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"Smart Technologies And Digital Transformation: A Study Of Industry 4.0 Implications"

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Abstract:

The global industrial landscape has witnessed profound transformations due to the advent of Industry 4.0, marked by the integration of cutting-edge technological advancements into the realm of manufacturing. This comprehensive essay delves deeply into the fundamental concepts, innovative developments, challenges, and prospective ramifications of Industry 4.0 with scholarly rigor and precision. The enormous influence of cyber-physical networks, the web, the Internet of Things (IoT), extensive data analysis, artificial intelligence (AI), and modern robots on manufacturing techniques is emphasized. The report also explores how Industry 4.0 will affect firms, the workforce, customer level satisfaction, and the larger society and SMME's. The report carefully explores impending obstacles, such as data privacy issues, cybersecurity flaws, and the need to upskill the workforce to meet changing needs. The report ends by speculating on probable future trends and trajectories that will direct Industry 4.0's continuous development, bringing in a fresh era of creative thought and progression in the world of manufacturing.

Keywords: Industry 4.0, development, Artificial Intelligence, Technology Advancement, Advancement.

Introduction:

India had a closed market until 1991, when the License Raj was established and the manufacturing sector was given a "quota" for output targets. For the Indian market, overproduction was penalized and imports from other nations came with exorbitant taxes, rendering them economically meaningless(Iyer, 2018). The entire globe has embraced Industry 4.0 as the fourth wave of industrialization. It is sometimes referred to as "smart manufacturing" or "advanced manufacturing," and the terms are frequently used interchangeably with "digital transformation"(López-Robles et al., n.d.). It is anticipated that this development expectation, backed by financial contributions and government programs as well as a proactive approach by private companies in India, will draw multinational manufacturing businesses to become more widespread across the country and foster competition (2020). Without a doubt, in this digital age, businesses are rushing to develop digital skills(2019). With the widespread use of electricity, petroleum, and steel to create mass manufacturing, electrification was a key component of the second industrial age (Industry 2.0). The use of electronic devices in manufacturing processes and the switch to sources of renewable energy were hallmarks of Industry 3.0, or the Third Industrialization. Technology from biology, information technology, and physics are combined to create the Fourth Industrial Revolution, or Industry 4.0(2020). In the early years of the twenty-first century, Industry 4.0 emerged(2019). The fundamental components of it are cyber-physical systems or the networking of the physical world. A multitude of digital and physical technologies, such as the Internet of Things, cloud computing, augmented reality, adaptive robots, and artificial intelligence (IoT), are coming together to create the fourth industrial revolution(Ustundag & Cevikcan, n.d.). Human interactions and communication with their environment have been altered by digitalization. Innovative devices and technology, such as computers, cellphones, autonomous cars, and smart Wearable technology have completely changed how we share and access information knowledge(2020). The rapid advancement of technology is perceived as a potent catalyst for change in the modern world, and its disruption has sparked the beginning of the fourth industrial revolution(2020). The fourth industrial revolution is referred to as "industry 4.0," and the term was first used in 2011 at the Hannover Fair of Industrial Technologies(2020). For a more thorough explanation, consider that Nine technologies, or "pillars," in addition to a dramatic change in the way production and human resource management are carried out, are what enable Industry 4.0 (2020). With the developments enabled by digital technologies such as 5G networks, quantum computing (QC), artificial intelligence (AI), and machine learning (ML), this fourth revolution is having a significant impact on business. It is altering not only how companies globally conduct business, the rapport between vendors and clients, but also the goods that are manufactured and the expectations of consumers for those products(2020). When we talk about digitalization in intelligent manufacturing, we're talking about the use of the most cutting-edge IDT, like the areas include Additive Manufacturing, Augmented Reality, Industrial Internet of Things, and computer-assisted design (CAD), and Manufacturing powered by High-Performance Computing, Blockchain technology, cloud-based computing, big data analysis, and Industrial Simulation (2020). While many nations are moving from analog to digital production processes in business and services, Saudi Arabia is still in the early phases of this shift(2021).

