



Challenges in implementing industry revolution 4.0 in INDIAN manufacturing SMES: insights from five case studies

Suresh N^{1*}, Hemamala K¹, Ashok N¹

¹ School of Business, Amrita Vishwa Vidyapeetham, Coimbatore, India, [3] Arba Minch Institute of Technology, Arba Minch University, Arba Minch, Ethiopia

*Corresponding author E-mail:

Abstract

Purpose-This research examines Small and Medium manufacturing Enterprises (SME's) awareness, current capability, willingness and ability to identify the challenges involved in implementing Industry 4.0(I 4.0) at their premises.

Design/methodology/approach-A set of questionnaire was framed to collect qualitative and quantitative data from five manufacturing SME's and they were analyzed to gain insight.

Findings -3 out of 5 manufacturing SME's are aware, capable, willing and have ability to identify the challenges for implementing Industry 4.0 at their premises. The study also found that implementation of I 4.0 depends on size of the firm. Medium size manufacturing firms had started investing in Information Technology but small scale industries is still struggling to figure out their long term benefit.

Practical implications - The advancement and the integration of the technologies such as Cyber Physical system, Internet Of Things, Artificial intelligence, Big data, Cloud computing and 3D printing provides greater flexibility to the manufacturing firms. In today's global competition with a huge demand for personalized products at low price with best quality, innovation and capability to full filling batch size of one is becoming important. Hence, to meet the market demand many large-scale industries started investing in advanced technology where SME has yet to pay attention.

Originality/value -Paper indicates the Indian manufacturing SME's preparedness for Industry 4.0. It contains five cases capturing the current manufacturing practices followed in the SME's and their capability towards implementing Industry I 4.0 in Indian environment.

Keywords: Big Data; Cps Technology; India; Industry 4.0; Smart Factory; SME.

1. Introduction

Flexibility is becoming a buzz word in manufacturing firm, either it be large scale Multi National Company or Small and Medium scale enterprise. Globalization and liberalization has entirely changed the life cycle of the products now a day. Customer's started moving to personalized products from standardized products reducing the production batch size to one, demanding high quality at low price. Due to immense competition the manufacturing firms were forced to establish production lines or process that can deliver high degree of flexibility to full fill the dynamic market needs. In order to meet such high requirement German federal government in the year 2013 conducted a industrial exhibition to unveil their strategic move "Industry 4.0". I 4.0 is a combination of information and intelligence technology, it is framed in such a way that to provide German industries competitive edge by the year 2020. Revolution of industry began in the early 18th century where steam was used to run engines known as Industry 1.0, then in the year 1870 Industry 2.0 was introduced where labor, assembly line and electric motor was used for production. Industry 3.0 came after a century in 1970 with the use of information technology, introducing automated production system. The era of internet and the growth of disruptive technology emerging day by day have played a significant role in establishing I 4.0. It will provide competitive edge to the large scale MNC in Germany unless their supplier's, generally SME's has a proper guidance, involvement and interest towards implementing or modifying their production

system as per requirement of I 4.0 otherwise it will be seen as a hype than a hike [3], [10], [21]. Many countries had started their journey towards I 4.0. In India SMEs contribute 8 % of GDP in the year 2016 and it is predicted that the contribution percentage to grow by 50% due to continues initiative schemes taken by Government of India. This research paper understands and measures the Indian manufacturing SMEs s awareness, current capability, willingness and ability to identify the challenge in implementing me 4.0.

The previous literature helped to identify the requirements for implementing Industry 4.0 in SME's. They are listed in the Table I. This paper not only brings out the challenges that Indian manufacturing SMEs 's is going to face in implementing Industry I 4.0, it also helps large scale enterprises to understand the problem that they may face when their supplier (most of them are SME's in case of India) don't have capability to meet their future requirement

2. Theoretical background

Every business in general should be aware, ready and capable to meet the challenges that are going to be imposed during the transition period. SME's in German are very much aware about digitalization and I 4.0 but their preparedness for it is too low. Their active participation is also goes down as the firm size decreases. While large scale enterprises are very keen in implementing I 4.0, the gap between expectation and actual capability of SME's in-

creases. If it continues then SME's will become victims than attaining advantage from this revolution [16]. SME's require exposure to the modern technology and the benefits that can be obtained from them. Fear of failure, skill and investment requirement act as the barrier for implementing I 4.0. By Integrating top and shop floor, creates high degree of transparency and provides real time status of supply chain. The real time information helps to take real time decision than carrying post-mortem of process [5]. Device or process performing an activity analyses its output and takes corrective action by their own or with less human intervention is known as smart device or smart process or smart factory. They add flexibility to the production the one of the most required factor for I 4.0. The success of attaining flexibility relays on two factors, one is the precision of integration of horizontal and vertical along with value chain and second one is managing and utilization of information flowing inside the chain. It also helps to reduce lead time, meeting small batch size along with financial benefit such as reduced capital cost, personal cost, out sourcing and energy consumption cost for production. Though there are many advantage the issues like dealing with real time data storage, processing and analysis, working under optimum capacity and standards for technical pre requisites to be addressed for long term success of I 4.0 [7]. Transformation or up gradation of manufacturing SME's towards I 4.0 requires new ideas. One of the ways to gain innovative idea is by integrating IT with manufacturing technology to build flexibility. Identifying the driving force will provide competitive advantage and helps to build core technology. But large scale industries should share their technology innovation with SME's, so that they can train and develop their capability to meet the expectations [20].

