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Industry 4.0 for Manufacturing Organization in India

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Abstract - *Industry 4.0 is changing the manufacturing environment with its cyber-physical infrastructure to support and help increase production performance. The cyber-physical infrastructure brings new technologies such as Internet of Things, big data, cloud computing, and machine learning using advanced algorithms. To deal with this new order to preserve asset performance, industrial maintenance needs to be prepared. This study aims to understand the impact of Industry 4.0 on the skills required within industrial manufacturing departments. A survey of industrial manufacturing professionals finds that the majority of training comes from internal sources and that much of the information systems used for training are out-of-date or does not exist. The results of this study show that Industry 4.0 will impact the manufacturing department and that a Change Management process should be put in place to accomplish this transition smoothly.*

1. Introduction

Industry 4.0 is a blend of advanced analytics, Big Data, Robotics & Automation, Artificial Intelligence, Internet of Things (IoT) and process Digitization across the business value chain.

Industry 4.0 is a collective term embracing a number of contemporary automations, information exchange and production technologies and can be seen as one part of the Internet of Things. It had been defined as a term for technologies and concepts of value chain organization which combine the elements of cyber-physical systems, cloud computing, RFID technology, cyber security and smart factory. The word Industry 4.0 originates from a high-tech strategy project in 2012 called 'Action Plan High-tech strategy 2020' of the German government, which promotes the computerization of manufacturing (Friedemann et al., 2010). The German government thereby wanted to expedite the technological and social development in this area. Furthermore, the project should strengthen the collaboration between different market players and innovators. Together with the German associations VDMA, Bitkom and ZVEI, a cooperation agreement beyond association boundaries would be concluded which forms the 'Plattform Industrie 4.0'. Nowadays the 'Plattform Industrie 4.0' is the leading driving force, with a goal of developing joint recommendations for the stakeholder, identifying relevant technology trends and setting standards for a uniform communication. The Plattform Industrie 4.0 defines Industrie 4.0 as: "the fourth industrial revolution with a new level of organization and the control about the value chain, including the entire life cycle of a product" (Plattform Industrie 4.0, 2015). This cycle is based on rising individual customer wishes regarding the development, production and delivery of a product all the way to recycling including related services. Industrie 4.0 enables the availability of all relevant information in real-time, and thus the ability to derive the optimal value flow from the data to any time" (Plattform Industrie 4.0, 2015).

1.1. Elements of Industry 4.0

According to the study from Wieselhuber & Partners (2015), Industry 4.0 consists of the following elements (Wieselhuber & Partner GmbH, 2015). Elements of Industry 4.0

I. Cyber-Physical Systems

Jay Lee, Behrad Bagheri , Hung-An Kao (2014)
Cyber-Physical Systems (CPS) are automated systems which connect the physical reality with digital infrastructure and virtual communication. Unlike traditional embedded systems, which are usually built as stand-alone machines, CPS focuses on connecting several devices with each other. These 'classes' of highly connected and collaborative computer-based systems, which are dependent on sensors and actuators, bring advances in the current digital world as well as in the physical world. A more technical approach is to define CPS as a combination of computation with physical processes. Embedded computers and network monitor(s) control the particular steps, often with feedback loops, in which physical processes influence computations and vice versa (Poovendran, 2010). Nowadays, CPS applications are so powerful that they outshine the latest IT revolutions. Possible areas of CPS applications are business sectors such as automotive, aviation, medical devices, traffic control, communication systems, manufacturing and smart living. As an example, the automotive industry could improve safety and efficiency by implementing embedded intelligence into cars or by using smart robots to build a 'smart factory'. To give another example, the entire process of payment in the retail industry could be dramatically revolutionized by using RFID or similar 'new' technologies. The economic impact would be massive. The CPS of tomorrow is expected to be embedded in almost every physical product or module, resulting in a higher degree of automation as well as a higher complexity forth system (Lee, 2008).

