics and decision prediction using data gathered across many systems employing Internet of Things technologies. The Internet of Things (IoT) is a network of interconnected computing devices, mechanical and digital machinery, items, animals, or people given unique identifiers and the capacity to transfer data over a network without needing human-to-human or human-to-computer interaction. To process the vast and ongoing data collected, a specific goal of forecasting the future should be used, combined with an explanation of the issue utilizing another high-tech system and model.
According to Kumar, S. et al. (2020) [175], processing the massive and continuous data generated should have the specific goal of predicting the future, as well as an explanation of the issue using another high-tech system and model. This work discusses the feasibility of implementing (designing and developing) such systems for so-called Tech-Business-Analytics for various real-world applications of predictive business choices.
According to Kumar, S. et al. (2023) [173], integration of ICCT underlying technologies and big data technology to develop a new kind of business analytics that can be used to solve semi-structured and unstructured problems of various industry sectors, including primary, secondary, tertiary, and quaternary industry sectors. The new investigation is dubbed Tech-business analytics (TBA). Understanding the concept of TBA and how it affects a company's innovation outcomes is the main objective of this study.

8. DESCRIPTION OF MODEL OF TECH-BUSINESS ANALYTICS IN SECONDARY INDUSTRY SECTOR :

A typical tech-business analytics paradigm in the secondary industry sector comprises the following steps (figure 2):
(1) Data Gathering: Gathering data is the first step, and it involves a variety of sources, including production machinery, supply chain activity, and customer feedback. One can utilize sensors, RFID tags, and other data collection methods to collect this data.

(2) Data Consolidation: Consolidating the collected data and producing a single database or data warehouse is necessary. Data that is accurate, complete, and useable is essential for analysis. Hence, this is important.
(3) Data Analysis: Following that, the data will be examined using a range of analytical methods, including statistical analysis, machine learning, and data mining. Patterns, trends, and insights that can be utilized to improve organizational operations can be found using this study. Data analysis results need to be presented clearly and straightforwardly through visualization. Using charts, graphs, and other visual representations of the data can give decision-makers more straightforward insights to understand and act upon.
(4) Making Decisions: Decision-makers can select the best course of action for their company to boost productivity, reduce expenses, and streamline operations using the information obtained via data analysis and visualization. To do this, it might be necessary to alter the supply chain management, marketing strategies, or production procedures.

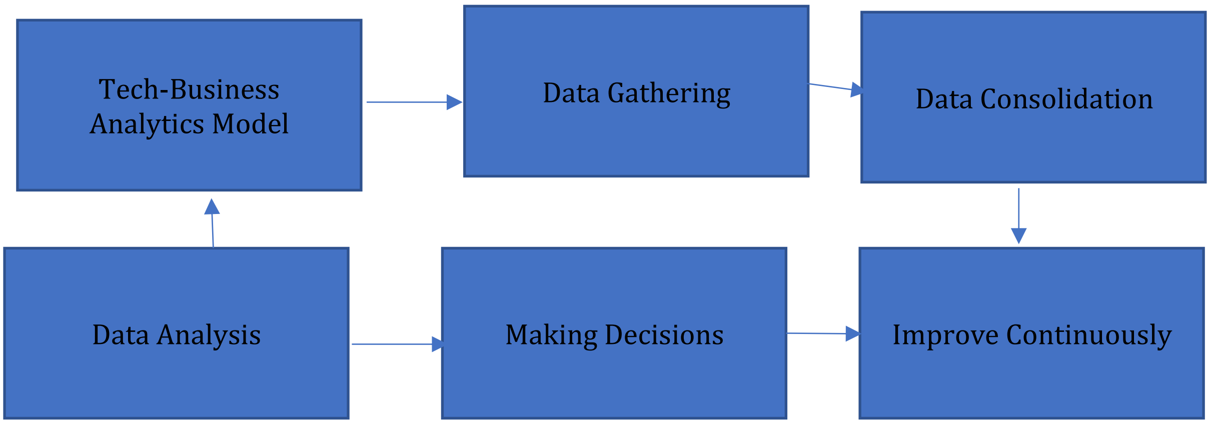

Fig. 2: Model of TBA in Secondary Industry Sector

(5) Improve continuously: To find opportunities for improvement, businesses must continuously gather and evaluate data as part of their business tech analytics process. Key performance indicators (KPIs) must be tracked to optimize performance, and processes must be modified as necessary. Therefore, the tech-business analytics paradigm in the secondary industrial sector entails gathering and interpreting data from many sources, comprehending business operations, and making wise decisions to enhance performance. This method can help businesses become more affordable, efficient, and lucrative.

8.1 Integration of BA with ICCT Underlying Technologies in Production Industry:

Integrating Business Analytics with Other ICCT Underlying Technologies in the Production Industry: Integrating Business Analytics with various ICCT underlying technologies presents a wealth of opportunities for the production industry. By leveraging data-driven insights and advanced technological tools, production processes can be optimized, efficiency can be enhanced, and decision-making can be significantly improved. Here are some of the critical opportunities that arise from this integration:

Table 14: Details of possible applications of Quantum Computing for Production Industry

S. No.	Application of Integration	Description
1	AI & Robotics in Production Efficiency	Production companies can achieve greater automation and efficiency by combining Business Analytics with AI and Robotics. AI-powered analytics can analyze vast production line datasets, identify bottlenecks, predict equipment failures, and optimize production schedules. Collaborating with Robotics can lead to autonomous

		manufacturing processes, reducing human intervention and production lead times.
2	Blockchain for Supply Chain Transparency	Integrating Business Analytics with Blockchain technology can revolutionize supply chain management in the production industry. The transparent and immutable nature of Blockchain allows for real-time tracking of raw materials, components, and finished products. Businesses can use Business Analytics to extract valuable insights from this data, enabling better inventory management, fraud prevention, and traceability of products throughout the supply chain.
3	Cloud Computing for Scalable Data Analytics	Cloud Computing offers scalable data storage and computing capabilities, making it an ideal partner for Business Analytics in the production industry. By harnessing the cloud's power, companies can analyze massive datasets in real time, enabling faster decision-making, optimizing resource allocation, and gaining deeper insights into production processes.
4	Cyber Security for Data Protection	As the production industry becomes more data-centric, cybersecurity becomes critical. Integrating Business Analytics with robust cybersecurity measures ensures that sensitive production data remains protected from cyber threats. Businesses can detect potential vulnerabilities and prevent data breaches by proactively monitoring and analyzing security logs and patterns.
5	IoT and Predictive Maintenance	Business Analytics integrated with IoT devices allows for predictive maintenance in the production industry. IoT sensors can continuously collect machine data, detecting anomalies and potential failures. Analyzing this data using Business Analytics enables companies to schedule maintenance proactively, reducing downtime and minimizing production disruptions.
6	3D Printing and Rapid Prototyping	Integrating Business Analytics with 3D printing facilitates rapid prototyping and iterative design processes. By analyzing market trends, customer feedback, and production data, businesses can identify opportunities for new product development and customization. This synergy leads to faster product launches and improved customer satisfaction.
7	Mobile Communication & Marketing Technology for Customer Engagement	Production companies can better understand customer preferences and behavior by integrating Business Analytics with mobile communication and marketing technology. Analyzing data from mobile apps, social media, and marketing campaigns enables targeted promotions and personalized customer experiences.
8	Information Storage Technology for Big Data Analytics	The production industry generates massive amounts of data daily. Companies can efficiently manage and analyze big data sets by integrating Business Analytics with advanced Information Storage Technology. This enables them to gain valuable insights into production trends, quality control, and supply chain optimization.
9	Ubiquitous Education Technology for Employee Training	Integrating Business Analytics with Ubiquitous Education Technology allows personalized and interactive employee training. Businesses can offer tailored training programs to improve workforce skills, productivity, and overall efficiency by analyzing individual learning patterns and performance.
10	Virtual & Augmented Reality for Simulation and Training	Integrating Business Analytics with Virtual and Augmented Reality enables realistic simulations of production processes and training scenarios. This immersive approach enhances employee training, reduces risks, and improves overall safety in the production environment.

11	Quantum Computing: Opportunity	Quantum Computing's immense processing power can significantly speed up complex data analysis in the production industry. Integrating Business Analytics with Quantum Computing enables manufacturers to solve optimization problems, such as supply chain logistics, with unprecedented speed and accuracy.

By harnessing the power of Business Analytics in conjunction with these ICCT underlying technologies, the production industry can achieve higher operational excellence, cost savings, and innovation, positioning itself at the forefront of the Fourth Industrial Revolution.

8.2 Integration of BA with AI & Robotics Technologies in Production Industry:

AI and robotics have many applications in the production industry, revolutionizing how businesses operate and improving efficiency, safety, and overall productivity. Here are some of the critical applications:

Table 15: Details of possible applications of AI & Robotics for Production Industry

S. No.	Application of Integration	Description
1	Automated Manufacturing Processes	AI-powered robots can perform repetitive and mundane tasks with high precision and consistency. This includes assembly, welding, material handling, painting, and packaging, leading to increased production rates and reduced errors.
2	Quality Control and Inspection	AI can be used to analyze and detect product defects during manufacturing. Computer vision systems can inspect items for flaws, ensuring only high-quality products reach the market.
3	Predictive Maintenance	AI can monitor and analyze equipment data in real time, predicting when machinery might fail or require maintenance. This enables proactive maintenance scheduling, reducing downtime and optimizing the use of resources.
4	Supply Chain Optimization	AI can analyze vast amounts of data to optimize supply chain operations. This includes demand forecasting, inventory management, and efficient logistics planning, ultimately leading to cost savings and improved delivery times.
5	Collaborative Robots (Cobots)	Cobots are designed to work alongside human workers safely. They can assist with heavy lifting, precision tasks, or potentially dangerous operations, enhancing productivity and worker safety.
6	Adaptive Manufacturing	AI can analyze data and adjust production processes in real time based on demand fluctuations, changes in raw material quality, or other external factors, enabling agile and adaptable manufacturing.
7	Warehouse Automation	AI-powered robots can automate warehouse tasks, such as order picking, packing, and inventory management. This helps streamline operations and reduce labor costs.
8	Product Customization	AI can facilitate mass customization by analyzing customer preferences and data to offer personalized products or configure manufacturing processes accordingly.
9	Process Optimization	Machine learning algorithms can optimize complex production processes, ensuring the most efficient use of resources and reducing energy consumption.
10	Human-Robot Collaboration	AI and robotics can enhance the collaboration between human workers and machines, leveraging the strengths of each to improve overall productivity and safety.
11	Waste Reduction	AI can analyze production data to identify areas where waste can be minimized, whether in raw material usage, energy consumption, or process efficiency.

12	Digital Twins	AI can create digital representations (digital twins) of physical production systems. These digital twins can be used for simulations, testing different scenarios, and optimizing production processes without disrupting the system.
13	AI-Driven Design and Innovation	AI can assist in product design by generating and evaluating multiple design options, leading to innovative and optimized products.

Thus, integrating AI and robotics in the production industry offers significant benefits, including increased efficiency, reduced costs, improved product quality, and safer working environments. These applications will become even more sophisticated and widespread as technology advances.

8.3 Integration of BA with Blockchain Technologies in Production Industry

Blockchain technology can bring several transformative applications to the production industry. Blockchain can address various challenges and streamline processes by providing a secure, decentralized, and transparent way to record and verify transactions. Here are some possible applications of blockchain technology in the production industry:

Table 16: Details of possible applications of Blockchain Technology for Production Industry

S. No.	Application of Integration	Description
1	Supply Chain Traceability	Blockchain can track and record every supply chain step, from raw material sourcing to final product distribution. This enables stakeholders to trace the origin of components, verify authenticity, and ensure compliance with quality and safety standards. It also helps to identify and rectify issues quickly, such as product recalls.
2	Provenance and Authenticity Verification	Blockchain can create an immutable record of a product's history, including details of its origin, manufacturing process, and ownership. This gives consumers confidence in the authenticity and quality of their products.
3	Smart Contracts for Automated Transactions	Smart contracts are self-executing agreements with predefined conditions. In the production industry, smart contracts can automate various processes, such as procurement, payments, and order fulfillment, reducing administrative overhead and ensuring adherence to agreed-upon terms.
4	Quality Control and Certification	Blockchain can store quality control data and certifications from different stages of the production process. This allows for easy verification of compliance with industry standards and regulations.
5	Inventory Management and Tracking	Blockchain can facilitate real-time inventory tracking, ensuring accurate and up-to-date stock levels and movement records. This helps optimize inventory management and reduce the risk of stockouts or overstocking.
6	Anti-Counterfeiting Measures	Blockchain can be used to create unique digital identities for products, making it difficult for counterfeiters to replicate or tamper with items. Consumers can verify the authenticity of products by scanning a QR code or accessing the blockchain-based record.
7	Data Sharing and Interoperability	Blockchain allows secure and permissioned data sharing among multiple stakeholders in the production ecosystem. This fosters collaboration and improves communication between suppliers, manufacturers, distributors, and customers.
8	Energy and Resource Management	Blockchain can facilitate peer-to-peer energy trading, where producers can directly sell surplus energy to consumers or other businesses, optimizing energy utilization and reducing waste.

9	Intellectual Property Protection	Blockchain can timestamp and record intellectual property rights, such as patents and designs. This provides a verifiable record of ownership and helps protect against infringement.
10	Environmental Sustainability	Blockchain can track and verify sustainable and eco-friendly practices in the production process, promoting transparency and accountability in environmental efforts.
11	Decentralized Manufacturing Marketplaces	Blockchain-powered platforms can directly connect manufacturers with suppliers and customers, enabling more efficient and cost-effective transactions without intermediaries.

Hence, blockchain technology holds immense potential for revolutionizing the production industry by enhancing transparency, security, and efficiency throughout the supply chain and production processes. As the technology matures and gains wider adoption, these applications will likely become more prevalent and impactful.

