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ABSTRACT

Industry 4.0 has the potential to transform the Indian Engineering Industry to be globally competitive to satisfy the customer needs. However, Industry 4.0 implementation is gradually making its entry into the Indian markets. The first step before application of Industry 4.0 is to assess whether the organization is ready to apply Industry 4.0. There is a plethora of Industry 4.0 model's assessment models, however, recent research suggests none of them captures then dynamics of the modern business environment. Therefore, there is a need for a study to design the "Industry 4.0 readiness model" in Indian Engineering Industry. Through our previous study, we had conceptualised the "Industry 4.0 readiness model", this study extends the work by empirically validating the same using the grounded theory methodology. This is the first empirically validated "Industry 4.0 readiness model" for Indian Engineering Industry.

Keywords: Industry 4.0; Readiness Model; Grounded Theory; Internet of Things, Cyber-Physical Systems.

1. INTRODUCTION :

In the year 2011, Germany introduced the concept of Industry 4.0 to the world. Industry 4.0 represents a new paradigm of the digital transformation of organizations using new technologies such as "Internet of things (IoT)" and "Cloud Computing", etc [1]. Ever since its introduction, Industry 4.0 is accepted by both the Academia, Industry and other stakeholders, hence is termed as "the fourth industrial revolution". Industry 4.0 is making gradual inroads in Indian Industry. Indian Engineering Industry which represents the largest segment in the Indian Industry, can be digitally transformed due to the application of Industry 4.0 [2]. The first step the Indian Engineering Industry should take before the implementation of Industry 4.0 is to assess whether they are ready to implement Industry 4.0. This is the most important step because if the assessment results are above average the organization can venture to implement Industry 4.0. In case if the assessment results are at a low level, organizations can work on those specific dimensions to improve the scores and subsequently implement Industry 4.0 [3]. A proper assessment before the implementation of Industry will help the organization to increase the probability of effective application of Industry 4.0 and thus will save millions of rupees due to failed implementation of Industry 4.0 [4]. "Industry 4.0 readiness model" describes "how ready an organization is for successful implementation of Industry 4.0". During the last four years, there have been a plethora of "Industry 4.0 readiness model" s developed by both the practitioners and academicians [5]. However, the vast majority of the "Industry 4.0 readiness model" s are less "pragmatic" in terms of the rapidly advancing objectives of the organizations [5]. "Industry 4.0 readiness model" is important for the organizations as it will help in understanding the present position of the organization and the change what is required for the application of Industry 4.0. In the Industry 4.0 implementation sense, it can be seen as a management tool, which will help in realignment, reconfiguration and renewal of organizations capabilities and capacities [6]. Furthermore, the application of Industry 4.0 will result in the creation of new business models, strategies, KPI, new customer base, new products and service, new manufacturing strategies, etc [5, 7]. The challenges an organization face in heavy engineering segment would be different from the textile segment. Similarly, there are locational challenges such as challenge in India would be different from Europe. To cite an instance India is 79th in Network Readiness Index [8] therefore, integration of "horizontal, vertical and end-to-end integration" may be a challenge due to network connectivity. Besides, there could a challenge to mobilize the initial investment for Industry 4.0 because the Indian Engineering Industries financial position is a bit weak due to export reduction by 6.2% in 2019-2020 and 2020, the Covid-19 pandemic has devasted the economy [9]. There are also challenges in India such as strong trade union, unavailability of skilled manpower, cybersecurity, technology acquisition, development of new business models, organizational culture, change management and so on [3]. There is no "Industry 4.0 readiness model" specifically designed for the Indian Engineering Industry. A conceptual analysis was developed by Sony and Aithal (2020) and through extant literature review, they have found following dimensions of "Industry 4.0 readiness model" : organizational strategy readiness of Indian engineering industry for Industry 4.0, digitization Level of Indian engineering industries, digitization level of the supply chain of Indian engineering industries, Level of smart products in Indian engineering industries, "Employee adaptability" with Industry 4.0 skills in Indian Engineering Industries and Top management support & leadership in Indian Engineering Industry for Industry 4.0.To extend this study further an empirical analysis has to be conducted to validate the theoretical model designed to confirm its dimensionality as well as to study whether addition or deletion to the above dimensions is to be carried out. Consequently, this study conducts an empirical analysis to understand how to assess Industry 4.0 dimensions in Indian Engineering Industry? We draw upon grounded theory methodology because it is the best method for inductive theory building for under theorized phenomenon [10, 11]. Besides, it will help us to make two contributions to the literature first, it will help us to understand from the perspectives of senior managers in Indian Engineering Industry what are the dimensions for assessment of "Industry 4.0 readiness model". The second contribution would be to rank the "Industry 4.0 readiness model" dimensions. Third, it could also help to enrich the theoretical model suggested by Sony and Aithal (2020) with the insights from the perspectives of senior managers. The rest of the paper is organized as follows, the methods would be discussed in the next section, followed by results, frequency analysis of the dimensions, discussion, and conclusion.