II. Cloud computing

Cloud computing enables a more decentralized approach for the allocation of information, services and entire enterprise models. It may be used to execute different software or apps as well as provide a platform for storing all of the data. Due to the fast development and the increasing demand of web-based networking among individual, machinery and objects, the combination of the virtual and actual world is handiest one step ahead. The fast development of the technology brings an incredible increase of data and information. To manage this growing records volumes, new strategies in terms of big data are required. Big data can be described as extremely large data sets that may be analyzed by computer systems to reveal patterns and trends, particularly relating to human behavior and interactions (Lee et al., 2014). Big data therefore combines several options to store, manage and use huge amounts of data. To deal with the volume and variety of the data, new technology and algorithms for data storage as well as for information analysis have to be developed. Further challenges in the future might be the transfer and adaption of conventional data analysis methods, such business intelligence to the large data approach. Additionally, new requirements stand up in the information area. Cloud computing permits demand-pushed data exchange with the internet in real-time by transferring all local services and processes to the cloud (Wiesel Huber & partner GmbH, 2015).

III. Smart factory

Cyber-physical systems and cloud computing are the prerequisites for smart factories. The connection and interplay in a smart manufacturing line may be between human-to-machine in addition to machine-to-machine. The network of the device-to machine application includes data networks, backend servers, connecting factors for the sensors and actuators as well as control components. The components for the interaction between human and machine are called human machine interfaces (HMI). HMIs may additionally assist humans to understand the complex processes and help them to communicate with the CPS (strategy&, 2015). in recent times there are a variety of distinctive applications for HMI interfaces available together with virtual touchscreens- and finger print recognition systems as well as audio voice- and language recognition systems. Those information contain product-, process- or aid-related information. As an instance, order data is probably collected through the entire year and afterwards analyzed in order to improve the order process for the following year. Smart phones and devices offer completely new opportunities for the operators. A machine has a breakdown, however has the capacity to inform the responsible operator on his smartphone. The machine can transfer the entire 'failure records' in order to potentially keep away from the next breakdown. Any other approach of smart factory is augmented reality (AR). AR is the integration of digital data with video as well as the user's environment in real-time. More simplified, AR takes a present picture and projects new information into it. By the use of AR, a variety of processes can be simplified to save costs such as trainings for brand new operators could be finished without interrupting the entire production line (Weiner et al., 2010).

IV. RFID technology

The RFID (Radio Frequency Identification) technology enables new possibilities within the shop floor and is therefore one of the basic prerequisites for Industry 4.0 applications (Gubbi et al., 2013). One example can be the communication between machines and machines or autonomous production control and scheduling through the manufacturing process. The main advantages of using RFID in terms of Industry 4.0 are quality improvement, shortening delivery time and efficiency improvement.

Due to RFID, the smart product knows itself the upcoming production steps, and it is able to talk with the machine and collect new information. To permit this potential, the products have to be equipped with a mobile data medium or so-called tag. The tag consists of a chip, which include the unique identity of the product, an antenna and information about the production process. This RFID tag represents the memory of the product and permits decision making in real-time. While a smart product arrives at a certain machine, the reader device detects the attached RFID tag and adjusts the associated machine to the proper process steps. Each production step may be written back and can thereby identify incorrect products immediately (Gubbi et al., 2013).

2 Literature Review

Madlool, Saidur, Hossain, and Rahim (2011) show that companies that manufacture cement have energy consumption totaling 29% of the total cost, with grinding being the largest consumer of electricity, at about 38%. The activity performed by the maintenance department in equipment lubrication can reduce the electric energy consumption of an electric motor by 1% to 2% (Saidur, 2010).

The principle of operation of the technology brought about by Industry 4.0 consists of the following:

- obtaining measured values and converting these physical measures into analyses,
- interpretation of this information and self-correction through self-learning algorithms (in some cases),
- communication and transmission of these data to servers in the cloud, and

- analysis of large volumes of data (Fleischmann, Kohl, & Franke, 2016; Guillén, Crespo, Gómez, & Sanz, 2016).