Because investments in manufacturing have a multiplicity influence on GDP growth, manufacturing is seen as a force multiplier. Achieving balanced economic growth requires manufacturing competitiveness because it fosters growth, employment, and productivity while also supporting other sectors of the economy like services and agriculture (2020). The manufacturing methods and formulas that, despite their parallelism, produce comparable outcomes and, as such, serve as the cornerstones of a profitable and competitive enterprise(2021). The integration of lean and I4.0 is changing the definition of manufacturing and could improve the application of LM to find and eliminate waste (2023). It is anticipated that this development expectation, backed by government programs and funding in addition to a proactive approach by private companies in India, will draw multinational manufacturing companies to increase their presence throughout the nation and promote competitiveness(2018). Supply Chains will be transformed by the new Industry 4.0, or I 4.0, paradigm, which improves the handling of assets, Capital flow, forecasting, planning, making decisions, scalability, and information interchange and use. Those who concluded that the shift to intelligent production and SC will play a crucial role in the ongoing industrial revolution have highlighted the need for new SC architecture for Industry 4.0(2023). The establishment of measurement infrastructure will primarily depend on the digital transformation of technological and metrological infrastructure, as well as the development of skilled labor with IT and technical domain knowledge in the coming years. The Government of India's Atma Nirbhar Bharat (self-reliant) goal, Industry 4.0, smart cities, Digital India, and Digital India will all depend heavily on it(2021). Numerous paradigm shifts have been sparked by scientific breakthroughs, innovations, and revolutions since the start of industrialization. Afterward, these were dubbed the "industrial revolutions." The emphasis has recently shifted to Technology 5.0, which seeks to supplement the current "Industry 4.0" strategy. It uses innovation and research to support the shift to a more resilient, sustainable, and human-centered industry(2022). This research aims to determine how Industry 4.0's digitalization components might be prioritized by India's small and medium discrete manufacturing establishments and how they relate to other transformational indicators like increased productivity, quality, efficiency, and flexibility. The project began with an array of awareness-building Industry 4.0 seminars, hosted at various sites across India since SMMEs face the initial issue of understanding what Industry 4.0 is and how those new technologies may improve things.

Literature review:

The convergence of smart technology has ushered in a digital revolution, causing a paradigm shift in our environment from manual to automated processes. Technology convergence is having a fundamental part in the development and evolution of embedded and smart in this age of computerized systems (2021)**.** The rapid advancement of digital technologies has made it possible for cities to change to provide new products and streamline smart services. The way stakeholders and residents live, work, interact, and communicate has changed as a result of digitization. This disruptive modification integrates with any data systems and procedures that are necessary for service delivery. Nonetheless, there are chances for creating smart cities as a result of the digital revolution. Municipalities continue to face challenges in handling the complexity and integration of

data(2021). The idea of sustainability has been gaining momentum among academics, supervisors, and decision-makers. Achieving equilibrium among the economy, society, an). smart technology is used to investigate how the digital transition affects corporate performance. The notion of long-term viability has been gaining traction with decision-makers, supervisors, and academics. Reaching a balance between society, the environment, and the economy requires implementing strategic changes, particularly with regard to the business model(2021). The business environment is changing due to digitalization, and businesses must overcome obstacles to advance. Verifying a company's readiness for digital capabilities, and the creation of well-defined improvement goals is the initial step in providing support. Using a self-check tool, assess the digital preparedness of seven businesses. A case study will be used to go further into the data and uncover the drivers, obstacles, and facilitators of digitalization(2019).

to learn the fundamentals of Industry 4.0, the movement in manufacturing technology and processes toward automation and data interchange. Industry 4.0: We urgently need to adapt and transform the way we operate. Thus, the issue that needs to be asked is: Are we prepared for Industry 4.0? Furthermore, what obstacles do you think we'll be facing soon? Index Terms: Industry 4.0, automation, advantages, and obstacles(2020). Researchers make an effort to address the "responsible production and consumption" SDG number twelve and offer manufacturing groups some guidance. There is still a dearth of studies on smart technologies (ST), digitization (DT), and eco-innovation (EI). Without DT and innovative technologies, enterprises cannot achieve SSCP, even if they are performing SDS and EI. Consequently, it is advised that managers use DT and ST in order to ensure that they are pursuing sustainable performance and making a contribution to the SDGs(2022).