2. METHOD :

To explore the dimensions of readiness factors a qualitative study using grounded theory methodology was conducted. Grounded theory methodology (GTM) is a method of inductive theory building using systematic guidelines for "gathering, synthesizing, analysing and conceptualising" the qualitative data to build mid-range theories. It provides flexibility in data collection and analysis and the stages are multi-layered, compared to other qualitative methodology where it is single-layered. It helps to understand a phenomenon in a natural setting. It has a reliance on the comparative method. Aids in the early development of categories and has a thrust towards early theory building [10–12]. The previous study by Sony and Aithal (2020) gave us some of the Industry 4.0 readiness factors in Indian Engineering setting through conceptual analysis. However, there is a debate on the number of dimensions of readiness factors[4], and hence this study uses a GTM for empirical validation of the dimensions.

2.1 Participants

In this study twenty-four, senior management professionals working in Indian Engineering Industry in India participated through a purposive sampling frame. The details firm level was obtained from the Engineering Export promotion Councils website and they were subsequently contacted after obtaining information from respective firms' website. The participants who responded were invited for a video conferencing through a popular free application on windows. The sample size in the qualitative study varies and a small sample is sufficient for analysis [13]. Usually, theoretical saturation is obtained after 12 -24 interviews [14]. Therefore, data collection was stopped after ascertaining no new category was getting added and theoretical saturation as propagated Glaser and Straus (1968) has reached. The respondents were contacted and were told about the purpose of the study. Subsequently, they were informed that data would be protected and no identifying information about the participant or the company would be parted with anyone, rather only summary data without identifying information would be used. Participants were given pseudo names to maintain the anonymity of respondents. This was deliberately done so that participant has faith in the research process and be comfortable to reveal the actual details about Industry 4.0 readiness factors without being judged [12]. They were also informed that there are no right or wrong answers and this research just wanted to capture the viewpoints. To account to gender representation both males and females were contacted. As experience is a major factor when considering readiness factors, it was decided that a minimum five years of experience at a senior management position in the Indian Engineering Industry with representation from heavy and light engineering Industry. All the participants were recruited from India.

2.2 Data collection Procedure

The interviews were conducted during off duty hours of the participant. This was decided mutually with the participants. The participants were interviewed via video conferencing. All the interviews lasted on an average 34± 8 minutes. The notes were taken from the interview verbatim. Subsequently, the notes were verified with the participants so that data validity could be obtained.

2.3 Interview Protocol & Data Analysis

The twenty-four number of interviews were conducted in a semi-structured manner. This was used to elicit a wide variety of responses from the participants. An open-ended questionnaire was used in this study to capture participants viewpoints [15]. A pilot interview was conducted which helped to uncover minor issues regarding the flow of questions. The interview was divided into first demographic questions, introductory questions about Industry 4.0 and readiness factors. The interviews were transcribed. The transcription was analysed inductively to explore the dimensions of readiness factors. A systematic procedure was used to make the study comprehensible and verifiable [16]. Using this process, the text was analysed to form individual meaning units. The related individual meaning units were combined to form a theme. The themes were further categorised into a higher-order theme. To bring in objectivity in the data analysis phase a colleague also independently analysed the data and categorised into themes and sub-themes [17, 18]. Wherever there was disagreement it was settled through discussion.

2.4 Ensuring Rigor in Grounded Theory Methodology

This research followed a well-known criterion for conducting inductive research i.e. “credibility, transferability, dependability and confirmability” [19, 20]. The steps suggested by grounded theory methodology was followed in this research such as “line by line coding”, “constant comparison”, “non-leading questions”, “memoing”, and “diagramming” [10, 11]. Besides, we read the interview transcripts many times for theoretical sensitivity, asked questions for clarifications wherever necessary, presented the results to participants and managed data using MS Excel.