A framework suggested by Fleischmann et al. (2016) in terms of PdM consists of a traffic of data between different technologies, such as the Internet of things (IoT) sensor devices, webservers, PDA, systems in the cloud, big data, self-learning machines, and datasets. Everything from these new technologies brought from Industry 4.0 can be embedded in common equipment. Based on the literature presented so far, even at the beginning of the fourth industrial revolution it is possible to predict features of future industrial equipment. In terms of mechanical and electrical features, they may gain few improvements. However, in terms of electronic and IT features, they will experience a huge change.

To bring this new technology to a manufacturing plant, a process for systems engineering is triggered. Gulati (2013) argued that there are eight primary functions to support system engineering. Design / development, build / construction / manufacture, deployment / fielding / commissioning, and support / maintenance are functions directly related to implementing Industry 4.0 inside a company. The department in which system engineering is assigned is the engineering department. The system design process will define that technology following the requirements gathered to manufacture a product (Blanchard & Fabrycky, 2011).

Industry 4.0 brought a new approach to the maintenance point of view with a heavy use of IT hardware and software. They are using PdM as it has never previously been used. To implement traditional PdM, a person qualified and experienced in industrial maintenance with a deep knowledge in diagnosis will need to make decisions based on collected data (Carnero, 2006). In these transition years, the technologies need to be assembled on actual manufacturing equipment. The cost, design know how, and delivery of these technologies are not worth it for the company to do by themselves. A third party will be used to design and deliver these technologies.

Especially at the beginning of the formation of this database for the equipment brought by Industry 4.0, the knowledge acquired on a day-to-day basis may not be enough to identify the cause and eliminate and repair the equipment in a reasonable time to not compromise the equipment availability. In the opposite direction, Vathoopan, Brandenbourger, and Zoitl (2016) stated that those who handle the equipment breakdown can be skilled or unskilled. This statement is potentially troublesome for the mission of maintenance departments as there are specific repairs that require only skilled labor due to the embedded technology. In this case, unskilled labor can damage the equipment, fail to repair the equipment, or take an extended time to repair the equipment.

According to CGI (2017) adoption of industry 4.0, world is growing more rapidly than before. Economic order is emerging, establish manufacturing industry deal with large digital and innovative star- up. Sensors (60%), bandwidth (40 times) and processing cost (60%) decreases dramatically in last decade. Because of decreases of cost, slightly become chipper. Now days is virtual world, new model used to simulate and analyses with physical world and control and optimize the manufacturing process. These model also can be used to support business decision. Industry 4.0 product quality, and asset utilization, productivity, solutions improve operations efficiency, product quality, and asset utilization, time to market, agility, workplace safety and environmental sustainability. The framework adopt following approach: (i) Clear the vision how will be impact your business (ii) Base on the vision, make plane to shape future operations. (iii) Base on the plane, change the current operation. (iv) Finally, model is delivered for future operation. This model includes an effective approach for program management, stakeholder engagement, and benefits and risk management, in order to control the transformation and its outcome.

3 Research Methodologies

In order to select and develop appropriate means of data collection it is important to frame a problem in such a way that it can be investigated by the use of particular designs and techniques; research methodology defines the type of a researchable problem and testable hypotheses (Creswell, 2013). The procedure by which researchers describe, explain and predict their work can be termed as research methodology. The chapter focuses on research design and methods that will be adopted to carry out the study.

3.1 Research Method

In order to perform this research study, seven steps have been identified which are listed below.