How a company's digital transformation can drive intelligent technologies and enhance relationship performance. The findings of a survey conducted among 280 small and medium-sized businesses (SMEs) in Finland demonstrate that, in order to improve relationship performance, digital transformation must be combined with intelligent technology. This indicates that the connection between digital change and relationship performance is totally mediated by smart technology(2020). the suitability of digital maturity frameworks for supporting smart device makers on their journeys of digital transformation and offer a series of suggestions to enhance the tool's usability in this particular situation. In order to do this, a number of design concepts are applied to the particular situation of smart product manufacturers through the examination of an array of seven maturity models. Based on the most pertinent findings, the model recommendations relate to the requirement for a prescriptive condition, a broad business perspective, and a wider tool scope when defining the dimensions (2020).

The fourth industrial revolution is the foundation for the development of smart cities, which is the primary trend in modern urbanization. Sector 4.0. On the other hand, Industry 4.0 technologies produce radically new "smart city" infrastructure. These new technologies enable the organization of urban production, the management of resource use and energy efficiency improvements, and the management of demographic shifts

in megacities (2019). In the Industry 4.0 era, digital transformation is essential to survival since it enables industries to become more competitive and makes it possible for them to make the best decisions possible at every stage of their operations. There are some real, ROI-verified advantages to Industry 4.0 and IoT (Dr. N. Venkateswaran). With the advent of Industry 4.0 tools and technology, manufacturing firms—particularly SMEs. The suggested model uses a multi-criteria decision support model, specifically AHP, a needs assessment framework based on the Quality Function Deployment approach, by merging the pillars of technology tools, benefits, and limitations of their usage in the manufacturing business(2019). to research the functional domains that might benefit from Industry 4.0 technology and aid in the transformation of India's manufacturing establishments. In light of India's small and medium-sized discrete manufacturing entities' (SMME) goals to implement digital technology for the designated functional areas, it does so. According to the self-assessment of the Indian SMME community, the desired transformation cycle consists of manufacturing and design adjustments after operational measurements(2020). Current maintenance practices using Industry 4.0 technologies and the ensuing opportunities for advancements in factory management and maintenance strategies(2020). In order to implement the European Greener Deal by reconsidering regulations for the provision of clean energy, decision-makers and legislators are considering the possibility of Industry 4.0 as a means of smart technology to develop a green economy. All facets of life will eventually be affected by Industry 4.0; yet, for a digital revolution to be sustainable, it is imperative to recognize the obstacles to its adoption. Of the fourteen challenges listed, the biggest obstacle to Industry 4.0 adoption is "resistance to change," which is followed by "governmental support"(2021). A strategic digitalization guideline is essential for small and medium-sized firms to succeed in the Industry 4.0 shift since the digital transformation required by Industry 4.0 is intricate and resource-intensive. With the help of Industry 4.0, the current study seeks to give manufacturing medium-sized enterprises (SMEs) a roadmap for successful digital transformation. -Eleven success factors are essential to SMEs' attempts to transform digitally. For instance, the results showed that the most difficult factor influencing success in the digital transformation of SMEs is operations technology readiness, with outside funding for digitalization being the first step toward achieving this goal(2021). An organized review of literature (SLR) outlining the relationships, connections, and interdependencies between knowledge management (KM), digital change (DT), and Industry 4.0. KM and decision-making, KM and innovation ecosystems, KM and frontier technologies, and KM and Industry 4.0 are among the several research clusters(2022). perceived advantages and management cooperation are the two main criteria that serve as stepping stones in the deployment of data and digital technology (IDT) of smart manufacturing. It is important to identify and analyze these elements. The results should help academics, businesspeople, and legislators gain a thorough grasp of the processes and environments that support smart manufacturing transformation and the digitalization of production in the Industry 4.0 age(2020). The production process is becoming more digital for the current generation, and this compelling, big shift in the industry has been called Industry 4.0, or the fourth industrial revolution(Nayyar & Kumar, n.d.).