I 4.0 is a series of networking of man, machine and process. IOT, IOS, CPS are going to be the technology driver used to build smart factory to deliver flexibility to the production line. This technologies are already exists it's a matter of networking together to gain advantage. I 4.0 has a wide range application technology being the main focus area replacing human and organization in future [9].

Rapid development in IT and computing skills lead to innovation many new technologies such as IOT, big data, cloud computing and artificial intelligence. By integrating these technology machines were able to communicate, analyze, negotiate and coordinate within themselves. This helped to make a factory as a "Smart Factory" adding flexibility. Though I 4.0 have huge scope they have to sort out hurdles like cyber security, high speed IWN protocol, handling big data, building flexibility etc. It's better to implement I 4.0 in stages than Instead of re-engineering the entire process in one go [19].

The internet boom in early 1990's lead to drastic change in consumer world by introducing online services such as shopping, banking, auctions, brokerage and video streaming. Similarly I 4.0 is going to be the future of manufacturing industry irrespective of people acceptance or adoption. I 4.0 assure us it's going to be a big hit if everyone joins hands together to overcome those challenges [3]. One of the challenge that CPS faces is co-coordinating different entities or machines to operate in a common global platform. This increases the complexity and decreases the performance of the entire process. Other such challenge is control over timely data sharing. CPS has less control on it if it is not addressed earlier it will lead to mistiming causing huge damage to the process. [13]. Any production system willing to implement I 4.0 has to three steps to do. First step is to identify and connect the area that requires continuous communication in the production system. Next step is to collect, transfer and analysis those data using application and finally integrate the application and production to take timely decision [15]. Most of the current manufacturing process perform inspection at the end of the process or shift. I 4.0 help firms to identify the problem in realistic approach known as digital lean. By reducing the waste through eliminating non-value added activities using sensors, robots, data analytics and automation [1], [2], [8]. I 4.0 prefer predictive manufacturing along with the help of advance prediction tool. It converts data's into information to

reduce the uncertainty while making decision. The key areas where data analysis helps I 4.0 are predicting machine health, transparent supply chain, reduction labor cost, better working environment, energy saving and maintenance schedule [11].

Table 1

Planning	SME's don't know how to detect
	the future growth opportunities [6].
Flexibility	Most of the SME's are currently working in between Industry 2.0 and 3.0 [18]
Horizontal and vertical integration	Integration between shop floor, top floor and other department using IT system are very less famous, so establishing a good communication network became Tough [14].
Awareness and Willingness	Many SME's are not aware of the concept Industry 4.0 and they have very less willingness to invest in Digital technology [16].
Ability to identify challenges	Roadmaps towards I 4.0 helps to identify the future requirement of production system for transforming from current state to I 4.0 [4]
Use of IT	Use of computers or information technology is restricted to admin Work [12].

3. Research methodology

To understand a research problems clearly, one of the best approach followed is explanatory method than quantitative or statistical approach. Especially in SME's, where they feel insecure and may try to mask their actual output when such detective kind of approach is followed to conduct research. So to bring researcher and the participants closer a self-explanatory case study approach is used to get insight about Industry 4.0 [17]. In order to improve external reliability a multiple case study approach has been used in this research. A questionnaire was prepared to collect qualitative as well as quantitative data regarding awareness, current capability, willingness and ability to identify the challenges involved in implementing Industry 4.0. Survey was conducted using the questionnaire with the Managers and CEO's of five different manufacturing SME's (casting, conversion, machining, molding and assembling) situated in Coimbatore, Tamil Nadu, and India.

4. Description of case units

Organization 1: It is a 27 year old ISO/TS 16949:2009 and ISO 14001 certified company. They produce grey iron, compacted graphite iron and ductile iron and has a installed an annual capacity of producing 24000 ton of casting. They act as a supplier to various sectors such as tractor, pump, valve, hydraulics, earth moving vehicles etc. they do export to different countries around the globe like USA, France, Portugal and Austria. Organization 2: A 25 year old company with ISO 9001: 2008 certification. They manufacture office stationary product such as files, folders, paper envelope. The organization is capable of producing revenue of 100 million per annum but their presence is limited to southern region of India (Tamilnadu, Kerala, Karnataka, Andhra Pradesh and Telugana). At Present they are not dealing with export. Organization 3: Company manufactures precision springs, press components and sub-assemblies for past 10 years. It has ISO/TS 16949 certificate, they do follow TQM, TPS, Kaizen and 5 S to streamline the process. Products range from compression springs, torsion springs, extension springs, circlips and wire forms. They do have a wide range of customers in automobile, textile, electrical, agriculture, aerospace and health care sectors. They do export their product to different countries. Organization 4: It is a 41 year

company with BIS and ISO 9001:2008 certification. They do follow TQM in their premises. Their products range from regenerative pumps, centrifugal mono block pumps, jet pumps, open well submersible pumps, bore well submersible pump. As of now the company has sold 5 million pumps to home. They do export to Dubai, Muscat, Doha, Bahrah, Kuwait, Vietnam, Iraq, Myanmar and Sri Lanka. Organization 5: A 15 year old organization with ISO 9000:2001 certification supplying spares to textile industry. Their product ranges from general spares to the machinery, retrofits and innovative solution through new product development. They do export products with the aid of middle man.