8.4 Integration of BA with Cloud Computing Technologies in Production Industry:

Cloud computing technology offers a wide range of applications and benefits for the production industry. Cloud computing can enhance efficiency, flexibility, and scalability for various production-related tasks by providing on-demand access to computing resources over the Internet. Here are some possible applications of cloud computing in the production industry:

Table 17: Details of possible applications of Cloud Computing Technology for Production Industry

S. No.	Application of Integration	Description
1	Data Storage and Backup	Cloud storage allows production companies to securely store and back up large volumes of data, including design files, production records, and customer information. This ensures data redundancy and protection against data loss due to hardware failures or disasters.
2	Collaborative Product Development	Cloud-based collaboration tools enable geographically dispersed teams to work together seamlessly. Engineers, designers, and other stakeholders can access and collaborate on the latest design iterations and share real-time feedback.
3	Resource Optimization	Cloud computing allows production companies to scale their computing resources up or down based on demand. Additional computing power can be quickly provisioned during peak production periods, and during off-peak times, resources can be scaled back to save costs.
4	Computer-Aided Manufacturing (CAM)	Cloud-based CAM tools can offer advanced machining simulations and optimization for the production process. This allows for faster and more accurate toolpath generation, reducing machining errors and improving overall efficiency.
5	Virtual Prototyping and Simulation	Cloud-based simulation platforms enable manufacturers to simulate product performance, manufacturing processes, and assembly procedures without expensive on-premises hardware. This helps in reducing physical prototyping iterations and time-to-market.
6	Industrial Internet of Things (IIoT) Integration	Cloud computing provides the infrastructure to collect, store, and analyze data from connected production equipment and sensors. This enables predictive maintenance, real-time monitoring, and process optimization.
7	Data Analytics and Business Intelligence	Cloud-based data analytics tools can help production companies gain insights from large datasets, such as production metrics, supply chain data, and customer feedback—these insights aid in making informed decisions and optimizing operations.

8	Software as a Service (SaaS) Solutions	Cloud-based SaaS applications offer a variety of production-specific software solutions, such as enterprise resource planning (ERP), customer relationship management (CRM), and product lifecycle management (PLM) systems.
9	Remote Monitoring and Control	Cloud computing allows manufacturers to monitor and control production processes and equipment remotely. This is particularly beneficial for companies with multiple production facilities or those needing real-time oversight of operations.
10	Production Line Simulation and Optimization	Cloud-based simulation platforms can model and optimize production line layouts, throughput, and efficiency, helping manufacturers identify bottlenecks and improve overall productivity.
11	On-Demand Training and Skill Development	Cloud-based learning platforms enable production industry professionals to access training materials, courses, and certifications from anywhere, facilitating continuous skill development.
12	Regulatory Compliance and Security	Cloud providers often offer robust security measures and compliance certifications, ensuring that production companies meet industry-specific regulations and protect sensitive data.

Hence, cloud computing technology empowers the production industry to leverage cutting-edge tools, streamline operations, and make data-driven decisions. It allows companies to focus on their core competencies while leaving the computing infrastructure management to specialized cloud service providers.

8.5 Integration of BA with Cyber Security Technologies in Production Industry:

Cybersecurity technology is crucial in ensuring data and systems' safety, integrity, and confidentiality within the production industry. With the increasing digitization and connectivity of industrial processes, there is a growing need for robust cybersecurity measures to protect critical infrastructure, prevent cyberattacks, and maintain operational continuity. Here are some possible applications of cybersecurity technology in the production industry:

Table 18: Details of possible applications of Cyber Security Technology for Production Industry

S. No.	Application of Integration	Description
1	Network Security	Implementing firewalls, intrusion detection and prevention systems (IDPS), and virtual private networks (VPNs) to secure the production network from unauthorized access and cyber threats.
2	Endpoint Protection	We are deploying antivirus, anti-malware, and host-based intrusion prevention software on production devices and machines to safeguard against malware and unauthorized activities.
3	Industrial Control System (ICS) Security	It is securing the control systems used in the production process, such as SCADA (Supervisory Control and Data Acquisition) systems, PLCs (Programmable Logic Controllers), and DCS (Distributed Control Systems) to prevent cyberattacks that could disrupt operations or cause physical harm.
4	Security Monitoring and Incident Response	Implementing security information and event management (SIEM) solutions to monitor network and system activities, detect potential security incidents, and respond promptly to any breaches or anomalies.
5	Data Protection	They encrypt sensitive data in transit and at rest to prevent unauthorized access and breaches, ensuring that production-related data remains confidential and integral.

6	Access Control	We are implementing strong authentication and authorization mechanisms to control access to critical production systems and data, limiting privileges to only authorized personnel.
7	Security Awareness Training	We are conducting regular cybersecurity training for production industry staff to raise awareness about potential threats, social engineering attacks, and safe online practices.
8	Patch Management	We keep production systems and software up-to-date with the latest security patches to address known vulnerabilities and reduce the attack surface.
9	Secure Software Development	You follow secure coding practices and conduct security testing while developing production-related applications to prevent vulnerabilities.
10	Physical Security Integration	It integrates cybersecurity measures with physical security protocols to protect production facilities from unauthorized physical access that could lead to cyber breaches.
11	Supply Chain Security	They ensure that third-party vendors and suppliers adhere to robust cybersecurity standards to prevent supply chain attacks and protect the production process from external threats.
12	Incident Response Planning	Developing comprehensive incident response plans to handle cybersecurity incidents effectively, minimize potential damages, and recover operations quickly.
13	Security Audits and Compliance	We conduct regular security audits to identify vulnerabilities and ensure compliance with industry regulations and cybersecurity standards.
14	Threat Intelligence Sharing	We collaborate with other production industry stakeholders, government agencies, and cybersecurity communities to share threat intelligence and stay informed about emerging cyber threats.

By integrating these cybersecurity technologies and practices into the production industry, organizations can significantly reduce the risk of cyberattacks, protect critical assets, and maintain smooth and secure operations.

8.6 Integration of BA with Internet of Things (IoT) Technologies in Production Industry:

The Internet of Things (IoT) technology has the potential to revolutionize the production industry by connecting devices, machines, and sensors to the Internet, enabling data exchange, automation, and improved efficiency. Here are some possible applications of IoT technology in the production industry:

Table 19: Details of possible applications of Internet of Things (IoT) Technology for Production Industry

S. No.	Application of Integration	Description
1	Predictive Maintenance	IoT sensors can be deployed in production machinery and equipment to monitor their health in real time. By analyzing data on factors like temperature, vibration, and usage, predictive maintenance algorithms can predict when equipment is likely to fail. This allows proactive maintenance, reducing downtime and preventing costly breakdowns.
2	Asset Tracking and Management	IoT devices can be attached to assets, such as raw materials, finished goods, or equipment, to track their location and monitor their condition. This improves supply chain visibility, reduces inventory losses, and optimizes asset utilization.
3	Inventory Management	IoT technology can automate inventory tracking, enabling real-time updates on stock levels. This data can be integrated with production

		schedules, ensuring materials are available when needed and minimizing stockouts or overstocking.
4	Quality Control	IoT sensors can be employed in production to monitor and measure product quality parameters continuously. This data can be used for real-time quality control, ensuring products meet specified standards and reducing defects.
5	Energy Management	IoT-enabled intelligent meters and sensors can monitor energy consumption in the production facility. This data can be analyzed to identify areas of high energy usage and optimize energy efficiency, leading to cost savings and reduced environmental impact.
6	Remote Monitoring and Control	IoT allows production managers to monitor and control production processes and equipment remotely. This capability is particularly beneficial for managing multiple production sites or for limited on-site presence.
7	Workforce Safety	Wearable IoT devices can be used to monitor the health and safety of workers in hazardous production environments. These devices can detect and alert supervisors in case of potential accidents or unsafe conditions.
8	Supply Chain Optimization	IoT technology can improve supply chain visibility by tracking the movement of goods in real time. This data can help identify bottlenecks, optimize transportation routes, and improve supply chain efficiency.
9	Process Automation	IoT-enabled devices can automate routine tasks in the production process, streamlining operations and reducing the need for manual intervention.
10	Data Analytics and Optimization	IoT generates vast amounts of data, which can be analyzed using advanced analytics to gain insights into production processes. This data-driven approach enables continuous improvement and optimization of production operations.
11	Environmental Monitoring	IoT sensors can be deployed to monitor environmental factors such as temperature, humidity, and air quality within the production facility. This data can help ensure compliance with environmental regulations and create a safer and healthier work environment.
12	Product Personalization	IoT technology allows manufacturers to gather data on customer preferences and usage patterns, enabling the production of personalized products tailored to individual needs.

By embracing IoT technology, the production industry can enhance operational efficiency, reduce costs, improve product quality, and create new opportunities for innovation and growth. However, it's essential to implement robust cybersecurity measures to protect IoT devices and data from potential cyber threats.

8.7 Integration of BA with 3D Printing Technologies in Production Industry:

3D printing, also known as additive manufacturing, is a transformative technology that has the potential to revolutionize the production industry. It allows the creation of three-dimensional objects by adding material layer by layer, providing several benefits such as design flexibility, cost-effectiveness, reduced waste, and faster production. Here are some possible applications of 3D printing technology in the production industry:

Table 20: Details of possible applications of 3D Printing Technology for Production Industry

S. No.	Application of Integration	Description
1	Rapid Prototyping	3D printing enables quick and cost-effective prototyping of new products. Designers and engineers can create physical prototypes

		to test and validate their ideas before moving on to traditional manufacturing processes.
2	Customization and Personalization	3D printing allows for the production of highly customized and personalized products. Manufacturers can tailor products to meet specific customer requirements and preferences without incurring high setup costs.
3	Tooling and Fixtures	3D printing creates jigs, fixtures, and tooling for assembly and production processes. These custom tools enhance precision, reduce production time, and improve manufacturing workflow.
4	Spare Parts Manufacturing	With 3D printing, obsolete or hard-to-find spare parts can be produced on demand, reducing the need for extensive inventory storage and ensuring ongoing maintenance and repairs.
5	Lightweight and Complex Designs	3D printing allows for the creating of intricate and lightweight designs that are difficult or impossible to achieve using traditional manufacturing methods. This is especially valuable in the aerospace, automotive, and medical industries.
6	Low-Volume Production	3D printing is well-suited for low-volume production runs, eliminating the need for expensive molds or tooling. It is particularly beneficial for niche or custom products.
7	Bioprinting	3D printing technology creates tissues, implants, and organs in the medical and pharmaceutical industries. Bioprinting holds promise for personalized medicine and regenerative therapies.
8	Construction and Architecture	Large-scale 3D printers are being developed to construct buildings and architectural structures. This method can significantly reduce construction time and costs.
9	Food Printing	3D printers can create intricate designs with food materials, allowing chefs and manufacturers to experiment with unique presentations and personalized nutrition.
10	Jewelry and Fashion	3D printing creates intricate and customizable jewelry designs, fashion accessories, and even clothing with unique textures and patterns.
11	Education and Training	3D printing is becoming increasingly prevalent in educational settings, allowing students to bring their ideas to life and gain practical experience in product design and manufacturing.
12	Entertainment and Gaming	In the entertainment industry, 3D printing produces action figures, collectibles, and props for movies and video games.
13	Art and Sculpture	Artists and sculptors use 3D printing to bring their creative visions to life, allowing for the production of complex and unique artworks.

Thus, 3D printing technology offers numerous opportunities for innovation and creativity in the production industry, leading to more efficient and customized manufacturing processes across various sectors. As technology advances, it is likely to find even more diverse and ground-breaking applications in the future.

8.8 Integration of BA with Mobile Communication & Marketing Technologies in Production Industry:

Mobile communication and marketing technology can significantly benefit the production industry by improving communication, enhancing marketing efforts, optimizing processes, and increasing efficiency. Here are some possible applications of mobile communication and marketing technology in the production industry:

Table 21: Details of possible applications of Mobile Communication & Marketing Technology for Production Industry

S. No.	Application of Integration	Description
1	Mobile Collaboration	Production teams can use mobile communication apps to facilitate real-time communication and collaboration among team members. They can share updates, discuss production issues, and coordinate tasks, regardless of their physical location.
2	Remote Monitoring and Control	Mobile applications can be developed to monitor and control production processes remotely. This allows production managers to stay informed about the status of operations and make adjustments as needed, even when not on-site.
3	Mobile Dashboards and Reporting	Production managers can access real-time production data and performance metrics through mobile dashboards. These mobile analytics tools enable quick decision-making and provide insights into operational efficiency.
4	Inventory Management	Mobile apps can assist production teams in managing inventory levels, tracking stock movement, and issuing purchase orders. This helps ensure that materials are available when needed, reducing production delays.
5	Maintenance and Repairs	Mobile apps can streamline maintenance tasks by providing technicians with maintenance schedules, access to equipment manuals, and the ability to report issues and order replacement parts directly from their mobile devices.
6	Employee Training and Safety	Mobile communication technology can be used for employee training and safety programs. Employees can access training materials and safety guidelines on their mobile devices, improving knowledge retention and compliance.
7	Customer Support	Mobile communication technology enables production companies to provide timely and personalized customer support through messaging apps, chatbots, or dedicated customer support apps.
8	Marketing and Sales	Mobile marketing technology allows production companies to reach potential customers through targeted mobile advertising, SMS marketing, and mobile-friendly websites. It can also facilitate customer engagement through mobile apps and loyalty programs.
9	Field Sales Support	Mobile apps equipped with product catalogs, pricing information, and customer data can support sales representatives in the field, enabling them to provide accurate and up-to-date information to customers.
10	Augmented Reality (AR) and Virtual Reality (VR)	AR and VR technologies integrated into mobile apps can enhance production processes by providing interactive training, design visualization, and virtual walkthroughs of production facilities.
11	QR Code and NFC Technology	QR codes and near-field communication (NFC) tags can track and identify products throughout the production and supply chain process, providing valuable information to stakeholders.
12	Mobile Payments	Production companies can offer mobile payment options to streamline transactions, mainly when selling directly to end consumers.

By leveraging mobile communication and marketing technology, production companies can optimize their operations, improve customer engagement, and stay competitive in a rapidly evolving market. However, it's essential to prioritize data security and privacy when implementing these technologies to protect sensitive production-related information.