- Development of appropriate knowledge base through review of relevant literature.
- Defining research problems and research objectives.
- Research design, formulation of hypotheses, and design of questionnaire.
- Pre-testing of Survey Instrument (questionnaire) Identification of survey pool or respondents and collection of data
- Management, analysis, and interpretation of response of respondents.
- Development and recommendation of appropriate strategies for eliminating the quality problems of Indian technical education sector.
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3.1.1 Development of appropriate knowledge base through review of literature

Review of literature forms an important part of any research as it provides the basic knowledge base about the field in which research is to be conducted. It also helps the researcher to understand that the present research study in hand is not a replica or duplication of a previous research study.

Inspirations and guidelines are also derived from similar research conducted in the past. For literature review, related academic journals, conference proceedings, government reports, books etc. have been consulted. The outcomes of earlier research work of similar nature as the study in hand were carefully studied. Mainly following two types of literature were reviewed in this study.

- The conceptual literature concerning the concepts and theories and
- The empirical literature consisting of research studies already conducted which are similar to the one proposed.

In the present research, literature review was helpful in gaining an in-depth understanding of the history and growth of technic in India and the concept of quality in manufacturing organization. This exercise was useful right from the stage of problem definition to report writing.

The outcome of this review was the body of knowledge, data and conclusions from previous similar research that helped the present researcher to gain insight into the area of proposed research and fine tune the research problem, plan research process, prepare survey instrument, collect and analyze data**.**

3.1.2 Research design, formulation of hypotheses and development of questionnaire

Research design is a conceptual structure within which research would be conducted and it facilitates research to be as efficient as possible which will yield maximal information. It constitutes the blueprint for the collection, measurement, and analysis of data. As such the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data. Hypothesis is a tentative assumption about some characteristics, attributes, features of any phenomenon, object, person, situation or event that has relevance to the research in hand. Hypothesis is based on known facts but has not been proved as yet. Hypothesis is tested on the basis of data obtained through experiment or survey and it is either accepted or rejected (Kothari, 1990).

3.1.3 Pre-testing of survey instrument (questionnaire)

Pre-testing of the survey instrument is important to ensure that the questionnaire is free from all kinds of errors and ambiguity enabling respondents to properly understand the questions and respond without any difficulty. Success of questionnaire method of data collection is highly dependent on this aspect because there is no one to explain the meaning of the questions to the respondents in case of any difficulty. The prepared questionnaire was first given to some senior faculty members of Indian School of Mines, Dhanbad management department and some employee which is working in manufacturing organization with a request to comment on its accuracy and clarity in understanding. With the help of their comments, the questionnaire was modified to bring it to present shape.

Subsequently, the reliability of the final questionnaire was tested by applying the statistical test Cronbach‟s alpha to 15 responses selected randomly out of 33 responses received from assorted respondents. Reliability refers to the extent to which a scale produces consistent results if measurements are made repeatedly. It is assessed by determining the proportion of systematic variation in a scale. This is done by determining the association between scores obtained from different administrators of the scale. If the association is high, the scale yields consistent results and the scale is reliable. One of the approaches of assessing reliability is by finding „co-efficient alpha‟ or „Cronbach‟s alpha‟, which refers to average of all possible split-half coefficients resulting from different ways of splitting the scale items. This coefficient varies from 0 to 1, and a value of 0.6 or less generally indicates unsatisfactory internal consistency reliability.

The Cronbach‟s alpha for 15 responses on 9 variables was found to be 0.890330, which is considered to be a very good sign of reliability of the questionnaire.

3.2 Data collection and Analysis approach

There can be a number of methods by which the data collection and analysis can be conducted such as qualitative method, quantitative method or mixed method approach. The research work adopted mixed methods approach or triangulation research strategy which includes both qualitative and quantitative data collection and analysis.
The subjective view of this research topic is taken by literature review and in order to have a complete subjective view expert opinion from industry and academics will be elicited by interview technique. By rationalization of the research problem the inadequacy of awareness about the research topic is aimed to be resolved. The following are the qualitative and quantitative approaches that are employed or will be employed during this study:

I. Literature Review: For orientation of the research topic the review of available literature.
II. Expert Interaction: For eliciting expert opinion from industry semi-structured and structured interviews will be conducted.
III. Observation: Observations are considered to be a source of relatively objective information adding new dimensions for understanding either the context or the phenomenon being studied (Yin, 2003).

