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A SURVEY ON INDUSTRY 4.0 READINESS OF MANUFACTURING MSME IN INDIA

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Abstract:

Industry 4.0(I4.0) refers to a new industrial revolution in which technology is used to integrate management processes to provide digital solutions to support market dynamism. The existing literature on Industry 4.0 has been largely focused on enabling technologies and their impact in various industrial situations. There is a scarcity of research that gives empirical information on how manufacturing industries, particularly manufacturing MSMEs, are dealing with digital transformation. The purpose of this research is to gather data on the degree of understanding, preparedness, and propagation of the Industry 4.0 paradigm in Indian Micro, Small, and Medium Enterprises (MSMEs). For the research, 356 MSMEs were interviewed. Industry interviews, as well as other data acquired and analyzed during this study, demonstrate that MSMEs have little awareness of Industry 4.0 and are unprepared to deploy it.

Keywords: *Industry 4.0 (I4.0), Smart Manufacturing, Survey, Readiness level, MSME, Technology.*

1. Introduction:

Consumers all around the globe expect a gradual improvement in living standards while also considering environmentally friendly options, and the business has been developing and changing to fulfill these needs (Young et al., 2010). Businesses all around the world must alter their business techniques and comply with both express and implicit customer needs as the consumption pattern changes on a regular and nearly unanticipated basis (Gilg et al., 2005). Rapid technological upgrading, evolution, and change are the actual key issues of industrial businesses, data and data

analytics have become a vital asset connected to organizational success. Industry 4.0 envisions a digital transformation in the company, fusing the cyber-physical world with the actual world of manufacturing to enable networked production with improved process transparency(El Hamdi et al., 2018)

The fourth industrial revolution, as well as the underlying digital change known as Industry 4.0, is advancing at an exponential rate (Ghobakhloo, 2020). Industry 4.0 is a component of the entrepreneurial strategy for surviving in quickly changing marketplaces (Brozzi et al., 2021).Industry 4.0 has developed to transform the globe, bringing with it digitalization and new technology. Companies and organizations from around the world have worked hard to support the effort, which aims to enhance how businesses operate. This is accomplished by enabling them to make real-time choices by providing a digital interface between all of the parts involved across the value chain (Treviño-Elizondo & García-Reyes, 2020). Industry 4.0 is a new industrial stage in which numerous developing technologies are convergent to give digital solutions(Frank et al., 2019).These innovative technologies enable ever-increasing levels of industrial efficiency. They also have the potential to have a significant impact on social and environmental sustainability development. Organizations must examine the impact of Industry 4.0 technology on sustainability (Bai et al., 2020).

The transition to Industry 4.0 has become critical for nations, and a cohesive transformation plan necessitates a complete view of the present status and future vision (Tripathi & Gupta, 2021). Digitization and intelligentization of production processes are essential in today's business. Currently, the manufacturing industries are transitioning from mass production to customized production. Rapid improvements in manufacturing technology and industrial applications aid in enhancing productivity (Vaidya et al., 2018).Industry 4.0 has just recently begun to make inroads into Indian manufacturing and other areas. The fourth Industrial Revolution, or Industry 4.0, is still in its early stages in India (Luthra et al., 2019).

Industry 4.0 techniques, concepts, and technologies are becoming increasingly important to obtain long-term and competitive benefits for industrial organizations as well as small and medium-sized businesses (Safar et al., 2020). Smart manufacturing is provided by the Industry 4.0 revolution, which systematically integrates industrial technologies and enhanced operational management. Adopting these high-level solutions can improve manufacturing efficiency, lower energy usage, and lower manufacturing costs. Simultaneously, small and medium-sized companies provided the foundation for economic growth and development. They still lack the information and decision-making power to validate the performance and application of this advanced technology (Chonsawat & Sopadang, 2020).

To remain competitive, manufacturing businesses must face significant challenges in the

disruptive ideas of Smart Manufacturing and Industry 4.0 (Zhong et al., 2017). Most multinational enterprises have begun the process of implementing Smart Manufacturing. Small and Medium-Enterprise are still trying to comprehend the complexity presented by Smart Manufacturing, and many of them are not ready to accept the notion of Smart Manufacturing as a mainstay of many industrial economies (Sariyer et al., 2021). To address this, before beginning on a Smart Manufacturing journey, Small, Medium and Micro enterprises must first analyze their preparedness and maturity (Radzi et al., 2021).