It has been determined that of the 10 firms taken into consideration in the study, the software and automotive industries may be the most suited to adopt Industry 4.0 technology, whereas the construction project management industry may be the least suited. The frequent obstacles to Industry 4.0 technology adoption are also listed, as explained by professionals from each of the ten companies. These three common obstacles include aversion to change, hazy financial gains, and issues with cooperation and coordination(2022). Indian industries are starting to noticeably adopt Industry 4.0. With the highest share in the industry, the Indian engineering sector has enormous potential if it adopts Industry 4.0. By implementing Industry 4.0, the Indian engineering sector can be revolutionized to provide intelligent goods and services(2020). The goal of Industry 4.0 is to build intelligent factories that will transform the way that manufacturing and production are now done by using smart machines to generate goods that are clever and smart. It demonstrates that government-provided Internet access at a discounted cost, financial assistance, and ongoing specialized skill development are the main facilitators since they have significant driving force(2020). The National Manufacturing Policy of the Indian government, which was created in 2011, has been updated to incorporate Industry 4.0 concepts. Government and industry-led initiatives are being initiated to restructure and stimulate India's manufacturing competencies. The maturity survey reveals a number of interesting findings. According to the self-assessment of the Indian SMME community, the desired transformation cycle consists of manufacturing and design adjustments after operational measurements. Because manufacturing and design strategies are dependent on performance metrics, they must first gather real-time machine data, analyze it, and then take the insights gained into account when making decisions about production and design(Dutta et al., 2020a, 2020b). examines India's existing preparation for the Fourth Industrial Revolution to change the ecosystem of its supply chain to smarter technologies. Based on a scale of 0 to 1, India's readiness is marginally above the global average, with a score of 0.44 (most ready). While digital infrastructure, regulations, and cybersecurity are the area's most in need of improvement, government and start-up culture have been identified to be major transformation factors(2023). Provide a conceptual model that illustrates how lean tools are affected by Industry 4.0 (I4.0) technologies. Furthermore, it gives I4.0 technologies top priority for lean factories' digital transformation. The results show that lean manufacturing, simulation, the industrial web of things, horizontal and vertical integration, and cloud manufacturing all affect 100% of the lean instruments, while cyber-security and big data analytics affect 93% and 74% of the lean tools, respectively(2023). A strong literature base demonstrates how industry 4.0 (I4.0) technology helps firms gain a competitive edge and lessen disruptive emergency situations. To achieve competitiveness in both normal and emergency situations, manufacturing organizations need to be more transparent about how they implement I4.0 technologies to digitally transform. This study captured the role, definition, and process of formulating MS4.0 and proposed a framework to assist practitioners in doing so(2023). The company raises the caliber of its Based on the degree of relevance of these variables, understanding into these variables, and sub-factors to prioritize them, 4.0 performs to its success. The AHP model shows that "Committed Leadership" is acknowledged as the most important organizational characteristic and is ranked highest, followed by quality culture and

collaboration, which are created at a higher level. Contributing qualities include these crucial organizational variables and the priorities of their subcategories (2022).

Research gap:

The preceding sections' contexts aid in the conceptualization of Industry 4.0 about SMMEs in India. However, it was noted that the majority of earlier research focused more on the IT portrayal of the technology in question, i.e., the isolated capabilities of the cutting-edge technologies that are available for both product and procedure definition, confirmation, interfacing, data generation, and data exchange. SMMEs to organize and carry out an Industry 4.0 technology rollout in a prioritized manner. One of the major gaps in the literature review is the lack of sufficient insights for SMMEs to prioritize the implementation of Industry 4.0 elements. SMMEs must comprehend how to develop a comprehensive view of the digitalized value chain over their businesses while also identifying the areas of greatest need where technologies from Industry 4.0 can be embraced to achieve transformation. It is crucial to understand that each SMME is distinct due to its line of business, the dominant drivers in the market, and the organizational principles it hopes to create and uphold. From this vantage point, SMMEs in particular must prioritize the most impactful areas of implementation to establish organizational preparedness based on current maturity levels and identify their specific process change needs before implementing smart manufacturing practices. Despite several studies on Industry 4.0 and its advantages for business, little is known about the actual transformation journey, including preparation, short-term target selection, ongoing monitoring, and action. Consequently, the absence of research insights on the process of transformation and the dynamic perspective of benefits obtained during such a journey is another significant gap identified from the literature study.

Furthermore, it was noted that although previous international academic study has looked at the components of disruptive technologies and Industry 4.0, it has not adequately highlighted the Indian context because there hasn't been much research done specifically on India in this field. Establishing a well-defined roadmap with success criteria is crucial in encouraging Indian SMMEs to adopt Industry 4.0. This covers the component of filling the skills and manpower gaps needed to facilitate organizational change. One of the main concerns for the coming industrial revolution is manpower since new skills are needed at every level, including managerial, supervisory, and technical. Thus, the lack of an Indian context under the body of research literature now in publication is another significant gap that the literature review has identified.