For the qualitative study, a group of experts from academic institutions and steel sector with substantial experience will be identified using judgmental sampling to be consulted. The expert opinion will be collected via semi structured and structured interview questionnaire at different steel plants across India to reduce the regional bias.

The aim of the quantitative study is to study and examine the collected data to identify the problems based on given hypotheses or theory and by the use of a statistical technique determining the causal relationship among collected data (Creswell, 2013).

In the research study quantitative study will be based on the survey that is to be conducted in different-different manufacturing organizations of India. The Unit of analysis is the Indian manufacturing plants both integrated and non-integrated. Managers and executives will be the target respondents from implementation of industry 4.0 in organization.

The research work will be conducted in the following phases

• Structured Questionnaire survey
A questionnaire survey will be conducted in Indian manufacturing industry with the aim of collecting necessary primary data and information by the use of structured questionnaire. The development of the structured questionnaire is based on lean literature and expert opinion for academics through qualitative survey. . The investigation will aim to obtain information from the managers/directors and technicians of the production area. Resources such as Linked In, Linked In groups, Industrial production network, Industrial production discussion list and Industrial production blogs will be used as resources to be used on survey. In this way, the results will show the current situation, and the gaps can be identified. Resources such as Linked In, Linked in Groups related to industrial production, Society for production and Reliability Professionals, other groups related to industrial production and professional network will be used as source for the survey. For technicians, the goal is to determine their level of general knowledge about Industry 4.0 and how much deeper knowledge of these technologies they may have. There will be people that work in the production area that do not perform management or execution functions. These people will be classified as managers/directors if they have completed a bachelor's degree or have more than seven years of experience in the production area. Otherwise, they will be considered a technician.

• The questions ask the respondents to state the degree of importance of the selected lean barriers and enablers on a 5 point Likert scale. Where 1= not important; 2= little important; 3= moderately important; 4= important; 5= Very important.

• Because the questions of a survey can influence the evaluation of responses, simple, clear, and concise questions facilitate understanding and guide the researcher to the answers that most closely match the reality of the respondent. To prevent respondents from becoming confused with questions and answers, a draft of survey questions will be sent to selected people in the manager/director and technician group. The purpose of this draft is to receive feedback regarding questions that are missing and questions that are difficult to understand. From the collected data, I analyses the data with the help of Pie-chat, Bar chat and Table.

Collection of data

Next step of data collection was collecting email IDs of proposed survey participants for which internet service was of immense help. Institution wise search was conducted for faculty names and their personal email IDs and large number of email IDs were thus collected. Some email IDs were also collected from the research publications where authors‟ email IDs had appeared. For obtaining the opinion of the respondents, the pretested structured closed ended questionnaire was administered to the survey participants through e-mail with a request letter explaining the importance and purpose of the survey.

Out of the participants who received the mail, some responded very quickly and also appreciated the effort. Some participants responded but they did not fill in the questionnaire because they felt that this was not a worthy exercise. Some participants responded with a delay because they were out of station or busy with other assignment. The content of the emails was posted on the LinkedIn groups related to professionals who work in the manufacturing department, and other announcements were posted on social media asking for participation. I collected the data in two phases, in 1st phase basic information about Industry 4.0 and in 2nd phase collected data about Industry 4.0 for Manufacturing Organization in India.

First survey to collect data to be used in this study was started on Oct. 31, 2018 and ended on Dec. 24, 2018. 104 participants replied to the survey on the period, and 2nd phase to collect data about Industry 4.0 for Manufacturing Organization in India held Feb. 4, 2019 and ended Feb. 24, 2019. In 2nd phase survey total 112 participant participated.