8.9 Integration of BA with Information Storage Technologies in Production Industry:

Information storage technology plays a crucial role in the production industry by efficiently managing, securing, and accessing vast amounts of data generated during production. Here are some possible applications of information storage technology in the production industry:

Table 22: Details of possible applications of Information Storage Technology for Production Industry

S. No.	Application of Integration	Description
1	Database Management	Information storage systems, such as relational databases, NoSQL databases, and data warehouses, store structured and unstructured data related to production processes, inventory, quality control, customer information, and more.
2	Historical Data Storage	Production companies often need to store historical data, including past production runs, quality metrics, and maintenance records. This data can be valuable for trend analysis, process optimization, and compliance.
3	Cloud Storage	Cloud-based storage solutions provide scalable and cost-effective options for storing production-related data, making it accessible from anywhere with an internet connection. Cloud storage also facilitates data backup and disaster recovery strategies.
4	Product Lifecycle Management (PLM)	PLM systems store and manage all product-related information, including design data, specifications, revisions, and change history. This ensures effective collaboration among design, engineering, and manufacturing teams.
5	Enterprise Resource Planning (ERP):	ERP systems serve as centralized databases for production-related information, integrating data from departments like sales, inventory, manufacturing, and finance.
6	Document Management	Information storage technology manages work instructions, standard operating procedures (SOPs), compliance documents, and safety protocols.
7	Sensor Data Storage	Production processes often involve using sensors and Internet of Things (IoT) devices to collect data. Information storage systems manage and analyze the data generated by these devices.
8	Supply Chain Management	Information storage technology is employed to manage data related to suppliers, procurement, logistics, and distribution, optimizing supply chain efficiency and reducing lead times.
9	Quality Assurance	Production companies store data related to quality inspections, non-conformance reports, corrective actions, and audits to maintain and improve product quality and compliance.
10	Big Data Analytics	Advanced information storage technologies and big data analytics allow production companies to process and analyze large datasets to gain insights into production performance, identify inefficiencies, and make data-driven decisions.
11	Simulation and Modeling	Complex simulations and models are used for design validation and process optimization in production industries like automotive or aerospace. Information storage technology is crucial in storing and retrieving these simulation results.
12	Intellectual Property Protection	Information storage systems help protect sensitive intellectual property and trade secrets related to new product designs and manufacturing processes.
13	Digital Twins	Information storage technology stores data from digital twin models, representing virtual replicas of physical assets. Digital twins facilitate predictive maintenance, performance monitoring, and optimization of production equipment.

8.10 Integration of BA with Ubiquitous Education Technologies in Production Industry:

Ubiquitous Education Technology integrates technology into various aspects of education, making learning accessible anytime and anywhere. When applied to the production industry, it can have several significant benefits. Here are some possible applications of Ubiquitous Education Technology for the production industry:

Table 23: Details of possible applications of Ubiquitous Education Technology for Production Industry

S. No.	Application of Integration	Description
1	Training and Skill Development	Ubiquitous Education Technology can provide employees with continuous training and skill development. Mobile learning applications, virtual reality (VR), and augmented reality (AR) simulations can offer hands-on training in a safe and controlled environment. This approach can be beneficial for training employees in operating complex machinery, ensuring safety protocols, and mastering new production techniques.
2	Performance Support	Employees can access real-time information, production guidelines, troubleshooting assistance, and best practices through mobile apps or wearable devices. This immediate resource access can enhance their problem-solving abilities and minimize downtime, increasing productivity.
3	Remote Learning	Ubiquitous Education Technology enables employees in the production industry to access learning materials and participate in training sessions remotely. Online courses, webinars, and virtual workshops can update employees on the latest industry trends, technologies, and regulations, even if they are not physically present at the production facility.
4	Data Visualization and Analytics	Technology can assist in presenting complex production data in a user-friendly and visual format. Interactive dashboards, data analytics tools, and performance tracking systems can help employees and managers monitor production metrics, identify trends, and make data-driven decisions to optimize processes.
5	Collaboration and Communication	Collaboration platforms and communication tools can be integrated to facilitate knowledge sharing and communication among production teams. Employees from different locations can collaborate in real time, share experiences, and exchange best practices, fostering a culture of continuous improvement.
6	Quality Control and Inspection	Ubiquitous Education Technology can improve quality control and inspection by leveraging AI-driven image recognition, IoT devices, and sensors. These technologies can help identify defects, ensure adherence to quality standards, and streamline the inspection process.
7	Onboarding and New Employee Training	When new employees join the production industry, ubiquitous education technology can provide comprehensive onboarding materials and training resources. This can accelerate their integration into the company and ensure they have the necessary knowledge to contribute effectively.
8	Continuous Learning and Upskilling	Through microlearning modules, gamification, and personalized learning pathways, employees can engage in continuous learning and upskilling. This approach empowers them to acquire new skills and adapt to changing production processes and technologies.
9	Safety Training	Safety is of utmost importance in the production industry. Ubiquitous Education Technology can deliver interactive safety training modules, conduct virtual safety drills, and reinforce

		safety protocols to ensure a safe working environment for all employees.
10	Performance Assessment and Feedback	Technology-driven assessments and feedback mechanisms can be used to evaluate employee performance. Managers can provide timely feedback, identify areas for improvement, and recognize exemplary performance, fostering a culture of accountability and motivation.

By leveraging Ubiquitous Education Technology in these ways, the production industry can enhance workforce capabilities, improve production efficiency, and adapt to the market's ever-changing demands.

8.11 Integration of BA with Virtual & Augmented Reality Technologies in Production Industry:

Virtual and Augmented Reality (VR/AR) technologies offer exciting possibilities for the production industry, revolutionizing various processes and enhancing overall efficiency. Here are some possible applications of VR/AR technology for the production industry:

Table 24: Details of possible applications of Virtual & Augmented Reality Technology for Production Industry

S. No.	Application of Integration	Description
1	Design and Prototyping	VR/AR can create immersive 3D models of products, machinery, and production layouts. Engineers and designers can visualize and interact with these virtual prototypes, enabling them to identify design flaws, make improvements, and optimize production processes before physical production begins.
2	Training and Simulation	VR/AR can provide realistic and safe training environments for employees to learn how to operate complex machinery and equipment. Workers can practice assembling, operating, and troubleshooting machinery in a virtual setting, reducing the risk of accidents and increasing their confidence and competence.
3	Remote Collaboration	VR/AR facilitates remote collaboration among production teams, suppliers, and experts from different locations. Participants can hold virtual meetings, visualize products or production processes, and make real-time decisions, saving time and travel costs.
4	Maintenance and Repair	AR technology can overlay digital information onto physical machinery or equipment, providing maintenance personnel with real-time instructions, schematics, and diagnostic data. This hands-free access to information can streamline maintenance and repair tasks, reducing downtime and increasing equipment uptime.
5	Quality Control and Inspection	AR can be used for real-time quality control and inspection. Workers equipped with AR headsets or intelligent glasses can compare physical products with digital models, identify defects, and ensure quality standards compliance.
6	Assembly Assistance	VR/AR can guide workers step-by-step during the assembly process. Digital instructions can be superimposed on physical parts, guiding workers through the correct assembly sequence and reducing the likelihood of errors.
7	Inventory Management	AR can help optimize inventory management by providing real-time information about stock levels, locations, and reordering points. Warehouse staff can visualize inventory data overlaid onto physical shelves, simplifying the picking and restocking processes.

8	Safety Training and Hazard Identification	VR/AR can simulate hazardous situations, enabling workers to undergo safety training in a controlled environment. Employees can learn to respond to emergencies, identify potential hazards, and practice safety procedures without risking their well-being.
9	Remote Support and Troubleshooting	AR can enable experts to provide remote support to on-site technicians. Using AR-enabled devices, on-site personnel can share a live video feed of the problem, and experts can annotate the video with instructions and guidance in real-time.
10	Data Visualization	VR/AR can display real-time production data and analytics visually compellingly. Managers can explore data in 3D, identifying trends, patterns, and areas for improvement more intuitively.

These VR/AR technology applications in the production industry can lead to increased productivity, reduced errors, improved safety, and enhanced collaboration among teams. As the technology evolves, its potential impact on the industry will grow even further.

8.12 Integration of BA with Quantum Computing Technologies in Production Industry:

Quantum computing technology is still in its early stages of development, but its potential applications in the production industry are vast and promising. Quantum computing relies on the principles of quantum mechanics to perform complex calculations and solve problems beyond classical computers' capabilities. Here are some possible applications of quantum computing technology for the production industry:

Table 25: Details of possible applications of Quantum Computing Technology for Production Industry

S. No.	Application of Integration	Description
1	Optimization of Supply Chain	Quantum computing can optimize supply chain operations by efficiently solving complex logistical problems. It can help determine the most cost-effective routes for transportation, minimize inventory carrying costs, and optimize production schedules to meet demand while minimizing costs.
2	Materials and Chemical Simulation	Quantum computing can simulate the behavior of materials and chemicals at the quantum level, leading to the discovery of new materials with unique properties or more efficient chemical processes. This could lead to advancements in manufacturing and production processes.
3	Drug Discovery and Development	Quantum computing can significantly speed up the drug discovery process by simulating molecular interactions and accurately predicting the effectiveness of potential drug compounds. This could lead to the developing of new and more effective pharmaceuticals for various medical conditions.
4	Process Optimization	Quantum computing can analyze vast amounts of data from production processes and supply chains to optimize various parameters. It can help identify the most efficient production processes, reduce waste, and improve productivity.
5	Cryptography and Data Security	Quantum computing has implications for data security. Quantum-resistant cryptography can be implemented to protect sensitive production and business data from potential threats posed by future quantum computers.
6	Computational Fluid Dynamics (CFD)	Quantum computing can enhance CFD simulations used in industries like aerospace and automotive. It can enable more accurate modeling and analysis of fluid flows, leading to better designs and improved efficiency.

7	Machine Learning and AI	Quantum computing can accelerate machine learning algorithms, enabling more advanced pattern recognition and optimization capabilities. This could be applied to the production industry's predictive maintenance, quality control, and demand forecasting.
8	Energy Optimization	Quantum computing can optimize energy consumption in production facilities, helping to reduce operational costs and environmental impact. It can analyze energy consumption patterns and suggest improvements to increase efficiency.
9	Portfolio Optimization	For manufacturing companies with diverse investments, quantum computing can optimize investment portfolios, ensuring the most efficient allocation of resources and maximizing returns.

It's essential to note that quantum computing technology is still in its early stages, and the practical applications mentioned above are mainly theoretical. The development of quantum computing is a complex and ongoing process, and it may take time before these applications become mainstream in the production industry. Quantum computing has immense potential to revolutionize various production and manufacturing processes.

9. ABCD ANALYSIS FRAMEWORK ON TECH-BUSINESS ANALYTICS IN SECONDARY INDUSTRY SECTOR FROM STAKEHOLDERS POINT OF VIEW :

9.1 ABCD ANALYSIS OF TBA AS FROM SUPPLIER POINT OF VIEW:

9.1.1 Advantages:

The TBA in the secondary industrial sector has a number of benefits:

Table 26: Advantages of TBA as stakeholder as supplier

S. No.	Aspects	Description
1.	Enhanced judgement	Business analytics powered by technology can give decision-makers insights into critical organizational data to help them make informed decisions.
2.	Efficiency gain	Tech-driven business analytics can help organizations identify operational inefficiencies to make the necessary modifications to increase productivity and reduce waste.
3.	More stringent quality assurance	Using tech-driven business analytics, organizations may monitor quality control systems and identify areas for improvement. Businesses can use this to ensure that their products are high caliber and conform to legal requirements, increasing consumer satisfaction.
4.	Improved inventory management	Business analytics powered by technology can aid organizations in managing inventories more effectively by providing real-time information on stock levels, demand patterns, and production capacity.
5.	Better supply chain management	Businesses can optimize their supply chains with tech-driven business analytics, ensuring that the right products and resources are always available when needed. Analyzing information on supplier performance, transportation costs, and other factors allow businesses to identify places where their supply chains can be streamlined and costs reduced.

To help businesses in the secondary industrial sector operate more effectively, reduce expenses, and improve the quality of their output, tech-driven business analytics is becoming increasingly popular. Businesses may use data to gain a competitive edge and position themselves for long-term success.

9.1.2 Benefits:

There are several ways that the secondary industrial sector might profit from using tech-driven business analytics.

Table 27: Benefits of TBA as stakeholder as supplier

S. No.	Aspects	Description
1.	Boosted profitability	By using tech-driven business analytics, businesses can find opportunities to cut expenses and streamline operations, which will enhance profitability.
2.	Customer happiness	The application of tech-driven business analytics has aided in this and may help organizations better understand the needs and preferences of their clients.
3.	Gaining a competitive edge	Businesses can compete in the market if they utilize data to the fullest extent possible. By using tech-driven business analytics to automate processes, reduce costs, and enhance product quality, businesses can become market leaders, attracting new customers and retaining those they already have.
4.	Efficiency gain	Technology-driven business analytics can help businesses reduce waste, increase efficiency, and streamline operations. Businesses may identify inefficiencies and make the necessary adjustments to boost productivity and save costs by accessing data on manufacturing processes, resource utilization, and supply chain management.
5.	Real-time insights	Businesses may receive real-time insights on their processes using tech-driven business analytics, enabling them to take prompt, logical action. With dashboards and data visualization tools, businesses can monitor key metrics and see trends in real-time, allowing them to make adjustments as needed.

9.1.3 Constraints:

Although there are many benefits to integrating tech-driven business analytics in the secondary industrial sector, organizations could encounter specific difficulties. Here are a few examples:

Table 28: Constraints of TBA as stakeholder as supplier

S. No.	Aspects	Description
1.	Data reliability and accessibility	If the data is faulty, incorrect, or outdated, its conclusions could not be trustworthy. Some businesses may not have access to the necessary data because of data silos or privacy issues.
2.	Cost	The price of continuous upkeep and training may also increase with time.
3.	Technical knowledge	Another hurdle for businesses may be a need for more technological expertise.
4.	Opposition to change	To present processes and workflows may be necessary to implement tech-driven business analytics. For some employees who may be wary of these changes, further training may be necessary to use new tools and technology.
5.	Adaptation to current systems	Incorporating new analytics tools with an organization's current infrastructure might also provide challenges.