As a result of Industry 4.0, industrial processes have been transformed(Stock & Seliger, 2016). Companies are increasingly being driven to change their operations to keep up with technological breakthroughs that have resulted in a digital revolution (Parida et al., 2019). Small and medium-sized enterprises, on the other hand, have the most difficulty assessing their industry 4.0 readiness status and developing a strategy to implement industry 4.0 ideas (Castro et al., 2019).A digital divide is growing in the industrial supply base between big defense and commercial manufacturers, Original Equipment Manufacturers, and Small and Medium-sized Manufacturers (Harris et al., 2019).

Technology's rapid advancement permits and pushes Industry 4.0, or the digital revolution of the industry (Lu, 2017). Businesses and economies face major hurdles as a result of the continually changing environment(Zhou et al., 2016). Enterprise executives must have a full awareness of their companies' preparation for the fourth industrial revolution to make the appropriate decisions to retain or grow their competitiveness (Rajnai & Kocsis, 2018).Industry 4.0 transforms the design, processes, operations, and services of commodities and industrial systems considerably. Adoption of this concept, without a doubt, has further consequences for management and future career chances via the development of new business models (Ślusarczyk, 2018).

Industry 4.0 is seen as an industrial idea that requires the integration of both value-added business divisions and value-added chains that leverage growing technology to provide digital solutions (Ghobakhloo, 2020). However, there is still a lack of understanding and competence concerning this concept, notably its implementation, project outcomes, and investment costs (Mrugalska & Stasiuk-Piekarska, 2020).

SAMARTH Udyog Bharat 4.0 is an Industry 4.0 project of the Government of India's Ministry of Heavy Industry and Public Enterprises. Manufacturers, vendors, and customers are the primary stakeholders. To raise awareness of Industry 4.0 among Indian manufacturing industries, experience and demonstration centers for Industry 4.0 have been proposed. However, the effects of the government's actions are unknown. This research sought to ascertain how Indian manufacturing MSMEs reacted to a series of major activities aimed at commencing the shift to Industry 4.0. The

purpose of this study is to elicit the views of Indian manufacturing MSMEs on issues concerning the knowledge and implementation of Industry 4.0 technologies.

2. Methodology:

This research is an exploratory quantitative analysis aimed to provide empirical data on how manufacturing MSME are dealing with the transition to Industry 4.0. A structured questionnaire was created in Google forms (Raju et al., 2018), and an email with a web link was sent to the responders.

The questionnaire was divided into two sections. The first section included preliminary information on the firm, such as respondent personal information and the company's size. The second section included questions adapted from (Tortora et al., 2021) about firm innovation and development aimed at developing R&D and other project collaborations, Industry 4.0 awareness on enabling technologies (Additive manufacturing, Advanced manufacturing solutions, Data Analytics, Blockchain, cloud, cyber security, IoT, Social e mobile, Intelligent materials, simulation), advantages and challenges in business activities, employees, technologies adopted, motivation, and internal organizational changes were examined, and future development in future programs and forecast for future investment in Industry 4.0 is considered.

The top three states with the highest number of registered MSMEs, Maharashtra, Tamil Nadu, and Uttar Pradesh, were chosen. A list of registered manufacturing MSMEs was obtained from the Ministry of Micro, Small, and Medium Enterprises' Udayam Registration portal, a simple random sampling technique was used to select the unit, and 500 units were selected using a lottery method from each state, and emails with a questionnaire link were sent.The data was gathered over one month, with a weekly reminder email sent out. At the end of the data collecting period, a total of 732 responses were obtained, which is within the acceptable range (Baruch & Holtom, 2008).

3. Results:

The sample consisted of 732 companies from three states Maharashtra, Tamil Nadu, and Uttar Pradesh.

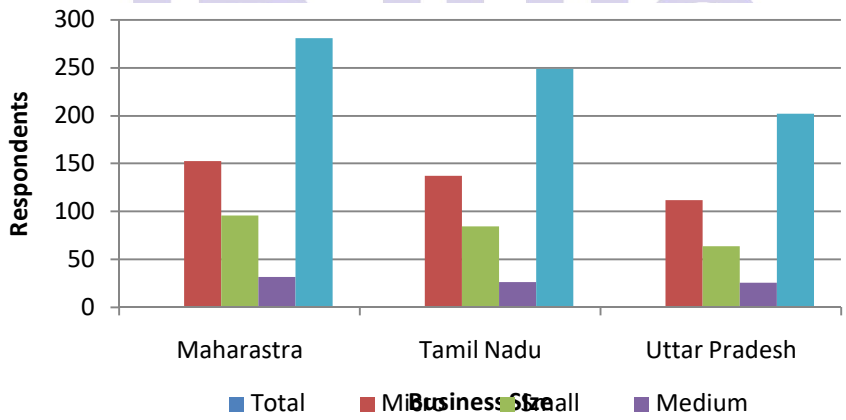


Fig.1. Distribution of the company size

3.1 Distribution of the company size:

Figure 1 depicts the distribution of respondents' firm sizes. A total of 732 replies were received, with Maharashtra (281) accounting for 38.4 percent, Tamil Nadu (249) accounting for 34.1 percent, and Uttar Pradesh (202) accounting for 27.5 percent. The sample includes 54.9 percent Micro size businesses, 33.5 percent Small size businesses, and 11.6 percent Medium size businesses.