Questions not answered, the blank answer was not included the correspondent analysis; in this case, the respondents were still analyzed if he/she answered another question.

3.3 Characteristics of respondents

Characteristics of respondents though the body of respondents comprises of 112 persons, it represents holding academic qualifications ranging from B.E. to PhD degree in technical stream, holding official positions varying from Director/manager to mechanics technician in various type of company in India. From gender point of view, participation of 87.50 % males and 12.50 % females has been observed. Age of participants varied from 20 years to 50 years. On the whole, the survey participants constitute a heterogeneous mixture of academicians considering their age, qualifications, type of company they are serving and their geographical location. This aspect is very much desirable as this guarantees an unbiased opinion and augments the reliability of the findings of the survey.

4. Data analysis, hypotheses testing and Presentation of findings

This section discusses the analyses performed on the collected data and the findings of then research study. In this section, purpose of the research survey, method used for data collection, and methods used for preparing and exploring data for analysis are mentioned. Subsequently, data analysis process used and results of the data analysis in the form of acceptance or rejection of hypotheses have been presented. Lastly, formulation of strategies for quality improvement of engineering education giving sufficient justification for each strategy have been presented in this section.

4.1 Purpose and method used for the survey

The purpose of this research survey is to elicit response from survey participants on 46 research questions centered around 5 research objectives identified by the researcher. For this purpose, „Questionnaire method" of data collection was chosen due to the fact that the sample for the survey was drawn from a population of different type of industry and it is located in different cities of India spread throughout the country. It was practically impossible for the researcher to personally meet them or even talk to them over telephone for seeking their participation in the survey as would be necessary if interview method would have been chosen. Although questionnaire method has its own limitations but looking into the widely spread geographical location of the respondents, this method has been finally selected. The instrument used for data collection was a closed ended questionnaire comprising of 9 research questions/ hypotheses to be answered on 5- point Likert scale. This type of questionnaire is advantageous, as the respondents find it easier to answer and the researchers find it easy to analyze the responses. Questionnaire was designed and modified subsequent to a pilot survey. For administering the questionnaire, services of internet were used which is not only fast but cheap too. The responses (hereinafter called „data") received from the respondents were coded, classified and organized in an orderly manner to render them amenable for analysis.

4.2 Preparing data for analysis

O"Leary (2004) has opined „In quantitative analysis, exploring the data entails visually inspecting the data and conducting a descriptive analysis such as calculating the mean, standard deviation and variance of responses in order to determine the general trends in the data. Researchers explore the data to see the distribution of the data and determine whether it is normally or non-normally distributed so that proper statistics can be chosen for analysis ".

4.3 Hypotheses testing

Once the data regarding each hypothesis/question has been collected and tabulated, the next step is to test each hypothesis using some statistical technique for accepting or rejecting the hypotheses.

4.3.1 Hypotheses testing using t- test

Firstly, hypothesis testing has been done with the help of t-test which is used to compare the means of two groups to determine whether the two groups are statistically different from each other. This test is applicable when we do not know the mean and standard deviation of the population but the mean and standard deviation of the sample (s) are known. Typically, in these situations, we should have small sample size but not always (Rumsey, 2010). Inferences about the population mean μ can be made when the population is normally distributed. For large population, frequency distribution may be assumed to be normal (Sarah & Paul, 2008).

4.3.2 Procedures adopted for performing t-test

- Determining H0 and H1
- Setting the criterion
- Finding out tcritical from Statistical table that depends on level of significance and degree of freedom.
- Calculating and s of sample data
- Calculating the test statistic (t0) using formula

$$t_0 = \frac{\bar{x} - \mu 0}{\frac{s}{\sqrt{n}}}$$

Where, $\bar{x}$ is the sample mean, μ0 is a specified value to be tested, s is the sample standard deviation and n is the size of the sample.