Therefore, even though tech-driven business analytics have many benefits for the secondary industrial sector, companies must consider potential drawbacks and challenges while implementing these solutions.

9.1.4 Drawbacks:

The secondary industrial sector's use of tech-driven business analytics has several drawbacks:

Table 29: Drawbacks of TBA as stakeholder as supplier

S. No.	Aspects	Description
1.	Reliance on data too much	Even though data can provide insightful information, a firm reliance on it may lead to a limited focus on quantitative measurements at the expense of other essential factors. Businesses must not recognize qualitative data since it can provide valuable insights into the human aspect of their operations. Employee feedback and customer reviews are two examples of such data.
2.	Security and privacy issues	When handling sensitive data, tech-driven business analytics might raise security and privacy concerns. Businesses must ensure they abide by all applicable data protection rules and regulations and have robust security measures in place to avoid data breaches.
3.	Complexity	It can be challenging and time-consuming to put tech-driven business analytics into practice. Businesses may need to spend money on new software, equipment, and specific skills to handle and evaluate data efficiently.
4.	Data bias	Analytics models can only produce results as accurate as the data they are based on. Data biases can produce inaccurate results. Businesses must use varied and representative data sets to avoid reinforcing existing stereotypes or creating new ones.
5.	Resistance to change	Tech-driven business analytics implementation may require significant changes to present processes and workflows. Some employees might have differing views on these changes or want further training to get used to cutting-edge tools and technologies.

Thus, even while tech-driven business analytics can provide beneficial information for businesses in the secondary industrial sector, several drawbacks must be considered.

9.2 ABCD ANALYSIS OF TBA AS PRODUCER POINT OF VIEW :

9.2.1 Advantages:

Being a producer offers numerous benefits to a stakeholder in tech business analytics (TBA). Several advantages are listed below:

Table 30: Advantages of TBA as stakeholder as producer

S. No.	Aspects	Description
1.	Insights and Decision-Making	As a TBA producer, you have access to a wealth of data and analytical tools that can offer insightful analysis of many business-related topics. You can utilize these insights to make knowledgeable decisions, streamline operations, spot patterns, and create growth and profitability strategies.
2.	Competitive Advantage	TBA producers can use data and analytics to obtain a competitive edge in the market. You can find patterns and trends to help you remain ahead of the competition by applying advanced analytics approaches, such as predictive modeling or machine learning algorithms.
3.	Improved Operational Efficiency	TBA can aid in streamlining processes and enhancing effectiveness across numerous company functions. You can pinpoint areas for improvement, better allocate resources, and cut costs by analyzing data on supply chains, inventory management, consumer behavior, or production processes.
4.	Targeted Marketing and Personalization	TBA makes it easier for you to comprehend demographics, consumer behavior, and preferences. You can better serve customers by customizing product offerings and marketing activities using this information. This focused strategy can result in increased customer happiness, greater brand loyalty, and higher sales and revenue.

5.	Risk Management and Fraud Detection	Utilizing real-time and historical data analysis, TBA enables you to spot possible dangers and catch fraudulent activity. You may proactively reduce risks, stop fraud, and guarantee regulatory compliance by utilizing anomaly detection methods and predictive analytics.
6.	Innovation and New Opportunities	The manufacturers of TBA are in an excellent position to recognize future markets, new trends, and innovative prospects. You can spot market gaps and create cutting-edge goods or services to fill those demands by analyzing data from multiple sources, including client feedback, market trends, and competition intelligence.
7.	Data-Driven Culture	A data-driven culture is promoted within an organization by being a TBA producer. This supports a systematic method of problem-solving and encourages evidence-based decision-making. Additionally, it encourages cooperation and knowledge exchange throughout the entire organization and aids in dismantling departmental silos.

Hence, you may use data and analytics as a producer and stakeholder in tech business analytics to guide strategic decision-making, boost operational effectiveness, acquire a competitive edge, and open up fresh possibilities for expansion and innovation.

9.2.2 Benefits:
It can benefit from several things as a producer and stakeholder in the field of tech business analytics (TBA):

Table 31: Benefits of TBA as stakeholder as producer

S. No.	Aspects	Description
1.	Enhanced Decision-Making	TBA offers you helpful information and insights to aid in decision-making. Making data-driven decisions reduces guesswork and increases the likelihood of good results by analyzing data and utilizing modern analytical tools.
2.	Competitive Advantage	It may allow obtaining a market advantage by using TBA. Using analytics, this can learn about client preferences, market trends, and rival plans. This may create unique items, create custom marketing strategies, and enhance overall business performance with the use of this information.
3,	Operational Efficiency	TBA makes business processes more efficient. It may locate bottlenecks, streamline procedures, and increase effectiveness by analyzing workflows, processes, and resource allocation data. As a result, expenses are reduced, productivity rises, and resources are used more effectively.
4.	Customer Insights and Personalization	TBA helps you better comprehend your customers. Analyzing their data may help you learn more about your customers' tastes, wants, and behavior. This information enables you to tailor marketing initiatives, develop targeted campaigns, and provide individualized experiences, improving client happiness and loyalty.
5.	Risk Management	TBA aids in risk identification and reduction. It can spot possible hazards, anticipate market changes, and take proactive measures to mitigate them by looking at past data and using predictive modeling. Your ability to manage risk is improved, as is your company's resilience.
6.	Improved Product Development	By offering knowledge about consumer preferences and market expectations, TBA helps with product creation. It can find chances for product innovation and enhancement by examining information

		on consumer feedback, product usage patterns, and market trends. Products that better satisfy consumer demands and preferences are subsequently developed.
7.	Business Growth and Revenue Generation	TBA can assist in boosting sales and business expansion. Effective growth strategies may be created by seeing market opportunities, streamlining processes, and utilizing customer data. It can use TBA to find underserved market niches, grow your clientele, and generate more money.
8.	Efficient Resource Allocation	Using TBA may allocate your resources. This may optimize resource allocation and ensure that resources are distributed to places where they provide the maximum value by analyzing data on resource utilization, demand patterns, and market dynamics. Saving money and managing resources more effectively result from this.
9.	Continuous Improvement	TBA encourages an environment of constant development inside the business. It may pinpoint areas for development, establish benchmarks, and measure advancement over time by routinely monitoring and analyzing performance indicators. This supports organizational learning and encourages an innovative and efficient culture.

Hence, as a stakeholder and producer in tech business analytics, it can gain advantages like improved decision-making, competitive advantage, operational efficiency, customer insights, risk management, business growth, and continuous improvement. In today's data-driven world, TBA equips you to use data and analytics to create corporate success.

9.2.3 Constraints:

Tech Business Analytics (TBA) has many benefits but has several limitations that stakeholders may encounter as creators. These typical restrictions should be taken into account:

Table 32: Constraints of TBA as stakeholder as producer

S. No.	Aspects	Description
1.	Data Quality and Availability	The availability and caliber of the data are crucial to TBA. Accessing pertinent and trustworthy data may provide difficulties for stakeholders. Data may impact analytics efforts' accuracy and efficacy.
2.	Security and Privacy of Data	This must manage delicate and private data as a TBA producer. To safeguard client information and adhere to rules, it is essential to guarantee data privacy and security. For stakeholders, managing data privacy issues, establishing strong security measures, and dealing with data breaches are constant difficulties.
3.	Technical Expertise and Resources	TBA needs qualified personnel with data analytics, statistics, and programming knowledge. Finding and keeping top talent can be challenging because there is a need for more qualified specialists. For some stakeholders, investing in the hardware, software, and other resources required for data analytics can also be expensive.
4.	Complexity and Interpretation	TBA uses sophisticated statistical models, machine learning methods, and complex algorithms. It could be challenging to interpret and comprehend the conclusions of these evaluations. Stakeholders must possess the knowledge and skills necessary to interpret the analysis results and turn them into insights that can be used.
5.	Change Management and	Changes to organizational procedures, structures, and cultures are frequently needed to implement TBA projects. Successful TBA implementation may be hindered by resistance to change, a lack of

	Organizational Alignment	stakeholder support, and difficulties coordinating organizational goals with analytics objectives.
6.	Ethical Considerations	TBA raises moral questions about data use, privacy, and bias. Stakeholders must deal with problems, including guaranteeing algorithmic decision-making is fair, preventing unintentional discrimination, and resolving potential biases in data gathering and analysis.
7.	Integration and Data Silos	The seamless data integration for analytics is hampered in many organizations by fragmented technologies and data silos. Stakeholders hoping to use TBA effectively may need more support to solve these integration problems and build a single data architecture.
8.	Scalability and Agility	Stakeholders find scalability a constraint as data volume and complexity increase quickly. Careful planning and resource allocation are necessary so TBA programs can manage growing data quantities and react to changing business needs.
9.	Legal and Regulatory Compliance	Stakeholders in TBA are subject to several legal and regulatory obligations around data security, privacy, and protection. Maintaining awareness of evolving legislation and ensuring compliance can be a considerable challenge, particularly in highly regulated businesses.
10.	Cultural Adoption and Change	The organization may need a cultural shift to implement TBA, where data-driven decision-making becomes the norm. Getting stakeholders to adopt analytics, improve their data literacy, and alter the way they make decisions might be difficult.

Despite these limitations, businesses can work to overcome them by investing in data governance, hiring skilled workers, adopting clear data policies, and promoting a data-driven culture. Stakeholders must overcome certain obstacles to utilize TBA and produce good results fully.

9.2.4 Drawbacks

There are many advantages to tech business analytics (TBA), but stakeholders may run into potential drawbacks and difficulties as producers. Consider these negative aspects:

Table 33: Drawbacks of TBA as stakeholder as producer

S. No.	Aspects	Description
1.	Overreliance on Data	TBA places a strong emphasis on data-driven decision-making, which could result in excessive dependence on statistics and a disregard for qualitative considerations like intuition and experience. There is a chance of ignoring crucial contextual data that cannot be obtained by data analysis alone.
2.	False Interpretation of Data	TBA strongly emphasizes data-driven decision-making, which could result in excessive dependence on statistics and a disregard for qualitative considerations like intuition and experience. There is a chance of ignoring crucial contextual data that cannot be obtained by data analysis alone.
3.	Data Bias and Inaccuracies	The accuracy of TBA results can be affected by biases and mistakes in the data utilized for analysis. To produce biased results and poor decision-making, data may reflect historical biases, inadequate information, or sampling errors. To address biases in data sources and analysis techniques, stakeholders must be careful.
4.	Implementation Challenges	TBA projects might be challenging to implement when integrating analytics tools into current company processes and systems. There must be extensive planning, coordination, and change management

		initiatives to embrace and implement the change across the organization successfully.
5.	Cost and Resource Intensiveness	TBA projects can be labor- and resource-intensive, necessitating substantial expenditures on IT infrastructure, analytical tools, and qualified employees. Particularly for smaller organizations with tighter resources, the expenses associated with data storage, processing, and analysis can be significant.
6.	Complexity and Technical Expertise	TBA uses sophisticated analytical methods, complicated algorithms, and statistical modeling. With the required technical know-how, stakeholders could successfully comprehend and use these strategies. Hiring and retaining qualified data scientists and analysts can take time and effort.
7.	Time Constraints and Timeliness of Insights	TBA procedures can take a while, especially when working with data. Finding insights into data and communicating them quickly can be difficult, especially when decision-making speed is crucial. Stakeholders must balance the urgency of decision-making and the requirement for thorough analysis.
8.	Resistance to Change	Employees who are hesitant to use TBA because they are averse to analytics or worried about how it will affect their jobs may be the ones to object. Change aversion can inhibit adoption, restrict the use of analytics capabilities, and prevent the integration of TBA into organizational procedures.
9.	Privacy and Ethical Concerns	Managing such a large amount of data by TBA raises security, privacy, and morality issues. Stakeholders must understand privacy laws, deal with possible biases in data, and guarantee that data is used ethically in analytical procedures.
10.	Constant Technological Advancements	New methods, devices, and technological advancements are often made in TBA, which is continually changing. To fully utilize TBA, stakeholders must keep up with recent developments and trends. Outdated analytics techniques could stem from a failure to keep up with technological advancements.

Stakeholders must be aware of these shortcomings and take proactive measures to overcome them through solid data governance, continual training and skill development, meticulous validation of outcomes, and ethical concerns. By controlling these difficulties, stakeholders can maximize TBA's advantages while reducing potential negatives.

9.3 ABCD ANALYSIS OF TBA FROM CONSUMER POINT OF VIEW :

9.3.1 Advantages:

There are various benefits this can enjoy as a stakeholder and user of tech business analytics (TBA).

Table 34: Advantages of TBA as stakeholder as consumer

S. No.	Aspects	Description
1.	Improved Decision-Making	TBA gives you, as a customer, the power to decide more wisely. You better understand your company's operations, market dynamics, customer behavior, and industry trends by utilizing analytics-driven insights and reports. Due to this knowledge, its decisions will be data-driven and in line with your company's goals.
2.	Competitive Intelligence	TBA offers you practical competitive intelligence. You can learn more about your industry's landscape and spot opportunities for differentiation by examining market statistics, customer trends, and competition plans. With the help of this intelligence, you may stay one step ahead of the competition and take calculated risks to seize business chances.