3. RESULTS OF THE GROUNDED THEORY STUDY :

The results of the thematic study are elucidated and thematically collated in this section. The ten dimensions of “Industry 4.0 readiness model” s for Indian Engineering Industry are (1) “Top Management Support for Industry 4.0” (2) “Employees Adapting to Industry 4.0 skills”(3) “Smart Products & Services” (4) “Supply Chain Digitalization” (5) “Level of Digitalization of the Organization” (6) “Aligning Industry 4.0 with Organizational Strategy” (7) “Industry 4.0 to meet customer's needs” (8) “Reward Systems for Implementing Industry 4.0” (9) “Organizational culture for Industry 4.0” and (10) “Industry 4.0 Business Models”.

3.1 Top Management Support for Industry 4.0

In this study, respondents voiced the significance of top management support as the readiness factor for the application of Industry 4.0. Industry 4.0 needs resources in terms of both technical and social (human elements) [21]. The top management support will benefit the organization in terms of acquiring the technical resources as well as human resources [22]. The respondent in this study explicated *"the top management support is very important for the success of Industry 4.0. They will help not only with the resources but also in managing change while implementing Industry 4.0*”. Industry 4.0 application will result in changing organizational structures, line of communication, method of carryings of activities, decision making, etc. Therefore, a rigorous change management initiative is required [23] and the top management support for Industry 4.0 will be critical for driving in change within the organization. The employee skills required in Industry 4.0 is higher-order skills [24], so top management should not unnecessarily interfere in trivial matters regarding implementation of Industry 4.0. The top management should empower the employees [25] so that complex decision making regarding Industry 4.0 implementation is facilitated with ease. One of the respondents remarked “*We should be given full* *autonomy to implement Industry 4.0. This will help us to decide on trivial matters, else we have to go to the top management for every small thing*". The payback benefits of Industry 4.0 are not clear and distinct in terms of tangibility. Some benefits are tangible in terms of cost-effectiveness or market share and some are intangible in terms of employee or customer satisfaction[26]. Hence, the top management should be patient in evaluating the benefits and should not put unnecessary stress on the employees for showing the results. One of the respondents remarked "*A boss who is on our neck to show results of Industry 4.0 very quickly will put us in trouble. The results of Industry 4.0 cannot be seen overnight but one has to patiently wait for some time before it becomes evident*". Industry 4.0 is a technology-driven business initiative and the top management must understand the principles of Industry 4.0 so that they can extend knowledge-based support for Industry 4.0 [27] rather than just market trend based support. A respondent said "*I would say the top management should know what is Industry 4.0. I would not expect them to know the details but at least what it is and how does it help the organization. This will help them not to create any magical expectations from Industry 4.0*".