Research methodology:

The research approach advocated in this study for comprehending the foundational principles of Industry 4.0 and the potential transformative impact of disruptive technologies on Small and Medium-Sized Enterprises (SMMEs) is a strategic response to a prominent challenge faced by Indian SMMEs. A significant proportion of these enterprises currently grapple with a dearth of personnel possessing requisite expertise, necessitating proactive measures to heighten awareness regarding the salience of Industry 4.0 in advancing their business ventures. These measures encompass the alignment of conceptual frameworks with Industry 4.0 specifications, followed by the execution of maturity self-assessments, aimed at discerning disparities between aspirational goals and organizational values.

The extant literature research has proven instrumental in facilitating an in-depth comprehension of Industry 4.0 technologies within the specific context of manufacturing firms, with a specific focus on Indian SMMEs. This literature review has served the dual purpose of contextualizing the ongoing research on digital transformation while furnishing a knowledge repository to be disseminated among representatives of Indian SMMEs, thereby fostering heightened awareness. Consequently, this initiative has empowered SMMEs to envisage targeted projects that align with their corporate objectives.

The research methodology devised for this study commences with a rigorous review of the contemporary literature pertaining to the technologies underpinning Industry 4.0, intelligent manufacturing paradigms, as well as the prevailing business imperatives and challenges confronting both Indian and international Small and Medium-Sized Enterprises (SMMEs), both presently and in anticipation of future trends. This extensive literature examination furnishes a holistic understanding of the technological constituents of Industry 4.0, elucidates its repercussions for Indian SMMEs, identifies critical gaps in existing research, and delineates the definitional boundaries of the present study. The overarching objective of this literature review is to systematically amass and consolidate pertinent data, thus laying the foundation for subsequent phases of the research inquiry.

Result And Analysis:

The outcomes of the maturity assessment were systematically compiled, categorized, and comprehensively analyzed within an Excel dataset, facilitating the derivation of overarching trends with respect to the seven functional domains. A straightforward methodological approach was devised to establish a unified perspective on the disparities between the present state of affairs and the ambitious responses across each facet of the seven functional areas. These insights are instrumental in guiding actionable decisions, particularly since the response dataset was non-probabilistic in nature, precluding the intent to draw probabilistic inferences. Program management, encompassing the synthesis of client requirements, development of specifications and detailed designs, vigilant monitoring of project budgets and timelines, and successful task completion within designated budgetary, temporal, and quality constraints, can be expedited through the utilization of digital technologies

that foster collaborative efforts. Evidently, a prevailing aspiration among the majority of Indian Small and Medium-Sized Enterprises (SMMEs) is to transition from their current status as component manufacturers to ascend the value chain and assume the role of system providers. In their production planning endeavors, SMMEs aspire to work in conjunction with an integrated manufacturing bill of process (IMBP), which delineates the resource allocation and process plans aligned with the final product design.

Within the purview of production engineering responsibilities, the automation of decision-making processes, validation of CNC and robotic program implementations, and virtual commissioning of PLCs and controllers for simulating and validating manufacturing process designs hold paramount significance. The integration of Industry 4.0 components represents a pivotal avenue for enhancing asset utilization and ensuring optimal manufacturing output from the outset. Furthermore, to meet customer service level agreements (SLAs) through predictive maintenance grounded in real-time data sourced from the field, the customer-facing post-sales services department aspires to leverage the Internet of Things (IoT) for seamless integration with maintenance processes.

In the context of employing diverse automation technologies and programmable equipment, such as PLCs, CNC machines, and robots, a noticeable discrepancy exists on the factory floor in terms of realization vis-à-vis aspirations. To bridge this gap, the adoption of offline computing and the integration of Industry 4.0 simulation components can significantly enhance operational efficiency, velocity, and precision. This is in stark contrast to the conventional approach characterized by computer programming or machine learning reliant on a trial-and-error methodology. An additional prominent area where a substantial aspirational deficit is evident pertains to alternative evaluations within the domain of design and production scheduling functions. Modern designers equip themselves with the ability to conduct multiple alternative design assessments, utilizing performance simulations to discern the optimal design solution. Process innovation is encouraged by alternative evaluations in the industrial planning function. Modern production planners choose the best option by simulating, assessing, and validating several process alternatives. As a result, production quality, equipment utilization, and overall efficiency all increase.