3.	Enhanced Customer Understanding	It can better comprehend your consumers, thanks to TBA. This may help you learn more about your customers' requirements, wants, and pain areas by studying their data, such as purchase history, preferences, and demographics. This may better satisfy consumer expectations and promote customer happiness by customizing your products, services, and marketing initiatives using this insight.
4.	Personalized Marketing and Customer Experience	The marketing and consumer experience can be tailored with TBA. It may deliver targeted marketing campaigns, individualized recommendations, and specialized experiences to specific clients by utilizing customer data and sophisticated segmentation techniques. Improved customer engagement and loyalty result from this personalization, increasing conversion rates.
5.	Operational Efficiency and Cost Savings	Your business operations can be optimized, and costs can be reduced with the aid of TBA. This can locate inefficiencies, restructuring processes, and improve resource allocation by analysing operational data. Profitability rises, costs are decreased, and operational effectiveness is enhanced.
6.	Risk Management and Fraud Detection	It can manage risks and spot fraudulent activity with the help of TBA. It can identify possible hazards, foresee market changes, and spot fraudulent behavior by analyzing data patterns, anomalies, and historical trends. This proactive approach to risk management safeguards your company and aids in developing more effective risk mitigation measures.
7.	Continuous Improvement	TBA actively supports a culture of ongoing development. Analyzing performance indicators lets you pinpoint problem areas, monitor development, and make data-driven changes to your operations and strategy. An iterative process promotes innovation, improves workflow, and maintains flexibility in shifting market conditions.
8.	Data-Driven Partnerships	TBA enables you to work with additional stakeholders who offer analytics services. By collaborating with analytics service providers, it can benefit from their knowledge and access to cutting-edge analytics tools and methods. Thanks to this relationship, it can obtain a competitive advantage, accelerate corporate growth, and extract valuable insights.

Hence, as a stakeholder and user of Tech Business Analytics, you can use data and analytics to learn important things, make wise choices, better understand your clients and markets, streamline processes, control risks, and promote business expansion. In the modern, data-driven corporate environment, TBA gives you the tools to stay competitive, flexible, and responsive.

9.3.2 Benefits:

There are various advantages it can enjoy as a stakeholder and user of tech business analytics (TBA):

Table 35: Benefits of TBA as stakeholder as consumer

S. No.	Aspects	Description
1.	Actionable Insights	TBA offers you data-driven insights that it can put into practice. TBA aids you in finding the obvious by utilizing advanced analytics approaches. These insights may help you make wise decisions and take specific measures to advance your business.
2.	Data-Driven Decision-Making	TBA allows you to base decisions on facts rather than feelings or speculation. You can rely on factual information to assist your decision-making by using analytics. This lowers the possibility of prejudice or subjective judgments and raises the possibility of making more precise and valuable decisions.

3.	Improved Customer Understanding	This can help you learn more about your clients, thanks to TBA. It may identify consumer categories, requirements, and pain points by analyzing data about them, such as demographics, buying behavior, and preferences. With this knowledge, you can better match their needs and improve their entire experience by customizing your offerings regarding goods, services, and marketing tactics.
4.	Targeted Marketing and Personalization	It may use TBA to apply tailored marketing tactics and customize consumer experiences. Customer data and segmentation strategies can give personalized messages, offers, and suggestions to particular consumer segments. This improves the relevance and efficacy of your marketing initiatives, which raises conversion rates and improves consumer engagement.
5.	Competitive Advantage	TBA gives you a market advantage. It may keep up with the competition by using analytics to track market trends, examine rival strategies, and find market opportunities. TBA enables you to make data-driven decisions that position your company for success and let you stand out in the industry.
6.	Risk Management and Fraud Detection	TBA assists in risk identification, risk mitigation, and fraud detection. It may proactively identify possible risks and implement effective risk management strategies by analyzing data patterns, anomalies, and historical trends. In addition, TBA helps you secure your organization and reduce financial losses by identifying fraudulent actions and behavior.
7.	Enhanced Operational Efficiency	It may streamline your business operations with TBA. It can find inefficiencies, bottlenecks, and places for improvement by examining operational data and performance measures. TBA aids in process streamlining, resource allocation, and operational efficiency enhancement, which results in cost savings and increased production.
8.	Continuous Improvement	TBA encourages your company's culture of continual improvement. This can find areas that need improvement, track your progress, and make data-driven changes to your strategy and operations by routinely analyzing and monitoring data. It can promote innovation, improve procedures, and maintain responsiveness to shifting market dynamics with this iterative methodology.
9.	Data-Driven Partnerships	TBA makes joint ventures with technology suppliers and analytics providers possible. It can get more valuable insights from your data by working with outside specialists and utilizing their specialized knowledge, resources, and technologies. Thanks to this relationship, your ability to make decisions will be improved, and you'll have access to cutting-edge analytical methods and business growth.

It may make data-driven decisions, improve customer understanding, gain a competitive advantage, manage risks, increase operational efficiency, and promote continuous improvement in your business operations by utilizing the advantages of Tech Business Analytics as a stakeholder or consumer. TBA gives you the tools to maximize the value of your data and create a competitive advantage.

9.3.3 Constraints:

As consumers, stakeholders can benefit significantly from tech business analytics (TBA), but several potential limitations exist. A few typical restrictions to think about are listed below:

Table 36: Constraints of TBA as stakeholder as consumer

S. No.	Aspects	Description
1.	Data Availability and Quality	Data that is pertinent and of high quality must be available for TBA. Constraints may result if the essential data is not readily available or

		of the proper caliber, completeness, or correctness. Inconsistent or inadequate data can hamper a decision-makers improved.
2.	Data Privacy and Security	When using TBA, consumer stakeholders must consider issues with privacy and security. Ensuring compliance with data protection laws is essential since handling sensitive consumer data has inherent dangers. A constant problem for stakeholders is ensuring data privacy and implementing effective security measures.
3.	Resource Constraints	It takes a lot of resources to implement and maintain TBA capabilities. Consumer stakeholders may experience budgetary, technological, and human resource restrictions. For TBA projects to be successful, adequate expenditures must be made on analytics tools, technologies, and expertise.
4.	Technical Expertise and Knowledge Gap	Effective use of TBA necessitates a certain amount of technical knowledge. They may have limitations if consumer stakeholders need to gain the knowledge and abilities to comprehend and analyze the analytics outputs. Getting the necessary expertise and filling the knowledge gap might take much work.
5.	Integration Challenges	It could be challenging to integrate TBA into current procedures and systems. To offer a complete view for analysis, data from different systems and sources must be merged. Compatibility problems, data silos, and outdated systems may make integrating TBA into organizational operations complex without any disruption.
6.	Ethical Considerations	The utilization of client data, privacy, and potential biases in algorithms are some of the ethical issues that TBA brings up. The use of data must be ethical and accountable, biases must be addressed, and analytics practices must remain transparent. It is essential to follow legal and ethical requirements.
7.	Change Management and Organizational Alignment	TBA might necessitate structural adjustments and a change in how people make decisions. The alignment of analytics activities with business goals may take time for stakeholders to achieve, or they may face employee opposition to change. Getting beyond barriers, cultivating cultures that value data, and connecting analytics to strategic objectives can be difficult.
8.	Complexity and Interpretation	TBA uses sophisticated statistical models, machine learning methods, and complex algorithms. In particular, consumer stakeholders may need more analytical knowledge to comprehend and evaluate the analytics data. It can be challenging to appropriately interpret the insights and turn them into practical solutions.
9.	Data Volume and Processing Speed	Managing massive amounts of data and ensuring timely analysis can be challenging for stakeholders in the consumer market. TBA has to handle real-time or nearly real-time analytics and has robust data processing capabilities. As data volume and velocity rise, scalability and processing speed may face difficulties.
10.	Return on Investment (ROI) Uncertainty	TBA has the potential to bring about a lot of advantages, but consumer stakeholders may need help calculating the ROI of their analytics projects. The immediate influence of analytics on corporate results can be challenging to measure, and evaluating the return on TBA investments can also be challenging.

To navigate these limitations, proactive steps must be taken, including investing in data governance, prioritizing data quality, upskilling personnel, resolving privacy and security concerns, and ensuring TBA projects align with organizational objectives. Stakeholders can use TBA successfully and realize its full potential by overcoming these obstacles.

9.3.4 Drawbacks

Despite the many advantages of tech business analytics (TBA), stakeholders may run through some disadvantages and difficulties as users. Consider these negative aspects:

Table 37: Drawbacks of TBA as stakeholder as consumer

S. No.	Aspects	Description
1.	Overreliance on Data	TBA strongly emphasizes data-driven decision-making, which could result in an overreliance on data and disregarding intuition, experience, and qualitative elements. There is a chance of missing crucial contextual information that cannot be obtained by data analysis alone.
2.	False Interpretation of Data	It takes skill and careful interpretation to analyze complicated data sets and get relevant insights. When statistics are interpreted or presented correctly, it can result in accurate conclusions and better decision-making. The outputs of the analytics must be accurate and consistent with the context of the business, according to stakeholders.
3.	Data Privacy and Security Risks	Since TBA depends on minimizing the risk of data breaches or unauthorized access, consumer stakeholders must ensure compliance with data protection laws, deploy strong security measures, and manage sensitive customer data responsibly.
4.	Complexity and Technical Expertise	Technical know-how in data analysis, statistics, and machine learning is necessary for using TBA efficiently. It could be difficult for consumer stakeholders to find or access the appropriate expertise within their organization. TBA capabilities implementation and upkeep may also necessitate spending on cutting-edge analytics tools and technology.
5.	Cost and Resource Intensiveness	TBA projects can be resource-intensive, requiring significant investments in technical infrastructure, analytics tools, and qualified employees. Particularly for smaller organizations with tighter resources, the expenses related to data storage, processing, and analysis can be significant.
6.	Change Management and Organizational Alignment	Organizational adjustments and a culture change could be necessary to integrate TBA into current workflows and decision-making processes. Aligning analytics activities with company goals, getting people to embrace change, and getting employees to use new technologies could be difficult for consumer stakeholders.
7.	Data Quality and Availability	TBA is dependent on reliable and pertinent data being accessible. The correct data sources may be difficult to access, and it may be challenging to manage data consistency across many platforms and systems and to ensure data accuracy and completeness.
8.	Limited Scope and Scalability	There can be restrictions on TBA's scalability and scope. TBA's applicability in some situations may be constrained because some data or business processes aren't well-suited for analysis. When data amount and complexity rise, processing times lengthen, and potential performance problems may arise. This raises questions about scalability.
9.	Ethical Considerations and Bias	TBA may raise moral issues relating to algorithmic biases, data privacy, and other unforeseen consequences. Stakeholders are responsible for ensuring the ethical use of data, addressing biases in algorithms and analysis techniques, and considering how their decisions may affect other stakeholders.
10.	Lack of Human Judgment and Creativity	TBA relies on numerical analysis and might need to fully capture the nuances and intricacies that human judgment and creativity can offer. Stakeholders need to create a balance between data-driven insights and the insightful ideas that only human knowledge and intuition can provide.

Stakeholders must be aware of these shortcomings and take proactive measures to solve them through data governance practices, ongoing training and skill development, ethical considerations, and a comprehensive approach to decision-making that blends data-driven insights and human judgment. Stakeholders can maximize the advantages of TBA while reducing any potential negatives by controlling these difficulties.

10. ABCD ANALYSIS OF INTEGRATION OF BA WITH ICCT UT :

10.1 ABCD of Integrating Business Analytics with AI & Robotics in Manufacturing Industry:

Table 38: ABCD Analysis of Integration of BA with AI & Robotics:

S. No.	Aspects	Description
Advantages:		
1	Enhanced Process Efficiency	By combining Business Analytics with AI and robotics, manufacturers can analyze real-time production data, identify inefficiencies, and optimize manufacturing processes for increased productivity.
2	Predictive Maintenance	The integration enables predictive maintenance, where AI algorithms can proactively anticipate equipment failures and schedule maintenance, reducing downtime and optimizing maintenance costs.
3	Improved Quality Control	Business Analytics coupled with AI-powered robotics can monitor production quality in real-time, enabling early detection of defects and reducing the number of faulty products.
4	Data-Driven Decision Making	The combination empowers manufacturers with valuable insights from data analysis, allowing them to make informed decisions for inventory management, resource allocation, and production planning.
5	Flexible and Adaptive Manufacturing	The combination empowers manufacturers with valuable insights from data analysis, allowing them to make informed decisions for inventory management, resource allocation, and production planning.
Benefits:		
1	Increased Productivity	The synergy between Business Analytics, AI, and robotics streamlines production workflows, leading to higher output rates and overall operational efficiency.
2	Cost Reduction	By optimizing processes, predicting maintenance needs, and reducing defects, the integration helps minimize production costs and waste, resulting in improved profitability.
3	Enhanced Safety	AI-powered robots can handle hazardous tasks, while Business Analytics ensures that safety data is closely monitored and used to improve worker safety.
4	Competitive Advantage	Manufacturers who leverage the integration gain a competitive edge by offering high-quality products at reduced costs, enabling them to meet market demands effectively.
Constraints:		
1	High Initial Investment	Implementing AI-driven robotics and Business Analytics systems requires substantial upfront investments in technology, training, and infrastructure.
2	Technical Expertise	Integrating these technologies demands specialized skills and expertise, which might pose challenges in finding qualified personnel.
3	Data Privacy and Security	As sensitive production data is involved, ensuring data privacy and protecting against cyber threats becomes critical when integrating AI and robotics with Business Analytics.
Disadvantages :		
1	Complexity and Integration Issues	Combining Business Analytics, AI, and robotics may lead to technical complexities and integration challenges, potentially causing delays and operational disruptions.
2	Dependency on Technology	Manufacturers become reliant on technology for decision-making, which could pose risks if systems encounter failures or malfunctions.

3	Workforce Concerns	Automation through AI and robotics might raise concerns among the workforce regarding job displacement and require careful transition management.

Hence, despite the constraints and disadvantages, the advantages and benefits of integrating Business Analytics with AI and robotics in the manufacturing industry hold immense potential for revolutionizing production processes, achieving higher efficiency, and staying competitive in an increasingly technology-driven market. It is essential for manufacturers to carefully plan and execute the integration while addressing the associated challenges to maximize its benefits.