3.2 Employees Adapting to Industry 4.0 skills

The modern factory is becoming more complex and intelligent due to "big data analytics", "machine learning" and "cloud computing" with the advent of Industry 4.0 [28]. Besides, technology enablers such as IoT, CPS, and Industrial internet makes the modern-day workplace a complex phenomenon [29, 30]. In this highly automated and integrated computing environment, the role of employees will be challenging. It is because all the jobs containing repetitive and simple activities will be done by the intelligent and self-regulating CPS. Those higher-order jobs which are left for the humans will require higher process integration, cross-functional perspectives, reduction in categorized levels, less demand for central management capabilities. In a nutshell, it can be described as the existing jobs will become complex requiring a large repertoire of skill set [31–33]. A respondent remarked "*We need an employee who are multiskilled and problem solvers who can solve tough ones. I believe that the simple day to day problems will be either eliminated or solved by machines in Industry 4.0. The employees need to be very creative and solve problems in a fast manner*" Thus, the success of Industry 4.0 will depend on the employee ability to adapt to Industry 4.0. The participants in this study also explicated the importance of employees adapt to Industry 4.0 technologies. Employees will have to work with others from their organization or other partner organization [34, 35]. One remarked "*I guess the key for workers would be to adapt with people from other organizations, another department, other disciplines, customers, other stakeholders etc. So, employees need the skill to work in teams*". Teamwork is common in organizations and over time the work teams have become complex [36]. A hallmark of effective teams is that they are "self-correcting", "adaptable", "flexible", and "cohesive". They also hold shared mental models of their "task and objectives"[37, 38]. In Industry 4.0, most of the works will be done in teams or groups [39]. In other words, it would be knowledge-intensive teamwork which would be a collaborative process wherein employees would use their unique and shared knowledge to achieve a common outcome. Therefore, employees will have to adapt to teamwork. The integration network will require employees from different hierarchal departments to adapt their style of work to work with others. Employees will have to continuously train, retrain and update the core ICT skills in addition to their core technical skills to adapt to Industry 4.0 requirements. A respondent remarked "*Employees will have to continuously update their knowledge. The organization cannot always train the employees because it is not always economically feasible. Employees should proactively work to solve the problems*". With the application of Industry 4.0, most of the standardised and manual jobs are going to be on the decline and there will be a shift towards higher qualified jobs or knowledge-based jobs [33]. To work in these higher-order jobs and solve the day to day business problems will require employees to be creative. A senior manager remarked "*Creativity will be the order of the day for employees. Education is one thing and using education creatively to solve a business problem is another thing. So I feel creative employees will be key to solve Industry 4.0 problems*" Industry 4.0 by digitalisation will change the modern working conditions in industrial settings [40]. The employees working in an Industry 4.0 set up will have a high degree of human-machine interaction [4]. This may impact the psychosocial factors and employee's health [41, 42]. Working in a highly automated environment increases mental workload rather than reducing it [41]. In a recent study on human-machine interaction, it was found that job stressors in a highly automated environment were due to "technical problems", "poor usability", "low situation awareness" and an enhanced requirement on employees' qualification. Thus, employees will have to deal with handling automation induced job stress. One manager commented "*The stress of the job would be immense because* *you would be dealing with machines. You would be dealing with big data day in and day out. So employees who deal with it will adapt*".

3.3 Smart Products & Services

The extent to which the products and services are smart in an organization is one of the readiness factor for Industry 4.0 [4]. The three core elements of a smart product are (1) "physical components such as electrical and mechanical elements" (2) "smart components such as sensors, microprocessors, data storage, controls, software, embedded operating system and digital user interface". (3) "Connectivity components such as ports, antennae, protocols, and networks which enable communication between the product and the product cloud, which are run on remote servers and contains products external operating system"[43]. Smart products, therefore, require a new supporting technology infrastructure. A manager remarked "*Well the modern products are smart. It communicates to the user and organization about its status such as health. Thus, I would say if your organization's product has already smartness built into it; implementation of Industry 4.0 would be easier*". The technology stack, therefore, provides, an opportunity for data exchange between the product and the user. A manager said "*If your organization's product is not smart you will have to work to make it smart so that product data can be integrated with organization IT systems*" The smart products further acts as an integration source from other related products, external sources and other functional business systems. Smart products will further act a means for analytics & data storage, real time data transmission of various parameters and controlled access. This technology will provide products with three features (1) "Products can *monitor* and report on their condition and environment". It will help to garner insights into various aspect of their use, performance, maintenance, and safety. (2) The complex product operations can be *controlled* by the users. This is possible through numerous remote-access options. The customers get an unparalleled ability to customize the product function, interface of products, performance, besides, getting to operate them in hazardous or hard-to-reach environments and (3) There is a new opportunity of optimization due to the combination of data monitoring and remote-control capability. Therefore, the algorithms can substantially improve utilization, product performance, and uptime. (4) The combination of remote control, data monitoring, and optimization algorithms allows *autonomy or learning ability*. Products can adapt, learn about the environment and user preferences. It can also service themselves, and operate on their own [44]. One manager responded "*The products should be customizable by the customer; it creates value in the eyes of the customer. Once user preference is known the product should have built-in intelligence to configure itself so that customer is satisfied*".