Based on the findings of the maturity assessment survey, it is evident that Indian Small and Medium-Sized Enterprises (SMMEs) are inclined towards prioritizing the incorporation of connected machines, data collection, and analytics within their Industry 4.0 adoption strategy. In this context, the pivotal elements of Industry 4.0 implementation encompass connected machines, Internet of Things (IoT), cloud computing, and big data analytics, which are facilitated through comprehensive systems integration, design enhancements, and manufacturing interventions. The integration of these technologies is imperative for optimizing design, quality, and production processes, yielding valuable insights and analytics. Furthermore, the adoption of digital documentation across all functions becomes essential to ensure regulatory compliance and preserve traceability. Integrated product costing mechanisms play a crucial role in maintaining profitability by meticulously monitoring both process and product costs, including change-related expenses. The utilization of metrics for

capacity and usage allows for precise control and productivity enhancement. To address the demands of a dynamic shop floor and unforeseen order fluctuations, industrial technological solutions that facilitate flexible automation are indispensable. Through effective human-machine interfaces, they enhance process transparency and enable real-time monitoring and diagnostics at various stages, such as machine, cell, line, and plant levels. Notably, these solutions identify, quantify, and track factors that influence production efficiency, ultimately simplifying shop floor decision-making and rendering it more user-friendly and agile. In summary, these strategic priorities embody the collective pursuit of fostering Industry 4.0 adoption within the SMME sector in India.

Conclusion:

Visualizing Industry 4.0, we aim to delineate prospective pioneering technologies, entrepreneurial prospects, societal hurdles, and human resource requisites intertwined with this transformative paradigm shift. (2022). The purpose of this study was to examine how each I4.0 digital technology affects lean tools in a theoretical framework and to rank I4.0 technologies based on a survey of industry comprehensive experts. The central theoretical contribution of this study resides in the presentation of the MS 4.0 conceptual framework, serving as a valuable tool for formulating a strategy to assimilate Industry 4.0 technologies into the realm of manufacturing. Industry 4.0's digital revolution and the AI it incorporates open the door to the development of Smart Factories that rely on CPPS(2021).

This framework also helps to reduce complexity when implementing smart and intelligent technologies, thereby easing issues in both routine and emergency scenarios. Drawing from the aforementioned study, it can be inferred that research on Industry 4.0 specifically for India, given the country's substantial SMME population, is now in the defining and awareness-raising stages.

Industry 4.0 serves as a catalyst for innovation and the advancement of mass customization, necessitating an evaluation and customization of techniques for specific implementations. The strategic approach in India must duly consider the burgeoning pool of skilled workers within the manufacturing workforce, which has emerged as a pivotal determinant of success in the journey toward Industry 4.0 adoption. The current research undertaking holds substantial potential for impacting both the scholarly community and industry professionals, as it represents an early and pioneering endeavor aimed at formulating an actionable blueprint for the digitization of manufacturing enterprises through the lens of production strategy.

The primary objective of this research is to accord Indian Small and Medium-Sized Enterprises (SMMEs) precedence in the realm of Industry 4.0 components. Among the eight facets of integrating Industry 4.0 systems, eight represent disruptive technologies available for selection and integration, while one has been specifically earmarked as a "priority" strategic endeavor to be undertaken by SMMEs in India. An integral facet of this

study has also encompassed an exploration of the unique organizational principles inherent to disruptive innovations, as comprehending these principles serves as the cornerstone for their adoption and prioritization.

The suggested framework, which is conceptual in nature, can be further explained in light of the insights obtained from actually putting the framework into practice. Future research opportunities were identified by the current study. The current approach has certain drawbacks that will need to be fixed in the future. Further research is required to determine whether this methodology can be applied more broadly to evaluate the adoption of Industry 4.0 maturity, even though the evaluation survey findings were unambiguous regarding the maturity definitions. In order to determine the maturity level of an organization, factual and perceptual assessments are also necessary.

The outcomes acquired will also verify the metrics used to investigate the advantages of implementing Industry 4.0 components. Although standardizing the maturity assessment technique is one of the research's long-term objectives. Future research initiatives are strongly encouraged to conduct case studies encompassing the implementation of the proposed MS 4.0 framework. To attain cost-effective process visibility, automated data collection, process orchestration for heightened throughput, utilization, and efficiency, and, most importantly, to identify areas of improvement both downstream and upstream, which can enhance business value and benefit the industries in India, further investigation and comprehension are imperative. The industry 5.0 idea, which emphasizes resilience, sustainability, and human centricity, is also something to consider(2022).

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