10.2 ABCD of Integrating Business Analytics with Blockchain in Manufacturing Industry:

Integrating Business Analytics technology with blockchain technology in the Manufacturing Industry can offer various advantages, benefits, constraints, and disadvantages. Here's a comprehensive list:

Table 39: ABCD Analysis of Integration of BA with Blockchain Technology:

S. No.	Aspects	Description
Advantages:		
1	Enhanced Data Security	Blockchain's decentralized and immutable nature ensures that data remains secure, preventing unauthorized access and tampering.
2	Increased Transparency	Blockchain's distributed ledger provides a transparent view of the supply chain, allowing stakeholders to trace the flow of goods and raw materials, thereby improving accountability.
3	Streamlined Supply Chain	Blockchain integration can optimize supply chain processes, reducing delays and eliminating inefficiencies by enabling real-time tracking of goods and assets.
4	Smart Contracts Automation	The combination of analytics and blockchain allows for automating intelligent contracts, streamlining payment processes and other contractual obligations.
5	Data Integrity	The combination of blockchain's immutability and analytics ensures that data is accurate and reliable, reducing the chances of errors and discrepancies.
6	Real-time Data Analysis	Business analytics can process data from blockchain in real time, providing manufacturers with valuable insights for better decision-making and performance optimization.
7	Improved Quality Control	By utilizing blockchain and analytics, manufacturers can track and verify the quality of raw materials, components, and finished products throughout the supply chain.
8	Reduced Counterfeiting	Blockchain's transparency helps detect and prevent counterfeit products, protecting the manufacturer's brand reputation.
Benefits:		
1	Efficient Inventory Management	Integrating analytics with blockchain can lead to better inventory management, reducing excess inventory and optimizing stock levels based on demand and supply data.
2	Predictive Maintenance	Business analytics can analyze data from blockchain-enabled sensors in manufacturing equipment, enabling predictive maintenance to minimize downtime and increase productivity.
3	Enhanced Product Lifecycle Management	Blockchain combined with analytics can provide insights into the entire product lifecycle, enabling manufacturers to identify potential bottlenecks and opportunities for improvement.
4	Data-driven Decision Making	Combining both technologies empowers manufacturers to make data-driven decisions, leading to better resource allocation and operational efficiency.

5	Improved Collaboration	Blockchain's shared and secure database and analytics facilitate better collaboration between manufacturers, suppliers, and other stakeholders.
Constraints:		
1	Integration Complexity	Integrating two complex technologies, blockchain and business analytics, might present implementation challenges and require skilled expertise.
2	Costs	Implementing and maintaining both technologies may involve high upfront costs and ongoing expenses.
3	Data Privacy Concerns	Blockchain's transparency might raise privacy concerns, especially if sensitive business information is exposed to all network participants.
4	Scalability	As the volume of data grows, the blockchain network's scalability might become a concern for handling large datasets required for analytics.
Disadvantages :		
1	Learning Curve	Employees may need time to adapt to the new technologies, potentially leading to a temporary decrease in productivity during the transition.
2	Potential Security Vulnerabilities	While blockchain is known for its security, integrating analytics applications could introduce potential vulnerabilities that need careful consideration.
3	Dependency on Internet Connectivity	Real-time analytics on blockchain require constant internet connectivity, which might be an issue in specific regions or during network disruptions.
4	Regulatory Challenges	The legal and regulatory landscape around blockchain and analytics may need to be more well-defined in some jurisdictions, posing compliance challenges.

Before implementing such integration, businesses in the Manufacturing Industry should thoroughly assess their specific needs, conduct a cost-benefit analysis, and ensure they have the technical expertise to overcome potential challenges.

10.3 ABCD of Integrating Business Analytics with Cloud Computing in Manufacturing Industry:

Integrating Business Analytics technology with cloud computing in the Manufacturing Industry can bring numerous advantages, benefits, constraints, and disadvantages. Table 40 depicts a comprehensive list.

Table 40: ABCD Analysis of Integration of BA with cloud computing Technology

S. No.	Aspects	Description
Advantages:		
1	Scalability	Cloud computing allows businesses to scale their analytics infrastructure based on demand, ensuring the system can handle large datasets and growing analytical requirements.
2	Cost Efficiency	Cloud-based analytics eliminates the need for expensive on-premises hardware and software, reducing capital expenses and allowing manufacturers to pay for resources as they use them.
3	Real-time Data Analysis	Cloud computing provides the processing power to analyze vast amounts of data quickly, enabling real-time insights that can lead to faster and more informed decision-making.
4	Flexibility and Accessibility	Cloud-based analytics can be accessed from anywhere with an internet connection, allowing key stakeholders to access and act upon critical data regardless of physical location.

5	Data Collaboration	Cloud platforms facilitate data sharing and collaboration among teams, departments, and external partners, enhancing communication and fostering data-driven decision-making.
6	Integration with IoT Devices	Cloud computing seamlessly integrates with Internet of Things (IoT) devices on the manufacturing floor, enabling real-time monitoring of equipment and processes and enhancing predictive maintenance capabilities.
7	Automatic Updates	Cloud analytics platforms often receive regular updates and improvements, ensuring manufacturers benefit from the latest features and advancements without manual intervention.
Benefits:		
1	Predictive Maintenance	Cloud-based analytics can process data from IoT sensors in real time, allowing manufacturers to predict equipment failures and perform preventive maintenance, reducing downtime and increasing productivity.
2	Supply Chain Optimization	By analyzing data across the supply chain, manufacturers can identify inefficiencies, reduce lead times, optimize inventory levels, and enhance overall supply chain performance.
3	Enhanced Product Quality	Cloud analytics can help manufacturers monitor and analyze product quality data, identifying defects or deviations early in production for improved quality control.
4	Improved Resource Management	Manufacturers can leverage cloud analytics to optimize resource allocation, such as raw materials, energy consumption, and labor, leading to cost savings and efficiency gains.
Constraints:		
1	Data Security Concerns	Storing and analyzing sensitive manufacturing data in the cloud raises security considerations, necessitating robust encryption and access controls to safeguard information.
2	Internet Dependency	Real-time analytics on the cloud require stable internet connectivity, and any disruptions may impact access to critical data and analytics applications.
3	Data Compliance and Regulations	The Manufacturing Industry may be subject to specific data regulations and compliance requirements, and using cloud services must align with these regulations to avoid legal issues.
Disadvantages :		
1	Latency Issues	For specific analytics tasks that require immediate response, the latency introduced by cloud computing may be a limitation.
2	Potential Downtime	Cloud services are not immune to outages, and any unplanned downtime could temporarily disrupt analytics processes and decision-making.
3	Data Transfer Costs	Large volumes of data transferred to and from the cloud can incur additional costs, particularly for businesses with limited bandwidth or high data usage.

Manufacturers considering integrating Business Analytics with cloud computing should thoroughly analyze their specific needs, evaluate the security measures of cloud service providers, and assess potential risks to make informed decisions about adopting this technology.

10.4 ABCD of Integrating Business Analytics with Cyber Security in Manufacturing Industry:

Integrating business analytics technology with cybersecurity technology in the manufacturing industry can have various advantages, benefits, constraints, and disadvantages. Here's a comprehensive list:

Table 41: ABCD Analysis of Integration of BA with Cyber Security:

S. No.	Aspects	Description
Advantages:		

1	Improved Threat Detection	By combining business analytics and cybersecurity, manufacturers can detect potential threats and cyber-attacks more effectively, enabling them to respond proactively and mitigate risks promptly.
2	Real-time Monitoring	Integrating analytics and cybersecurity allows manufacturers to monitor their systems in real time, identifying anomalies and potential breaches as they occur, leading to quicker response times.
3	Data-driven Decision Making	Business analytics provides valuable insights into manufacturing operations, enabling data-driven decision-making for enhancing security protocols and processes.
4	Predictive Maintenance	Manufacturers can predict potential security risks and system vulnerabilities by analyzing data from business operations and security systems, reducing the likelihood of unplanned downtime.
5	Resource Optimization	Integration of analytics and cybersecurity helps manufacturers optimize resource allocation by identifying areas where security investments are most needed.
Benefits:		
1	Compliance and Risk Management	Manufacturers can better adhere to industry regulations and compliance standards with the help of analytics, reducing the risk of penalties and legal consequences.
2	Enhanced Incident Response	The combination of analytics and cybersecurity streamlines incident response procedures, enabling faster identification, containment, and resolution of security incidents.
3	Business Continuity	Improved cybersecurity through analytics integration can minimize disruptions to manufacturing processes, ensuring business continuity and reducing financial losses.
4	Supply Chain Security	By analyzing data across the supply chain, manufacturers can identify potential security weak points and strengthen the overall security of the supply chain network.
5	Competitive Advantage	Companies that effectively integrate business analytics and cybersecurity can gain a competitive edge by demonstrating higher security and reliability to customers and partners.
Constraints:		
1	Complexity	Integrating two technologies can be complex and time-consuming, requiring skilled personnel and specialized knowledge.
2	Cost	Implementing and maintaining integrated systems may involve high upfront costs and ongoing training, software, and hardware upgrade expenses.
3	Data Privacy Concerns	Combining business analytics and cybersecurity technologies may raise privacy concerns, mainly if sensitive data is used for analysis or shared between systems.
4	Skill Gap	Finding and retaining professionals with expertise in business analytics and cybersecurity can be challenging due to the specialized nature of these fields.
5	Interoperability Issues	Integrating existing analytics and cybersecurity solutions might lead to compatibility issues, potentially causing disruptions or data loss during integration.
Disadvantages :		
1	False Positives/Negatives	More reliance on analytics can lead to false positives (raising unnecessary alarms) or false negatives (missing actual threats), impacting the effectiveness of security measures.
2	Overwhelming Data Volume	Integrating both technologies can generate a large volume of data, making extracting meaningful insights and identifying genuine security threats challenging.

3	Training and Adoption	Constraints and Employees may require extensive training to utilize integrated systems effectively, and some may resist change, affecting the overall adoption of the technology.
4	Overemphasis on Data	Integrating too much data from various sources can lead to information overload, making prioritizing and acting on critical security alerts difficult.
5	Technology Risks	As with any technology integration, there is a risk of technical failures or vulnerabilities in the integrated system, potentially exposing new attack vectors.

When considering integrating business analytics technology with cybersecurity technology, manufacturers should carefully weigh the advantages and benefits against the constraints and disadvantages to make informed decisions that align with their business goals and security requirements.

10.5 ABCD of Integrating Business Analytics with Internet of Things (IoT) in Manufacturing Industry:

Integrating business analytics technology with the manufacturing industry's Internet of Things (IoT) technology offers several advantages, benefits, constraints, and disadvantages. Here's a comprehensive list:

Table 42: ABCD Analysis of Integration of BA with Internet of Things (IoT):

S. No.	Aspects	Description
Advantages:		
1	Predictive Maintenance	Combining business analytics and IoT allows manufacturers to analyze real-time data from connected devices and machinery, enabling predictive maintenance. This helps identify equipment failures and maintenance needs, reducing downtime and increasing operational efficiency.
2	Enhanced Data Insights	IoT devices generate vast amounts of data, and when combined with business analytics, manufacturers can gain deeper insights into various aspects of their operations. This includes production performance, supply chain optimization, and customer behavior.
3	Optimized Resource Management	With the help of integrated analytics and IoT, manufacturers can optimize resource allocation, including energy usage, raw materials, and workforce, leading to cost savings and environmental benefits.
4	Real-time Monitoring and Control	IoT technology provides real-time data from sensors and devices across the manufacturing process. Integrating business analytics enables manufacturers to monitor operations, detect anomalies, and make timely adjustments for optimal productivity.
5	Improved Quality Control	By analyzing data from IoT sensors and devices, manufacturers can implement better quality control measures and detect defects or deviations from standards more efficiently.
Benefits:		
1	Inventory Management	Business analytics combined with IoT data enables manufacturers to track inventory levels accurately, identify demand patterns, and optimize inventory management processes.
2	Supply Chain Visibility	Integrating IoT and business analytics provides end-to-end supply chain visibility, helping manufacturers monitor shipments, predict delays, and enhance overall supply chain efficiency.
3	Data-Driven Decision Making	The combination of IoT and business analytics empowers manufacturers to make informed, data-driven decisions based on real-time insights and historical trends.

4	Process Optimization	By analyzing IoT data, manufacturers can identify bottlenecks, streamline workflows, and optimize production processes, increasing productivity and reducing waste.
5	Competitive Advantage	Companies that successfully integrate IoT and business analytics gain a competitive edge by leveraging data-driven insights to improve operational efficiency, product quality, and customer satisfaction.
Constraints:		
1	Data Security Risks	Integrating IoT devices with business analytics introduces new security risks as more data points become accessible, potentially increasing the attack surface for cyber threats.
2	Data Privacy Concerns	Combining data from various IoT devices and business analytics may raise privacy concerns, especially when dealing with sensitive information about production processes or customer data.
3	Complexity	Integrating and managing a vast network of IoT devices and analytics infrastructure can be complex and require specialized expertise.
4	Cost	Implementing and maintaining IoT devices and business analytics systems can involve high upfront costs and ongoing expenses.
5	Interoperability Issues	Integrating diverse IoT devices from manufacturers with business analytics platforms may challenge interoperability.
Disadvantages :		
1	Data Volume and Processing	Integrating IoT devices can lead to overwhelming data processing, requiring powerful analytics tools and infrastructure.
2	Scalability	As the number of IoT devices and data sources grows, scalability can become a concern, requiring regular updates to accommodate increased data processing needs.
3	Reliability and Downtime	If IoT devices or analytics systems experience downtime, it can disrupt manufacturing operations and lead to losses in productivity.
4	Training and Adoption	Employees may require training to use the integrated IoT and analytics systems effectively, and some may need help adopting new technologies.
5	Energy Consumption	Integrating IoT devices may increase energy consumption, potentially offsetting some sustainability benefits achieved through optimized resource management.

Before integrating business analytics technology with IoT in the manufacturing industry, organizations must carefully assess the advantages and benefits against the constraints and disadvantages to ensure a successful and secure implementation. Robust security measures, data privacy policies, and scalable infrastructure are crucial to the success of such integration.