3.4 Supply Chain Digitalization

The extent to which the digitalization of the supply chain of the organization is one of the key readiness factors for the success of Industry 4.0. The digitalization of operations of all participating members of the supply chain is the key hallmark of Industry 4.0 [4]. One respondent remarked "*The supply chain digitalization is important for the success of Industry 4.0. If the entire supply chain is digitalised it will help in managing the organization. Besides, a supply chain which is digitalised will help in the implementation of Industry 4.0*".The upstream and downstream supply chains integration through Industry 4.0 technologies will result in a large amount of data which can be used effectively to plan, monitor & autonomously control the supply chain activities [45]. A manager said "*The big data which will be generated with the digitalization of supply chain will help in managing all supply chain members from the customer to the supplier. I feel that supply chain digitalization is must see the full potential of Industry 4.0*". The supply chain in smart factories has a "dynamic structure" which has the ability to reconfigure as per the needs of customers. The optimization of such "dynamic structures" is a challenge in terms physical configuration with smart algorithms [46]. Another important factor to consider in a supply chain is smart logistics. The inputs for the production process are supplied by the logistics. A logistics system which is adaptive, intelligent, capable of real-time monitoring of materials flow, better management of transportation modes with risk minimisation, reduced cost and speed will help the organization [47]. Such logistic support is the best one can get. However, in real life logistics opportunities are a huge challenge. The degree to which logistics are digitalized is a pertinent factor [4]. One participant in this study expressed that "*Logistics is one of the main bottlenecks in the supply chain operations. If we have digitalized logistics, we will be able to plan everything from operations to sales, therefore a responsive and digitalized supply chain is important for the success of Industry 4.0*".

3.5 Level of Digitalization of the Organization

The level of digitalization of organizational assets in terms of percentage of assets in the organization which are equipped in addition to electrical and mechanical components, a smart component such as microprocessors, sensors, controls, data storage, embedded operating system, software, digital user interface and connectivity components such as ports, antennae, protocols, and networks which enable communication between an asset and the cloud. These are further run on remote servers and contains asset operating system [22]. A manager remarked "*An important point to consider how well the organization is digitally connected. Is the various department within the department digitally connected? Are operations connected to marketing or sales or finance? Such interconnection will help the organizations to operate as one digital system."* In other words, it can be defined as the percentage of assets in an organization which are connected to the cyber system. The level of readiness is also defined in terms of how much the organization uses such data from these smart and connectivity components of these assets for planning, operation and maintenance purposes [48]. Another dimension of the level of digitalization could be gaged in terms of how the different departments within the organization are interconnected using the cyber systems for day to day operation within the organization. To cite an example if the production and marketing department are digitally connected, both departments have wealth of information in a real-time manner which can be used for production and marketing management in an autonomous and self-regulated manner [22]. The level of digitalisation has one component called the degree of IT security. Organization information is vital for the success of the organization in the marketplace. One manager said "*A connected organization will be an agile organization. It will respond to the needs of the customer efficiently and very quickly. I would say that the more departments within the organization are interconnected the better the organization performs*". Various competitors are eyeing on the sensitive information [49]. Therefore, the organization and its supply chain cyber networks are targets[50]. The degree of IT security deployed by strategically identifying the cyber threats in a systematic manner and strategies used for mitigating the same will determine the level of digitalisation within the company. A manager supposed "*The interconnection of the various department is not without a challenge of security of data. Now we will have people looking at data which are not responsible for hence there is a chance that cybersecurity will be a threat*."

3.6 Aligning Industry 4.0 with Organizational Strategy

Industry 4.0 encompasses all aspects of an organization rather than just focussing on supply chain or production, therefore, alignment of Organizational Strategy with Industry 4.0 is a decisive factor for the successful implementation [51]. Industry 4.0 changes the following relationships within an organization. (1) "Organization & nature: it improves the resource efficiency and sustainability"(2) "organization and local communities: it leads to increased geographical proximity and acceptance, and integration of customers in design and manufacturing processes" ; (3) "organization and value chains: the distributed and responsive manufacturing through collaborative processes enables the mass customization of products and services"; and (4) "organization and humans: this includes human-oriented interfaces and improved work conditions" [52]. A manager remarked "*The success of Industry 4.0 implementation is depended on how well it is linked to the organization strategy. Once Industry 4.0 is implemented everything will change from short term goals to long term goals. So, I feel organization strategy should be analysed and changed after the implementation of Industry 4.0*". Another manager believed "*Well Industry 4.0 creates a need to change the existing mission, goals, strategies. Old strategies may not be always relevant after implementing Industry 4.0*". The organization strategy should therefore be aligned in these four dimensions of Industry 4.0 implementation.