5. Analysis and interpretation

By analyzing five cases, we categorized SME's in four level with respect to I 4.0 as shown in the below figure.

5.1. Awareness

Awareness about digitation and I 4.0 is very high for the organization 1, 3 and 4. The processes followed in these industries are moving from high labor intensive market to high capital market now a day. The technology development has replaced human with machine with a option of automation. Hence in order to reduce the total cost per unit and human error automated new technology machines are deployed. The demand for the product like casting, spring and pump from various industries such as equipment manufacturers, automobile, agriculture, piping is increasing day by day. Innovation and competition among the various sector also increases the variety of the product. This requirement pushes this company to be updated with the new technology or new method being launched in the market so that they can gain competitive advantage. Organization 2 and 3 has less awareness. One of the reasons for showing less interest towards knowing about technology up gradation is the market requirement. These industries focus a particular segment of the market unlike the other three organizations where they have a requirement to full fill demands from multiple sectors. They do produce standard part which means fewer requirements for variety. They either manufacture in batch or on demand, leading to higher pay back time for their current investment. This makes their Return On Investment (ROI) in advanced technology risky. Hence these firms have very less interest towards learning about new and emerging technologies.

5.2. Current capability

Organization 1, 3 and 4 has very high capability towards implementing I 4.0 in their firm. As they have to deal with huge product mix in terms of variety, volume, delivery time and price, flexibility becomes crucial throughout their supply chain. In order to achieve it planning, monitoring, controlling, co-ordination and communication have to be freely flowing between the various stake holders. Hence they invest in technology to keep thing in control. I 4.0 also demands continuous improvement and these firms aware that the technology benefits of ERP, SRM, and CRM will help them to identify the area to improvise. From survey we understood that they have high tech equipment's for producing (primary function) but they are lacking in application of high tech solution for their supporting function such as data storage, analysis and CRM. Organization 2 and 5 has less capability to implement I 4.0 in their respective firms. Conventional machine suits better than an automated Computer Numerical Machines (CNC) to produce standardized product at low volume. Investing in advance technology machine will have a huge impact in their books, when their demand is uncertain in a stagnated market. The availability of substitute and the alternative products has created complication for their operations. As like the other three these organization has less demand for innovation has made them less interested to invest in IT too. They feel that such huge capital will be an added burden to them.

5.3. Willingness

Organization 1, 3 and 4 are fairly willing to modify their current setup. As discussed these firms has noticed the huge raise in demands from the different sectors and also growing competition day by day. This forced firms to build competitive edge either in price, quality, delivery speed or in after sale service. I 4.0 help them to take decision in this regards using real time data analysis, less human errors and intervention. Organization 2 and 5 has very high resistance towards change from their current position. They are not interested to implement I 4.0 in their firm because they don't have requirement either from market or process. They also worried about the infrastructure, skill and investment required for making those changes and the ROI and payback they may get from it.

Organization	Awareness	Capability	Willingness	Identifying challenges
1.Casting	Very aware	Capable	High	High
2.Conversion	Aware	Less capable	Low	Moderate
3.Machining	Aware	Capable	High	High
4.Machining +Assembly	Very aware	Capable	High	High
5 Assembly + Moulding	Less aware	Not capable	Very low	Very low

Fig. 1:

5.4. Ability to identify the challenge

Organization 1, 3 and 4 as they have a need and opportunity for future growth they were very good in identifying the challenges that they may face while implementing I 4.0. However, in case of other two organizations they did not have skill sets and experience to trace the future growth opportunity. So they do find difficult to identify the challenges involved in implementing I 4.0.

6. Conclusion

This study captured preparedness of Indian manufacturing SMEs with respect to Industry Revolution 4.0. It is clear that technology is going to rule the upcoming years. Firms that don't cope up with it are going to face serious problem. India being one of the fastest growing economies has to pay attention towards such revolution in technology as China does. From this research it is evident that Indian manufacturing SMEs are mostly aware about the concept of Industry 4.0 and their benefits. They have fair capability to implement I 4.0 in their firm but it depends on size. Small scale enterprises have less capability. 3 out of 5 SME's was willing to change their current setup but has concern regarding investment, ROI and payback period. SME's were able to identify the challenges they may face while implementing I 4.0. We found that SME's hesitate to invest in software's thinking that they are costly and only applicable for large scale industry. The current study has few limitations. The one of the most critical is that the research is limited to Indian manufacturing SMEs. The results obtained in this study to be taken as tentative and to be carefully generalized. Hence further research with cross- industry at large sample size can be conducted in order to have broad understanding the challenges involved in implementing Industry 4.0 in Indian environment.

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