3.2. Innovation and R&D development:

Figure 2 displays the possibilities for Manufacturing MSMEs in terms of innovation and R&D. In 33% of situations, medium-sized businesses cooperated with bigger organizations, 13% collaborated with the government; 11% engaged with other entities, and 1% collaborated occasionally on R&D and innovation development. 26 % of small businesses have collaborated with bigger organizations, 7% with government, 11% with other entities, and 3% have collaborated on occasion for innovation and R&D. 12% of micro businesses collaborate with bigger organizations, 8% collaborate with the government, 10% collaborate with other entities, and 9% collaborate on occasionally for development of innovation and R&D. In the micro, small, and medium industries, respectively, 61%, 53%, and 42% do not collaborate on innovation and R&D.

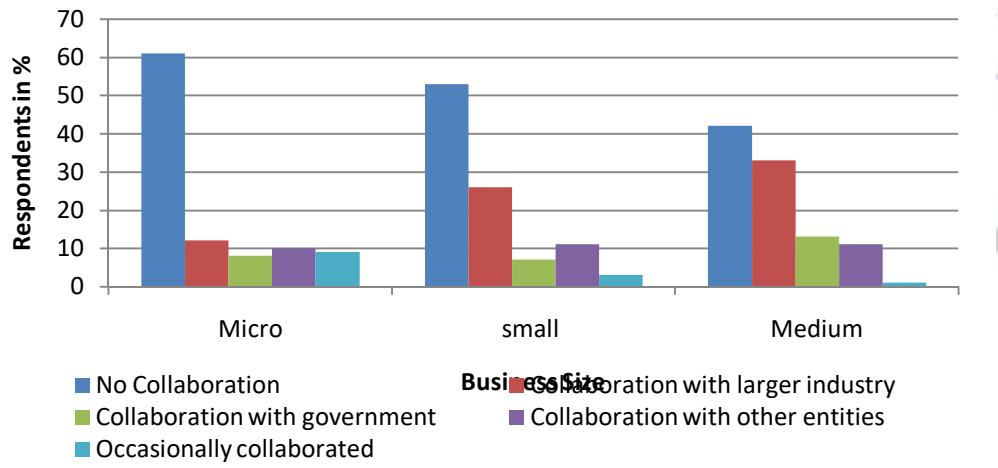


Fig.2. Innovation and R&D development

3.3. Industry 4.0 Awareness:

Figure 3 indicates the respondents' degree of Industry 4.0 awareness. 23.8% of micro businesses, 18% of small businesses, and 12.1% of medium businesses are unaware of Industry 4.0 trends and technology.

Table 1 will offer a thorough overview of the MSME's degree of knowledge and application ofIndustry 4.0 enabling technologies by company size, the findings suggest that many micro-businesses have a basic understanding of the technologies. Data analytics, social and mobile technology, and simulation technologies are all areas where 29.1% of small enterprises excel. 33.5% of medium-sized enterprises have an advanced understanding of additive manufacturing, advanced

manufacturing, and simulation methods. Only 39.5% of micro-firms have used this technology in their operations. Small enterprises have a somewhat greater rate of adoption (16.6%) and 38.6% are in the early stages of using these technologies. Medium-sized enterprises have shown the highest rate of implementation with 22.5%, 55.1% have started to adopt them. However, 51.2%, 44.2%, and 22.4% of micro, small, and medium businesses, respectively, have made no steps toward using industry 4.0 technologies in their businesses.