3.7 Industry 4.0 to meet customer's needs

The success of any organization depends upon how well they meet the customer needs. The classic pyramid model expounds "company-customer", "company-employee", and "employee-customer" relationship, by keeping technology at the centre of the three-dimensional type of relationship [22]. A manager remarked "*Meeting customer needs is important for the success of the organization. If by implementing Industry 4.0 the organization needs are met, then Industry 4.0 would be a success*". Therefore, technology is the fundamental underpinning which will bind all three forms of relationship. Industry 4.0 technologies will form the base on which the interaction rests and if used successfully can result in delightful customer experience [53, 54]. A manager said "*Industry 4.0 technology can be used to meet and often delight customer needs. To cite an instance if the customer need for customization for the automobile graphics is met, there will be a delight. Similarly, if I can tailor-make the machines it can cause a meeting of needs and customer delight*". The implementation of "horizontal, vertical and end- to- end integration" espouses a large amount of data and managers can use this data to successfully meet customer needs and create a unique service experience.

3.8 Reward Systems for Implementing Industry 4.0

The human resource strategy should be selected in such a manner which will support the organizational strategy [55]. The reward system of the organization should be designed in such a manner that it will attract and retain employees with knowledge, skills, and abilities to implement Industry 4.0[56]. An employee remarked "*Attracting and retaining the top talent in Industry 4.0 is a challenge. If we can use a better reward system for the highly skilled employees, they will not only stay but will perform at the topmost level*" The reward system should be aligned to the Industry 4.0 strategy to achieve a high level of individual and organizational performance [57]. The organizations should fine-tune the reward system which makes it supportive of Industry 4.0 strategy[58]. There should be a reward system which will reward both the individuals and teams. A manager said "*Well organizations should not only target monetary rewards but also look at non-monetary reward system. The motto is to motivate the best employees to work for you or make the existing employee best to implement Industry 4.0, therefore we should have a sound reward system for employees"* Organizations should tie Industry 4.0 implementation to employee performance appraisal[59]. Organizations may go for concepts such as Industry 4.0 skill-based pay, profit sharing, gain sharing, and employee stock ownership.

3.9 Organizational culture for Industry 4.0

Organizational or corporate culture is the "pattern of values, norms, beliefs, attitudes and assumptions that may not have been articulated but how people in organizations behave and things get done. It can be expressed through the medium of a prevailing management style in the organization" [60]. A manager remarked "*Culture within the organization is most important as it will determine how the employees will behave to get things done. If we have a culture of openness and innovation, all employees will behave like an unwritten norm*". The "innovative culture" is the type of culture that is more appropriate for the application of Industry 4.0 [61]. In such a culture an organization produces an environment that promotes employees to take risky behaviour, recognizes new challenges and provides support for creative work to meet the quality goals [22]. A manager said "*A culture which is risk-taking and trying to find new solutions will help the organizations to implement Industry 4.0*" Not all organizations have such a conducive organization culture and therefore, this is a non-adoption factor for the implementation of Industry 4.0.

3.10 Industry 4.0 Business Models

In manufacturing firms, there are claims that the migration from Industry 3.0 to 4.0 will result in profits for the organization [62]. There is also a suggestion that the manufacturer should transform their business model towards "servitization", "cloud manufacturing", "intelligent manufacturing", "C2B manufacturing", and so on [63, 64]. One manager responded "*Industry 4.0 has immense potential to diversify the existing business models to create new opportunities. If you don't capitalise these new opportunities Industry 4.0 implementation will not realise the full potential*" Many studies have shown previously that without an appropriate business model the organizations which use new technologies have failed [65]. Therefore, modern organizations should not only device innovative products and processes but also business model innovation. Organizations whose business models are innovative are more successful than others [66]. "*A mediocre technology pursued within a great business model may be more valuable than a great technology exploited via a mediocre business model*" [67]. Most organizations find it challenging to modify existing business models while implementing Industry 4.0 [68]. The four major components of business models are "who is the target customer", "what does the customer value", "How is the value proposition built and distributed" and "why is the business model financially viable?" [69]. One of the managers remarked "*While implementing Industry we should always think of broadening our customer base from the existing ones. We need to change the way we create value for our customers. This is important as it will help the organizations to go in unchartered waters which they have not yet thought off. So, I feel Industry 4.0 should broaden your business*".

3.11 Frequency Analysis of Ten Dimensions

To rank the dimension of Industry 4.0 model a frequency analysis of the themes was carried out on the 24 interviews. The dimensions are ranked based on the frequency of themes of dimensions which appeared in the interview. They were sorted in descending order to depict the most important dimensions. The analysis is explicated in table 1.