- Rejecting H0 if t0 is greater than tcritical

Following the above procedure, one-sample t test for Question No.1 to Question No. 9, with n =104 to 112 has been performed as mentioned below,

- Null hypothesis (Ho): Population Mean (μ) ≤ μ0 (in this case 3.00, being the mid-point of the scale 1 to 5)
- Alternative hypothesis (H1): Population Mean (μ) > μ0 (in this case 3.00)
- For level of significance = 5%, tcritical (for degree of freedom =104 to 112) has been found to be 1.65 for one tail test from the table.
- t0 was calculated for each research question/ hypothesis.
- H0 was rejected, if t0> 1.65 and H1 was accepted.
- Acceptance of H1 implied that Population Mean (μ) exceeds 3 and the research hypothesis was accepted.
- For those hypotheses where H1 were accepted, it was concluded that majority of the respondents believe that the concerned research hypothesis was true.

The hypothesis for the t-test was 2.5; that is, the middle value on a scale of 0 to 5. All answers that received the score zero, it does mean, have no any knowledge on industry 4.0, were discarded for the purpose of statistical analysis. Function in the company and Industry 4.0 knowledge, shows data regarding the function of director/manager/supervisor.

From collected data, mean of digital maturity of your organization 2.8 in which manufacturing organization digital maturity is low and IT sector have maturity level is high.

Alternate Hypothesis is Indian Organization is digitally matured but Alternate Hypothesis is rejected. It means Indian organization is not digitally matured, mainly manufacturing Organization. In India online shopping/ Business is increasing day by day still offline is dominant.

We identified five broad themes for external support required from other industries and the government.

Now days, we have to understand the market trend and customer requirement and also to compete the competitor, organization need to get a pulse on the changing market and adjust their. Therefore, Organization has a digital vision to transform for meeting of the new market needs. Alternate Hypothesis is Organization has a digital vision to transform for meeting of the new market needs but Alternate Hypothesis is rejected. From the survey data, Mean is more than 2.5, it means digital vision is important to meet the new customer needs. 25 % organization still have not such effective digital vision to understand the market needs. Top five barriers to digital transformation success in India:

- Data privacy and security concerns
- Regulation and legislative changes
- Lack of the right in-house skill sets and expertise
- Information overload
- Weak digital governance and structure

Total 101 participants participate in this question, but only 85 participants agree, their organization have leadership has made an effort to translate the digital vision for all levels of the organization. Alternate Hypothesis is Leadership has made an effort to translate the digital vision for all levels of the organization but Alternate Hypothesis is rejected. Still 26.73% participant's organization have not dedicated leadership towards organization's digital transformation. Few Organization have not dedicated leadership towards organization's digital transformation. Several organizations have leadership to translate the digital vision but not dedicated.

Organizations always try to satisfy the customer satisfaction so, used to stay in touch with the customers and to solve their challenges. By digital technology, organization get the data from feedback, review or by survey and try to continuously improve solution and services

By this response, mean is higher than 2.5 because every organization always try to solve the customer challenges and fulfil the customer requirement. More than 87% people agree that in their organization have Digital technology is used to stay in touch with the customers and to solve their challenges.

4.4 Proposed Implementation Model

No improvement has ever taken place without a strategic plan. Therefore, following some strategies have been identified from the conclusions drawn from the results of hypotheses testing (t-test) for manufacturing organization in India.

- From the question, find that Indian Organization is not digitally matured, sample mean is 2.81 and stander deviation is 0.77. Mean is slightly higher than 2.5 because of IT company. Organization need to understand customer demand and utilize digital technologies to create and deliver them in an innovative and integrated solution. For example, company could use cloud technologies and Internet of thing for digitalization so that company can share manufacturing resources.
- In the field of industrial change, there is little awareness of Industry 4.0. Most of the manufacturers are still unaware of the potential

opportunities that Industry 4.0 technologies can offer. While technological aspects of Industry 4.0 draw all attention of industries, the impact of deep understanding of Industry 4.0, even in managerial level, has been underestimated, only 56.85 % participant agree that they heard of the term Industry 4.0 and 30 % people know about it. Industry 4.0 might have a disruptive effect on companies and change their landscape. Some aspects of digitalization will undoubtedly be tricky. High and mid-level managers need to deeply understand different elements of Industry 4.0 and gain proper knowledge, skills and confidence to be adept at dealing with different situations and manage threats from new technologies of competition in the market.