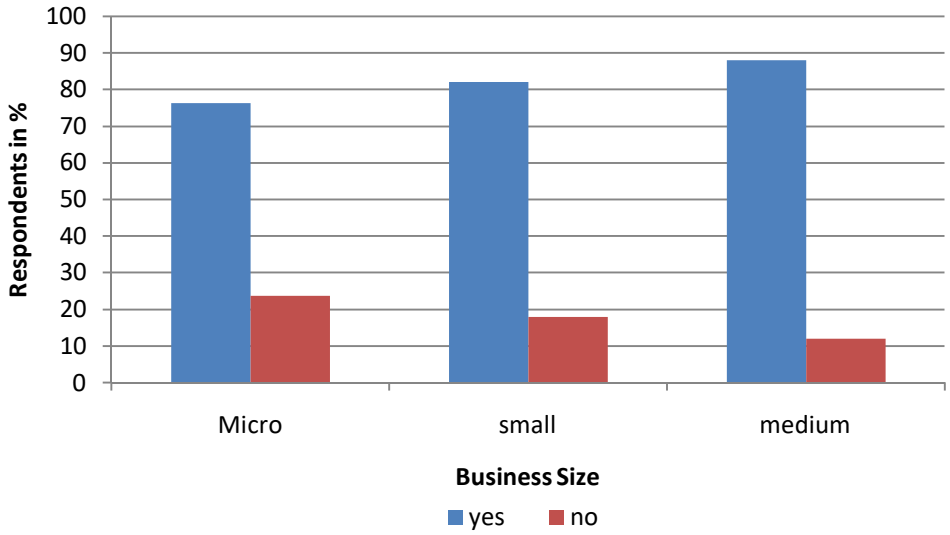


Fig.3. Knowledge on Industry 4.0 Trend

Technologies	Knowledge degree (in %)									Application degree (in%)								
	Micro			small			medium			micro			small			medium		
	High	Basic	None	High	Basic	None	High	Basic	None	High	Initial stage	No action	High	Initial stage	No action	High	Initial stage	No action
Additive Manufacturing	2	78	20	16	71	13	56	38	6	0	52	48	7	53	40	16	51	33
Advanced Manufacturing solutions	12	63	25	26	41	33	42	51	7	8	43	49	12	27	61	22	73	5
Data Analytics	26	43	31	54	41	5	26	53	21	9	47	44	17	41	42	18	67	15
Cloud	33	64	3	27	73	0	43	57	0	11	36	53	26	43	31	24	68	8
Block chain	43	52	5	28	59	13	37	63	0	23	31	46	8	21	71	16	43	41
Cyber Security	37	28	35	31	64	5	34	47	19	10	32	58	16	33	51	19	53	28
IOT activities	12	75	13	23	18	59	24	49	27	6	51	43	23	49	28	26	59	15
Social & Mobile	23	68	20	38	53	9	18	62	20	18	68	14	38	46	16	38	59	3
Intelligent Material	35	26	39	12	59	29	12	73	15	2	12	86	6	20	68	9	26	65
Simulation	13	29	58	36	50	14	43	51	6	6	23	71	13	53	34	37	52	11

Table 1: Application and Knowledge degree

3.4 Opportunities and challenges:

According to the data, adopting industry 4.0 practices and technologies in their business would result in several benefits, including increased productivity, new market exploration, improved competitiveness, the creation of new business models, sustainability, and, most importantly, product customization based on customer needs. However, these firms have severe challenges in adopting Industry 4.0, which must be addressed. Lack of financial resources, technology adoption, training, skill shortages, and a lack of technology suppliers are just a few of the issues that need to be addressed.

Figure 6 depicts the results in terms of manufacturing MSMEs' obstacles in implementing Industry 4.0 technology. A primary challenge, according to 41% of respondents, is securing financial resources. A secondary challenge, according to 26% of respondents, is adopting new technology. A third challenge, according to 12 percent of respondents, is training employees on new technologies. A third challenge, according to 13 percent of respondents, is a shortage of skilled personnel to assist in the adoption of new technologies.