Table 1: Frequency Analysis of Industry 4.0 readiness dimensions

Factors of "Industry 4.0 readiness model" in Indian Engineering Industry	**Frequency**
Smart Products & Services	21
Level of Digitalization of the Organization	19
Top Management Support for Industry 4.0	18
Supply Chain Digitalization	17
Aligning Industry 4.0 with Organizational Strategy	14
Industry 4.0 to meet customer's needs	13
Industry 4.0 Business Models.	12
Employees Adapting to Industry 4.0 skills	11
Organizational culture for Industry 4.0	8
Reward Systems for Implementing Industry 4.0	6

4. DISCUSSION :

This study explored the ten components of "Industry 4.0 readiness model" in Indian Engineering Industry through a grounded theory study conducted on senior managers working in Indian Engineering Industry. The most important factor unearthed in this study was "smart product and services". Products and services are the most significant for the success of any firm[70]. Industry 4.0 warrants a total digital transformation of the organization [71]. If the products are smart, firms will be able to better manage the digital integration [72] and thereby creating value in the customer's eyes which leads to an immense competitive advantage over the rivals. The second factor that was unearthed in this study is "level of digitalisation of the organization". The higher the level of digitalization means most of the departments will be digitally integrated to create a digital eco system[50]. This will enable real-time data-driven decision making, self - regulation, agility, effectiveness to meet the firm's goals and objectives. The third most important factor is "top management support". The "top management support" will help in both allocations of resources and also managing organizational change within the organization[3]. Besides, the leadership skills exhibited by the top management will motivate the employees in the digital transformation of the Indian Engineering Industry. The fourth factor unearthed in this study is "supply chain digitalisation". The firm will be able digitally to plan, lead, control, coordinate, and organize the supply chains of the firm to meet its goals and objectives in an optimum manner [73]. The higher the level of supply chain digitalisation, the more predisposed a firm will be to implement Industry 4.0. The fifth factor uncovered in this study is aligning Industry 4.0 with organizational strategy. It is the sum of all activities the organization undertakes to achieve its long goals and objectives [22]. By the aligning the actions with Industry 4.0 implementation, the organization will be in a better position for achieving its long-term goals. An organization exists for the customers. The more satisfied the customers, the better the organization flourishes. Therefore, in this study, the sixth factor found for Industry 4.0 readiness in Indian Engineering Industry was Industry 4.0 is aligned to meet customer needs [74]. Industry 4.0 technology should be deployed by the organizations to meet customer needs. Better the alignment the stronger the chances of success in Industry 4.0 implementation. The seventh factor for assessing readiness is having Industry 4.0 business models. The firms existing business models should be substantially modified to exploit full benefits out of the application of Industry 4.0[7]. The employees are the most important in the implementation of Industry 4.0 and therefore, employee adaptability towards Industry 4.0 is the eighth factor. Industry 4.0 is the joint optimisation of "socio and technical" systems, therefore, in addition to the technical system, employee adaptability attains perennial importance [21]. The ninth factor for the realization of Industry 4.0 is having an open and innovative organizational culture. Industry 4.0 implementation is a complex process and therefore, organizations which have a risk-taking, innovative and supportive organizational culture will be better placed [61]. Motivating an employee through financial and non -financial rewards will help the employees to sustain their Industry 4.0 efforts [2]. Therefore, in this study respondents have suggested it as a tenth factor for assessing Industry 4.0 readiness in Indian Engineering Industries. This study suggests that organization should consider both financial and non-financial reward systems to attract, retain best employees and to get the best out of them. All the ten dimensions are interrelated and hence the organizations should assess all ten dimensions prior to the implementation of Industry 4.0, else holistic assessment of Industry 4.0 readiness will not be evaluated.

5. CONCLUSIONS :

This study evaluated Industry 4.0 readiness dimensions in Indian Engineering Industry using the grounded theory methodology. Previous studies have conceptually evaluated Industry 4.0 readiness dimensions; however, this is the first study to empirically validate ten dimensions of "Industry 4.0 readiness model". The ten dimensions unearthed in this study are (1) Top Management Support for Industry 4.0 (2) Employees Adapting to Industry 4.0 skills (3) Smart Products & Services (4) Supply Chain Digitalization (5) Level of Digitalization of the Organization (6) Aligning Industry 4.0 with Organizational Strategy (7) Industry 4.0 to meet customer's needs (8) Reward Systems for Implementing Industry 4.0 (9) Organizational culture for Industry 4.0 and (10) Industry 4.0 Business Models.

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