10.6 ABCD of Integrating Business Analytics with 3D Printing in Manufacturing Industry:

Integrating business analytics with 3D printing technology in the manufacturing industry can lead to various advantages, benefits, constraints, and disadvantages. Table 43 depicts a comprehensive list.

Table 43: ABCD Analysis of Integration of BA with 3D Printing:

S. No.	Aspects	Description
Advantages:		
1	Enhanced Design Optimization	By combining business analytics with 3D printing, manufacturers can analyze design data, identify patterns, and optimize product designs for improved performance and efficiency.
2	Cost Savings	Business analytics can help identify cost-saving opportunities in the 3D printing process, such as material usage optimization and reducing printing errors.

3	Customization and Personalization	Integrating analytics with 3D printing enables manufacturers to analyze customer preferences and create personalized products more effectively, addressing specific market demands.
4	Reduced Time-to-Market	Analytics-driven insights can streamline the 3D printing process, reducing production lead times and enabling faster product launches.
5	Inventory Reduction	With on-demand 3D printing driven by analytics, manufacturers can produce items as needed, reducing the need for extensive inventory storage.
Benefits:		
1	Waste Minimization	Business analytics can aid in optimizing 3D printing parameters, minimizing material wastage, and contributing to a more sustainable manufacturing process.
2	Quality Control	Integration of analytics with 3D printing allows manufacturers to monitor the quality of printed products in real time, identifying defects and ensuring higher quality standards.
3	Design Validation	Business analytics can help validate 3D-printed designs by comparing them against simulations and real-world performance data, leading to more reliable products.
4	Rapid Prototyping	Manufacturers can rapidly iterate prototypes by using analytics to refine 3D printing settings, accelerating the product development cycle.
5	Better Resource Allocation	With analytics, manufacturers can assess the utilization of 3D printing resources, ensuring efficient allocation for maximum productivity.
Constraints:		
1	Data Privacy and Security	Integrating business analytics with 3D printing systems may introduce security risks if sensitive design or manufacturing data is involved.
2	Initial Investment	Implementing 3D printing and analytics technologies can involve substantial upfront equipment, software, and training costs.
3	Skill Gap	Utilizing both technologies effectively requires skilled personnel with 3D printing, data analytics, and integration expertise.
4	Data Overload	Integrating analytics with 3D printing can generate a vast amount of data, potentially overwhelming the system and making it challenging to extract valuable insights.
5	Complexity	Integrating two distinct technologies can introduce complexities in managing and maintaining the integrated system.
Disadvantages :		
1	Interoperability Issues	Ensuring compatibility and seamless communication between 3D printing and analytics platforms may be challenging, especially with diverse software solutions.
2	Scalability	As data and printing volumes grow, the integrated system must be scalable to handle increased demands.
3	Accuracy and Calibration	Precise calibration and accurate data input are critical for achieving optimal results in the integrated process, and errors could lead to faulty products.
4	Regulatory Compliance	Manufacturers must ensure that integrating analytics with 3D printing complies with industry regulations and standards.
5	Adoption and Change Management	Employees may require training and support to adapt to the integrated system, potentially leading to resistance or initial productivity dips.

Employees may require training and support to adapt to the integration. Before integrating business analytics technology with 3D printing in the manufacturing industry, organizations must carefully consider the advantages and benefits against the constraints and disadvantages. They should also focus on data security, scalability, and ensuring proper training and skill development to make the most of this integration and achieve business goals effectively.

10.7 ABCD of Integrating Business Analytics with Mobile Communication in Manufacturing Industry:

Integrating business analytics technology with mobile communication technology in the manufacturing industry can offer several advantages, benefits, constraints, and disadvantages. Table 44 depicts a comprehensive list.

Table 44: ABCD Analysis of Integration of BA with Mobile Communication:

S. No.	Aspects	Description
Advantages:		
1	Real-time Data Access	By integrating business analytics with mobile communication technology, manufacturing personnel can access critical data and insights in real-time, regardless of location, enabling faster decision-making.
2	Enhanced Collaboration	Mobile communication facilitates seamless communication and collaboration between different teams and departments, allowing for better coordination and problem-solving.
3	Remote Monitoring	Business analytics combined with mobile technology enables remote monitoring of manufacturing processes, equipment, and performance, improving efficiency and reducing the need for on-site presence.
4	Improved Productivity	Mobile access to analytics data empowers employees to stay informed and make informed decisions on the go, leading to increased productivity and agility.
5	Faster Issue Resolution	Mobile communication with analytics integration allows for swift identification and resolution of production issues and anomalies, minimizing downtime and disruptions.
Benefits:		
1	Supply Chain Visibility	Integrating analytics with mobile technology gives stakeholders real-time visibility into the supply chain, helping track shipments, inventory levels, and demand patterns.
2	Customer Insights	Mobile analytics can give manufacturing companies valuable insights into customer preferences, feedback, and buying behavior, facilitating better customer engagement and product development.
3	Asset Management	Mobile access to business analytics data aids in efficient asset management, helping track and maintain manufacturing equipment and infrastructure.
4	Data Visualization	Mobile communication technology allows for interactive and visually appealing data visualization, making it easier for users to grasp complex analytics insights.
5	Competitive Advantage	Manufacturers who effectively utilize analytics through mobile communication gain a competitive edge by responding quickly to market changes and customer demands.
Constraints:		
1	Data Security Risks	Integrating business analytics with mobile technology may expose sensitive manufacturing data to security risks, especially if not adequately protected.
2	Device Compatibility	Different mobile devices and platforms may require customizations to ensure smooth integration and consistent user experiences.
3	Bandwidth and Connectivity	Mobile analytics require reliable and high-speed internet connectivity to deliver real-time data, which can be a constraint in remote or low-bandwidth areas.
4	User Training	Employees may require training to effectively use mobile analytics tools and interpret data on mobile devices.
5	Privacy Concerns	Using mobile devices for analytics access raises privacy concerns, mainly if personal or sensitive data is accessed through these devices.

Disadvantages :		
1	Screen Size Limitations	Mobile devices have smaller screens than desktops, which can limit the amount of data displayed at once and potentially reduce data comprehensibility.
2	Data Consumption	Real-time access to analytics on mobile devices can lead to increased data consumption, potentially resulting in higher mobile data costs.
3	Technical Support	Manufacturers must ensure adequate technical support for mobile analytics users to address any technical issues promptly.
4	Integration Complexity	Integrating analytics with mobile communication technology can be complex, requiring seamless integration between various systems and databases.
5	Resistance to Change	Some employees may resist using mobile devices for analytics, preferring traditional desktop setups.

Manufacturers should carefully evaluate the advantages and benefits against the constraints and disadvantages to determine the feasibility and effectiveness of integrating business analytics technology with mobile communication technology. Addressing security, connectivity, and user training issues will be crucial to successful implementation and maximizing the benefits of this integration.

10.8 ABCD of Integrating Business Analytics with Information Storage Technology in Manufacturing Industry:

Integrating business analytics technology with information storage technology in the manufacturing industry can offer several advantages, benefits, constraints, and disadvantages. Table 45 depicts a comprehensive list:

Table 45: ABCD Analysis of Integration of BA with Information Storage Technology:

S. No.	Aspects	Description
Advantages:		
1	Data Centralization	Integrating business analytics with information storage technology allows manufacturers to centralize and organize their data, making accessing and analyzing critical information from various sources easier.
2	Enhanced Data Analysis	With centralized data storage, manufacturers can perform in-depth data analysis and gain valuable insights into production processes, supply chains, customer behavior, and other critical aspects of their operations.
3	Real-time Reporting	The integration enables real-time reporting and data visualization, empowering decision-makers to monitor performance and make informed decisions promptly.
4	Predictive Analytics	By combining business analytics with historical data stored in the information storage system, manufacturers can employ predictive analytics to forecast demand, optimize production schedules, and plan inventory levels more effectively.
5	Improved Efficiency and Productivity	Access to timely and relevant data through integrated analytics and information storage technology enables process optimization, increasing efficiency and productivity.
Benefits:		
1	Data-Driven Decision Making	The integration empowers manufacturing leaders to make data-driven decisions based on accurate and up-to-date information, reducing guesswork and enhancing overall decision-making processes.
2	Quality Control and Compliance	Manufacturers can use integrated analytics to monitor product quality, identify defects, and ensure compliance with industry standards and regulations.

3	Supply Chain Optimization	The combination of analytics and information storage technology allows manufacturers to optimize their supply chain by tracking inventory levels, monitoring supplier performance, and improving logistics.
4	Cost Reduction	Data-driven insights from the integrated system can help identify cost-saving opportunities, such as streamlining operations, reducing waste, and optimizing resource allocation.
5	Competitive Advantage	Companies that effectively integrate business analytics with information storage technology can gain a competitive edge by being more agile, responsive, and efficient in their manufacturing processes.
Constraints:		
1	Data Security Risks	Integrating business analytics with information storage technology may introduce security risks as sensitive manufacturing data becomes accessible from a centralized location.
2	Data Privacy Concerns	Manufacturers must address data privacy concerns and ensure compliance with relevant data protection regulations when centralizing and analyzing sensitive information.
3	Technical Compatibility	Integrating different information storage systems with analytics platforms may require technical adjustments to ensure compatibility and smooth data flow.
4	Initial Investment	Implementing the integrated system may involve significant upfront software, hardware, and training costs.
5	Data Volume and Processing	Large volumes of data stored in the information storage system can pose challenges in data processing and analytics, requiring robust infrastructure.
Disadvantages :		
1	Skill Gap	Utilizing the integrated system effectively requires skilled personnel with business analytics and information storage technologies expertise.
2	Data Integration Challenges	Integrating data from diverse sources can be complex and time-consuming, requiring careful data mapping and integration strategies.
3	Data Redundancy	Data duplication across different storage systems can lead to redundancy and increased storage costs.
4	Scalability	As data and manufacturing processes grow, the integrated system must be scalable to accommodate increased demands.
5	Resistance to Change	Employees may require training and support to adapt to the integrated system, potentially leading to resistance or initial productivity dips.

Manufacturers must carefully assess the advantages and benefits against the constraints and disadvantages when integrating business analytics technology with information storage technology. Addressing data security, privacy concerns, technical compatibility, and employee training will be critical to successful implementation and achieving the desired outcomes.

10.9 ABCD of Integrating Business Analytics with Ubiquitous Education Technology in Manufacturing Industry:

Integrating business analytics technology with ubiquitous education technology in the manufacturing industry can offer various advantages, benefits, constraints, and disadvantages. Table 46 depicts a comprehensive list.

Table 46: ABCD Analysis of Integration of BA with Ubiquitous Education Technology:

S. No.	Aspects	Description
Advantages:		
1	Enhanced Workforce Training	Ubiquitous education technology enables manufacturers to provide continuous and personalized training to their workforce, improving their skills and knowledge.

2	Data-Driven Skill Development	By integrating business analytics, manufacturers can analyze employee training data to identify skill gaps and tailor training programs accordingly.
3	Improved Onboarding	Ubiquitous education technology combined with analytics can streamline the onboarding process, ensuring new hires receive the necessary training and resources to become productive quickly.
4	Enhanced Safety Training	With integrated technology, manufacturers can deliver real-time safety training, reducing workplace accidents and improving overall safety measures.
5	Performance Monitoring	Business analytics can track employee progress and performance in training programs, enabling management to assess the effectiveness of educational initiatives.
Benefits:		
1	Continuous Learning Culture	Integrating education technology with analytics promotes a culture of continuous learning, encouraging employees to stay updated with the latest industry trends and technologies.
2	Reduced Training Costs	Ubiquitous education technology can offer cost-effective training solutions, and analytics help optimize training investments by focusing on areas that yield the most significant impact.
3	Employee Engagement	Interactive education technology can enhance employee engagement and motivation, increasing retention rates and job satisfaction.
4	Knowledge Retention	The integration allows for the assessment of knowledge retention, enabling manufacturers to reinforce learning where necessary and ensure long-term knowledge retention.
5	Improved Decision-Making	With a well-trained and knowledgeable workforce, manufacturers can make better-informed decisions, leading to improved operational efficiency and competitiveness.
Constraints:		
1	Initial Investment	Implementing and integrating education technology with business analytics can involve significant upfront software, hardware, and training costs.
2	Technical Compatibility	Ensuring seamless integration between education technology platforms and analytics systems may require technical adjustments and customizations.
3	Data Privacy and Security	Integrating education technology with analytics may raise data privacy concerns, especially involving employee training records and performance data.
4	Skill Gap	Manufacturers need skilled personnel who can effectively utilize education technology and analytics to maximize the benefits of integration.
5	Content Quality	The effectiveness of education technology relies on the quality of content and training materials. Ensuring high-quality and relevant content can be challenging.
Disadvantages :		
1	User Adoption	Employees may need training and support to adapt to the integrated system, and some may resist using new technologies for training purposes.
2	Overwhelming Information	Ubiquitous education technology may provide abundant training resources, potentially overwhelming employees and reducing training effectiveness.
3	Reliability and Downtime	Technical issues or connectivity problems with education technology can disrupt training programs and affect employee productivity.
4	Content Customization	Tailoring training content to meet specific manufacturing industry needs may require additional effort and resources.

5	Tracking and Assessment	Measuring the direct impact of education technology and analytics integration on employee performance can be challenging, requiring comprehensive tracking and assessment mechanisms.

Manufacturers must carefully assess the advantages and benefits against the constraints and disadvantages when integrating business analytics technology with ubiquitous education technology. Addressing data privacy, content quality, user adoption, and technical compatibility will be crucial to successful implementation and achieving the desired outcomes in workforce development and productivity.

10.10 ABCD of Integrating Business Analytics with Virtual and Augmented Reality Technology in Manufacturing Industry:

Integrating business analytics technology with virtual and augmented reality technology in the manufacturing industry can offer several advantages, benefits, constraints, and disadvantages. Table 47 depicts a comprehensive list.