- In survey, only 70% participant agree that there is dedicated team to the organization's digital transformation and change but mean is slightly higher than 2.5 it means dedicated team is not working properly. Organization should make a dedicated team for digital transformation.
- Employee should be given proper training regarding Industry 4.0. During the survey, find that employee did not get formal training of Industry 4.0.
- Once the organization got all the information and study their current status and digital maturity, need to develop a roadmap. Advance technology is a backbone of industry 4.0, must have to identify and studied about that. Hence, a technology choice method must be developed to assess and rank key available technologies based on company's criteria and objectives.
- To provide proof of concept and demonstrate the technologies, we have to setup pilot projects. In pilot project all possible option including installing, automations and different type of sensor on critical manufacturing machines and predictive explorer maintenance by using big data analytics.

5. CONCLUSIONS

The Industry 4.0 evolution is bringing new technologies to the manufacturing arena. These new technologies require new skills in areas such as IT, engineering/design, manufacturing, and maintenance. This study has focused on the manufacturing field. At this point in the evolution of Industry 4.0, manufacturing workers, both white and blue collar, have a lack of knowledge of Industry 4.0 in terms of concept and infrastructure, and data analysis indicates that the categories of white collar or blue collar and did take or didn't take formal training heavily influence Industry 4.0 knowledge.

Filling the gap in knowledge will generate some impact, since the main way to acquire knowledge, as revealed by the survey, is informal and on-the-job training. The information system to be used to support this knowledge transfer needs to be improved.

The technology in place regarding Industry 4.0, such as temperature, pressure, humidity, ultrasound, and vibration analysis, follows the industry on the third revolution, but with cyber-physical characteristics, which is the main distinction from Industry 3.0 as stated on the literature presented on this study.

Measurement devices, sensors, and advanced algorithms can give equipment conditions for its life, but the execution of the maintenance on these new devices must be done by a human being in the majority of cases. Because of this, training is key to acquiring the best results for maintenance. The survey's results and the data analysis point to providing training regarding Maintenance 4.0 for professionals who work in manufacturing departments, regardless of their function.

All this transformation should be followed by a very structured change in management plans, so as to get the expected results and a smooth implementation.

Opportunities for improving the survey were identified. The question regarding "What is your function at the Company? "Had the answer "Director/Manager/Supervisor" which limited some additional analysis. The suggestion is to break the answer into individual answers such as Director, Manager, and Supervisor. Regarding the scales used to determine mean, standard deviation, hypothesis testing etc, a description for each value is necessary to help the respondents provide an accurate answer.

According to survey, we found that maximum participant is young age, old employees are not easily accepted new technology, and very less people get formal training of Industry 4.0. In hypothesis testing, test nine questionnaire in which six are rejected, in which questions are like, Indian Organization is digitally matured, Organization has a digital vision to transform for meeting of the new market needs, People Know about Industry 4.0. Analyze the survey questionnaire and propose suitable environment for Industry 4.0 for manufacturing organization in India.

Limitation of the study

- I took survey by using social media too and find that several participants are from same company, because of that I got same type of response.
- In my survey response, I did not get response from all over India manufacturing organizations, my survey response is limited to some manufacturing organization. If participants are from all over India manufacturing organizations, result might be more accurate.

- In my survey, only 112 participants participated, in order to get an accurate analysis, there is a need of higher number of participants.
- Indian people are not well versed with digital technology due to which companies are facing difficulty in gathering the relevant data or information like feedback, market demand and they face problem to make strategy.

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