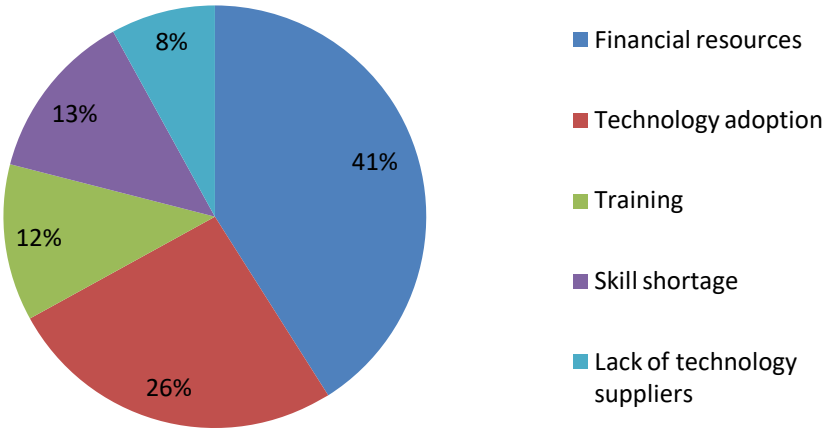
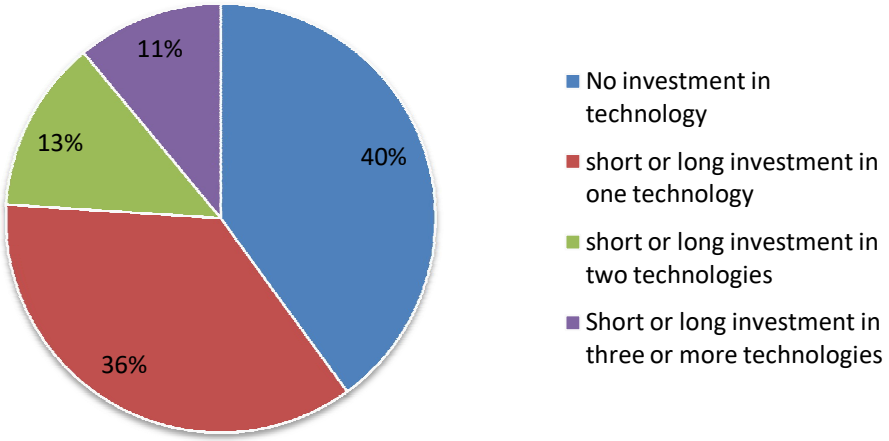


Fig.4. Challenges faced in

3.5 Future initiatives:

Industry 4.0 efforts must be developed over time since they demand significant investment and training. It's a long-term process that necessitates creating and evaluating long-term goals. Figure 7 depicts the MSMEs' future business ambitions in enabling technology. Micro businesses have no immediate intentions to invest in technology, but they do have long-term plans to spend in technology over the next five years. 38.6% of Small businesses have begun to invest in both short and long-term innovative technology.55% of the medium sized businesses has already implemented industry 4.0 technologies.



Additive manufacturing advanced manufacturing processes, social and mobile technologies, and simulation technologies are among the technologies that manufacturing MSMEs are most interested in. Respondents are particularly interested in receiving training on Industry 4.0 challenges as well as staff training, specifically on software technologies, automation, and simulation technologies.

4. Discussion and conclusion:

Industry 4.0 is focused on the rigorous integration of humans in the industrial process to achieve continuous improvement and a focus on value-added activities by minimizing waste. In practical applications, there is an enormous technological drive. This technological drive has already had an impact on daily life in many domains, leading to increased mechanization and automation, digitalization and networking, and miniaturization.

Analyzing the individual level of adopting enabling technologies to prove that MSMEs in most cases are not interested in investing in technologies. Some respondents have low or short investments in technologies and this is due to their lack of understanding of Industry 4.0 technology concepts.

According to the findings of this study, manufacturing MSMEs have little awareness of enabling technologies based on Industry 4.0. According to the study results, manufacturing MSMEs in India are underserved when it comes to Industry 4.0 and associated technology. More than 40% of the MSMEs in the research had just a rudimentary understanding of the technology. This shows that MSMEs are still a long way from adopting change in preparation for Industry 4.0. There is a huge demand for the development of new business models, which necessitates the availability of appropriately qualified individuals to embrace technology and reap its benefits.

As a result, it is clear that investing in technology does not ensure competitive success; it is also necessary to adequately inform and train the staff to achieve the strategic transformation in the

organization. Due to financial constraints, some responders do not have access to equipment and software. To deal with this, MSMEs must utilize the best technique for lowering production costs by enhancing labor and technological efficiency.

Manufacturing MSMEs understand the need of investing in technology, but there is a gap owing to a lack of digital culture and training programs. To increase innovation and R&D, MSMEs should work more closely with bigger enterprises, governments, and other agencies to adapt to the Industry 4.0 paradigm.

The findings of this study provide a preliminary overview of the present state of manufacturing MSMEs' adoption of Industry 4.0. It will aid in the development of a framework for decision-makers. Most MSMEs are ignorant of the potential prospects presented by Industry4.0 since it necessitates a thorough understanding, expertise, and skill.

5. Limitations and future research:

This study included MSMEs from several manufacturing sectors, which inevitably affects the dimensionality of the study; a more extensive examination among different sectors and clusters may be relevant. Given the sample size, the top three states with the most registered manufacturing MSMEs were chosen for this exploratory study; however, this analysis can be expanded to include other states for more meaningful findings. This study will serve as a foundation for understanding how manufacturing MSMEs are embracing digitization in preparation for Industry 4.0. The impact of applied technology on industrial performance will be an intriguing area for future investigation. This research will serve as a foundation for future studies on the digitalization process, technological adaption, and industrial performance for Industry 4.0.

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