Table 47: ABCD Analysis of Integration of BA with Virtual and Augmented Reality Technology:

S. No.	Aspects	Description
Advantages:		
1	Enhanced Data Visualization	Business analytics combined with virtual and augmented reality allows manufacturers to visualize complex data and analytics insights more immersive and interactively, making it easier to comprehend and analyze trends and patterns.
2	Real-time Monitoring	Virtual and augmented reality technology enables real-time monitoring of manufacturing processes, and by integrating analytics, manufacturers can gain immediate insights into performance metrics and identify potential issues as they occur.
3	Remote Collaboration	Integrating analytics with virtual and augmented reality facilitates remote collaboration, allowing teams from different locations to work together, conduct virtual meetings, and analyze data collectively.
4	Improved Training and Simulation	Manufacturers can use virtual and augmented reality for training employees on complex tasks and scenarios. Integrating analytics helps assess employee performance during training and identify areas for improvement.
5	Predictive Maintenance	By combining business analytics with virtual and augmented reality, manufacturers can predict equipment maintenance needs more accurately, reducing downtime and optimizing maintenance schedules.
Benefits:		
1	Design Visualization and Prototyping	Virtual and augmented reality technology enables manufacturers to visualize product designs and prototypes in a realistic 3D environment. Integrating analytics helps refine designs based on user feedback and performance data.
2	Quality Control	Virtual and augmented reality can be used for quality control inspections. Integrating analytics allows manufacturers to analyze inspection data and identify defects more effectively.
3	Safety Enhancement	Integrating analytics with virtual and augmented reality can improve safety training and provide real-time safety information to workers, reducing workplace accidents.
4	Enhanced Customer Engagement	Manufacturers can use virtual and augmented reality to showcase products to customers. By integrating analytics, they can gather customer feedback and preferences for product improvement.
5	Competitive Advantage	Companies that effectively integrate business analytics with virtual and augmented reality gain a competitive edge by leveraging data-driven insights and innovative visualization techniques.

Constraints:		
1	Technical Complexity	Integrating multiple technologies, including virtual and augmented reality business analytics, can be technically challenging and require specialized expertise.
2	Initial Investment	Implementing and integrating these technologies can involve high upfront hardware, software, and employee training costs.
3	Data Security and Privacy	Integrating business analytics with virtual and augmented reality may expose sensitive manufacturing and customer data to security risks if not adequately protected.
4	Device Compatibility	Different virtual and augmented reality devices may require customizations to ensure compatibility with the analytics platform.
5	Skill Gap	Utilizing analytics and virtual/augmented reality technologies effectively requires skilled personnel with expertise in these areas.
Disadvantages :		
1	User Adoption	Employees may require training and support to adapt to using virtual and augmented reality technologies for analytics purposes.
2	Data Overload	Integrating analytics with virtual and augmented reality can generate vast amounts of data, potentially overwhelming the system and making it challenging to extract valuable insights.
3	Content Quality	The effectiveness of virtual and augmented reality experiences relies on the quality of content and data visualization.
4	Regulation and Compliance	Integrating these technologies may raise regulatory and compliance concerns related to data usage and privacy.
5	Maintenance and Support	Ensuring the reliable and smooth operation of integrated virtual and augmented reality systems may require ongoing maintenance and technical support.

Manufacturers must carefully assess the advantages and benefits against the constraints and disadvantages when integrating business analytics technology with virtual and augmented reality technology. Addressing data security, technical complexity, user adoption, and content quality will be crucial to successful implementation and maximizing the potential benefits in the manufacturing industry.

10.11 ABCD of Integrating Business Analytics with Quantum Computing Technology in Manufacturing Industry:

Integrating business analytics with quantum computing technology in the manufacturing industry can offer various advantages, benefits, constraints, and disadvantages. Table 48 depicts a comprehensive list.

Table 48: ABCD Analysis of Integration of BA with Quantum Computing Technology:

S. No.	Aspects	Description
Advantages:		
1	Faster Data Processing	Quantum computing can handle complex calculations and data processing significantly faster than traditional computing, allowing manufacturers to analyze vast amounts of data in real time.
2	Advanced Data Analysis	Quantum computing enables more sophisticated and in-depth data analysis, uncovering patterns and insights that might be difficult or impossible to identify using classical computing methods.
3	Optimized Supply Chain	Integrating business analytics with quantum computing allows manufacturers to optimize their supply chain by simultaneously considering multiple variables and constraints, leading to more efficient inventory management and logistics.

4	Improved Predictive Analytics	Quantum computing can enhance predictive analytics models, allowing manufacturers to forecast demand, maintenance needs, and quality control more accurately.
5	Enhanced Optimization	Quantum computing's ability to handle complex optimization problems can help manufacturers optimize production schedules, resource allocation, and process efficiency.
Benefits:		
1	Accelerated Research and Development	Quantum computing can speed up research and development processes, enabling manufacturers to explore innovative materials, designs, and manufacturing techniques rapidly.
2	Improved Machine Learning	Quantum computing can enhance machine learning algorithms, leading to better predictive models and decision-making systems.
3	Energy Efficiency	Quantum computing can reduce energy consumption in computing processes, contributing to overall sustainability in manufacturing operations.
4	Competitive Advantage	Manufacturers that adopt quantum computing technology for business analytics gain a competitive edge by leveraging advanced data analysis capabilities to make more informed and strategic decisions.
5	Drug Discovery and Material Design	Quantum computing can accelerate drug discovery and material design processes, allowing manufacturers to develop new products with enhanced properties and functionalities.
Constraints:		
1	Limited Availability	Quantum computing technology is still in its early stages, and commercially available quantum computers are currently limited in capacity and accessibility.
2	Cost	Quantum computing technology is expensive to develop and implement, and its current cost may be prohibitive for some manufacturers.
3	Skill Gap	Quantum computing requires specialized expertise, and there is a need for more professionals with the necessary knowledge to operate and utilize quantum computing in manufacturing.
4	Hardware Complexity	Quantum computing hardware is intricate and sensitive to external influences, requiring specialized maintenance and environment control.
5	Quantum Error Correction	Quantum computers are susceptible to errors due to quantum decoherence, requiring sophisticated error-correction techniques to maintain accuracy.
Disadvantages :		
1	Data Integration	Integrating business analytics with quantum computing may require data storage and processing methods adjustments, given the differences in computing paradigms.
2	Quantum Algorithms	Developing quantum algorithms for specific manufacturing tasks can be challenging and may require extensive research and testing.
3	Scalability	Scaling quantum computing systems to handle larger datasets and more complex manufacturing problems remains a significant challenge.
4	Security Concerns	Quantum computing poses security risks, as it can break existing cryptographic protocols, requiring manufacturers to adopt quantum-resistant encryption methods.
5	Regulatory Compliance	Integrating quantum computing into manufacturing may raise regulatory and compliance concerns about data handling and security.

Manufacturers must carefully assess the advantages and benefits against the constraints and disadvantages when considering integrating business analytics technology with quantum computing technology. While quantum computing holds promise for advanced data analysis, its limitations and complexities must be considered for successful implementation in the manufacturing industry.

11. IMPLEMENTATION, AND IMPACT OF TECH -BUSINESS ANALYTICS ON PRODUCTIVITY OF SECONDARY INDUSTRY SECTOR :

11.1 Implementation:

Secondary industrial enterprises can considerably boost their efficiency by utilizing tech-driven business analytics. Table 49 contains some examples of how:

Table 49: Implementation of TBA on productivity of secondary industry sector

S. No.	Key Aspects	Description on Implementation
1.	Process optimisation in manufacturing	Tech-driven business analytics can help businesses optimize their production processes by finding opportunities to reduce waste, reorganize workflows, and increase efficiency. Businesses can increase productivity by employing data analysis to assess the efficiency with which resources are being used, the performance of the machines, and the volume of output being generated.
2.	Using technology to generate business analytics	By providing them with real-time access to data on inventory levels, shipping schedules, and demand estimates, businesses can help them streamline their supply chains. By examining this data, businesses can make their supply chains more effective by ensuring that the right products are accessible at the right time, reducing delays, and boosting productivity.
3.	TBA can help organisations cut downtime.	TBA can help by anticipating potential issues. By studying data about the performance of their equipment, businesses can identify failure trends and set up preventative maintenance programs to reduce the chance of unplanned downtime.
4.	Real-time observation	Businesses can monitor essential performance measures in real-time thanks to tech-driven business analytics, which enables them to identify and fix issues that might be stifling production quickly. Utilizing dashboards and data visualization tools, businesses can keep tabs on factors such as manufacturing output, equipment utilization, and inventory levels. This allows them to make informed decisions in real time.
5.	Commercial predictive analytics	Predictive analytics, which enables businesses to anticipate future trends and issues before they materialize, can also be provided via tech-driven business analytics for businesses. Market trends, consumer behavior, and production output data can be analyzed to help businesses make decisions that will position them for long-term success.

The efficiency of companies in the secondary industrial sector can be significantly increased by employing tech-driven business analytics. Businesses may boost output and profits by leveraging data to streamline processes, cut downtime, and make wise decisions.

11.2 Impact:

Business analytics powered by technology may significantly impact the secondary industry sector's productivity. Using tech-driven business analytics, the following techniques (Table 50) can help one to work for more productively:

Table 50: Impact of TBA on productivity of secondary industry sector

S. No.	Key Aspects	Description on Impact
1.	Using data to inform decisions	Businesses now have access to real-time data and insights through technology-enabled business analytics. Processes will be

		streamlined, output effectiveness will be improved, and problem areas will be identified using this data.
2.	Improved efficiency Businesses	Using tech-driven business analytics can identify inefficiencies in processes and operations. Analyzing data to identify bottlenecks, areas of waste reduction, and process simplification opportunities can help businesses increase efficiency.
3.	Preventing future problems	Utilizing technology-driven business analytics to anticipate when machinery or equipment may need maintenance, businesses may lower the chance of unplanned downtime. Businesses can foresee problems before they arise and take preventative action by analyzing equipment performance data.
4.	TBA can help businesses optimise their inventories.	Businesses can optimize their inventory using technology-driven business analytics so that the correct products are always available at the right time. Businesses can alter their inventory levels to avoid stockouts and reduce waste by accessing data on customer demand and production output.
5.	TBA can assist businesses with supply chain optimisation.	Technology-driven business analytics can help companies optimize their supply chains to have the assets and raw materials needed to generate their goods. Businesses may boost efficiency and eliminate supply chain bottlenecks by obtaining data on shipment schedules, inventory levels, and demand projections.

Hence, tech-driven business analytics can significantly affect the secondary industry's sector productivity. Businesses may increase productivity and profitability by using data to streamline processes, reduce waste, and make informed decisions.

12. SUGGESTIONS ON HOW TO USE TBA IN PRODUCTION INDUSTRY :

Efficiency, productivity, and decision-making may increase significantly in the production industry using technology and business analytics. Here are some suggestions for utilizing digital business analytics in the manufacturing sector:
(1) Establish a reliable method for gathering data to capture pertinent information during production. Data on equipment efficiency, stock levels, production rates, quality indicators, and other information may be included. Create an extensive library by combining data from numerous sources, including sensors, machinery, and ERP systems.
(2) Use cutting-edge analytics methods to monitor the production process continuously. This can assist in locating possible bottlenecks, equipment problems, or quality problems before they become more serious. Demand forecasting, manufacturing schedule optimization, and predicting maintenance needs are further predictive analytics applications.
(3) To find areas for improvement and compare key performance indicators (KPIs) between various manufacturing lines, shifts, or facilities. Use analytics to set performance goals, monitor development, and draw attention to outliers. This supports efforts for continual improvement and data-driven decision-making.
(4) Analytics should examine high-quality data and find trends or anomalies that might point to errors or poor quality. This may entail employing machine learning strategies to find relationships between process variables and quality outcomes, enabling proactive quality management measures.
(5) The supply chain, comprising procurement, inventory control, and logistics, can be made more efficient using business analytics. Demand forecasting, inventory optimization, and supplier relationships can all be streamlined by using predictive models. In addition to lowering lead times and reducing stockouts, this can boost the effectiveness of the entire supply chain.
(6) Utilise analytics to monitor and improve the production process's use of resources, waste management, and energy. Determine opportunities for energy savings, examine usage trends, and put plans in place to lessen waste and increase sustainability.
(7) Create interactive reporting tools and dashboards that offer in-the-moment insights into performance trends and KPIs. Enable managers and operators to immediately spot areas that need attention or areas where improvements may be made by presenting data user-friendly.

(8) Optimise maintenance schedules using predictive analytics to find needed maintenance. It can proactively schedule maintenance activities, minimize downtime, and increase the lifespan of crucial assets by analyzing equipment data and seeing early warning signals of future breakdowns.
(9) Analytics should support continuous improvement programs and decision-making processes. Perform a root cause analysis to pinpoint inefficient processes and produce insights that may be put to use for process improvement and cost-cutting.
(10) Optimise workforce planning, resource allocation, and skill development in the production sector using analytics. Analyse employee performance, training needs, and skill gaps to find chances for skill upgrading or retraining. This could increase staff effectiveness overall, increase productivity, and decrease turnover.
As a result, adopting tech business analytics in the manufacturing industry necessitates a multidisciplinary strategy involving data gathering, analytics skills, IT infrastructure, and change management. To guarantee maximum value and effect, it's critical to coordinate technological projects with specific business goals. You should also regularly evaluate and fine-tune your analytics strategy.

13. CONCLUSION :

Therefore, applying TBA may result in considerable gains in productivity for businesses in the secondary industrial sector. Businesses may increase efficiency, reduce procedures, and make lucrative decisions by leveraging the power of data. TBA offers businesses real-time data and insights that can help them identify inefficiencies in their operations and procedures, anticipate maintenance needs, increase inventory levels, and improve supply chain management. The result is a rise in output, a decline in downtime, and a competitive edge for the company. But before using tech-driven business analytics, it's essential to carefully assess potential limitations and drawbacks, including the need for qualified people, worries about data privacy and security, and the cost of setting up and maintaining such systems. As a result, businesses in the secondary industrial sector can significantly benefit from using tech-driven business analytics. However, weighing the benefits and drawbacks carefully is crucial and ensuring that the technology maximizes the benefits while minimizing potential drawbacks.

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