

Implications of Industry 4.0 for Improving Industrial Performance

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Abstract-- The fourth industrial revolution or Industry 4.0 is digital transformation of production, operation and other related industries in their value creation process. It represents a new stage in the organization and manages & controls the value chain of industries. Cyber-Physical Systems are the backbone of “Industry 4.0”. They make use of state-of-the-art management systems and have built-in software systems, as well as access to the Internet addresses to connect with the help of the internet of things. These changes presented from the digital revolution pose the actual challenge for the enterprise.

Organizations are supposed to develop strategies to exploit the new challenges and possible opportunities of Digitization which will help to improve the established processes and also in the development of new business models. The sample for this study is 180 working employees at a manufacturing plant by using purposive sampling. Responses of the respondents were taken on the 3 Point Likert Scale and the T-test Hypothesis (One-tailed test) using SPSS is considered.

For this study, the Maruti Suzuki Manufacturing Plant of Manesar District of Haryana is considered. The objective of this paper is to evaluate the role of Industry 4.0 in enhancing industrial performance. And also to assess the mindsets of the employee towards “Industry 4.0”. The combination of novel technologies presented by “Industry 4.0” like cyber-physical systems, internet over things, and digitalization are considered for this study. The findings in a framework show positive role of industry 4.0 in enhancing industrial performance. And researchers also concluded benefits of industry 4.0 by perception of employees. The findings cannot be generalized for other manufacturing industries and other areas of the country.

Keywords: Industry 4.0, Digital transformation, Cyber-physical systems, Digitization, Industrial performance, Mindsets

I. INTRODUCTION

MILLENNIAL generation is the generation that should utilize opportunities presented by industry 4.0. Manufacturing and Information and Communication Technology (ICT) brought industry 4.0 into the manufacturing world. This is making it convenient to connect with the information, objects, and human due to the convergence of the physical and cyberspace in the form of cyber-physical systems. Industry 4.0 presents the concept of revolutionizing the status and pattern of

manufacturing and generating innovative methods for industries to enhance operations and creates values for organization.

The success and failure of business depend on the impact of environmental conditions as well as on opportunities available. Industry 4.0 affects all levels of the production line and supply chain. It affects smart factories, the industrial internet of things, smart industry, and advanced manufacturing. Factories are shifting from mass production to mass customized production systems and adapt to dynamic changes in business. New concepts like ‘smart factory’, ‘cyber-physical system’, ‘Internet of Things’ are being proposed and present many benefits like mass customization, flexible production, increased production speed, high quality of products, decreased error rates, advanced analytics, data simulation, predictive maintenance, better customer proximity, new value creation method which leads to the improved work life.

Internet of things communicates objects based on internet technologies. It also detects and identifies using IPV6-addresses (128-bit address space). The data is being shared and managed using internet technology.

Industrial Internet of Things: IIoT platform in Industry 4.0 will be a centralized control system that communicates and interacts with various equipment and systems. IIoT allows for real-time traceability and tracking, as well as decentralized analytics and decision making. Cohesive cross-company collaboration is possible because of IIoT. It will enable fully automated value chains, boosting organizations’ functional and operational capabilities skills in business [1].

Cybersecurity: With widespread adoption of Industry 4.0, cybersecurity concerns are expected to rise [2]. Secure, dependable communication, as well as sophisticated identification and access control, are all possible. Cybersecurity is a critical necessity for the long-term viability of Industry 4.0 systems; thus, cybersecurity policies should be included in enterprises’ information technology systems.

The fourth-generation industrial revolution is booming with the emergence of smart robots, technology, automatic vehicles, and

the development of neurotechnology which enables humans to fertilize their brain function. Industry 4.0 opens doorways of many opportunities for everyone who can connect with the social network. It brings opportunities for everyone. All over the globe, Industry 4.0 is transforming the future of conventional manufacturing industries.

Advances in technology and digitalization facilitate the merger of real and digital world in creation of a new era of physical to digital to physical and present the way for disruptive approaches for development, production and the entire logistics chain. This era of interconnectivity and digitization comes up with ample opportunities for businesses and manufacturers to explore new means for achieving objective of business. Internet of Things, Cyber-Physical Systems and growing technologies create the potential and possibility to develop improved and better operations, business to transform their entire value chains, conversion from raw material to the final product, and their business models.

The fourth industrial revolution is impacting everything at an accelerating speed. Therefore, it will bring opportunities as well as challenges, for which kind of leaders are needed who understand the digital era. Industry 4.0 is not just the latest buzzword, the technologies behind this will bring and touch all aspects of manufacturing processes. Then these technologies will provide a clear opportunity for companies to improve their productivity and reassert their status globally.

Industry 4.0 will expectedly drive productivity increments positively as compared to those which were generated by introduction of steam engine in industrial revolution. It may deliver \$1.2 trillion to \$3.7 trillion in gains. In industrial zone 4.0 now everything and anything will be done digitally using the emerged technology. Here comes a matter of concern about human energy. Every kind of change comes with its pros and cons. The 4.0 revolution will eliminate up to 35 percent of the work in the coming next five years and this will increase up to 75 percent in the next 10 years . The reason is transferring of human activities into digital activities. This will make the process of production faster and easier with minimal involvement of humans.

This presents opportunity for entrepreneurship as the human element will be missing and most activities in the organization will be self-automated. For organizations, such changes are beneficial but when we consider the human resources it will bring a dangerous impact if it is not properly considered and taken care of. Human activities will be replaced by artificial intelligence and robotics. With the help of elaboration in the introduction part, the problem for this study is “What are the different opportunities for businesses provided by industry 4.0?”. This research study checks the mindsets and acceptability of employees towards industry 4.0 in a Business organization.

II. LITERATURE REVIEW

Recently, rapid development of information and communication technology and its integration with the supply chain led to the

Sized applications	Potential economic impact, \$ billion, annually	Estimated potential reach in 2025, %	Potential productivity or value gains in 2025
Operations management — manufacturing	76–245	<ul style="list-style-type: none"> 50–70 	<ul style="list-style-type: none"> 5%–12.5% reduction
Predictive maintenance — manufacturing	38–91	<ul style="list-style-type: none"> 50–70 	<ul style="list-style-type: none"> 10%–40% reduction in spend, 3%–5% improvement in equipment lifetime, 50% reduction in equipment downtime
Farms — increase farm yield	10–57	<ul style="list-style-type: none"> 10–30 	<ul style="list-style-type: none"> 10%–25% yield improvement
Inventory optimization — manufacturing	17–55	<ul style="list-style-type: none"> 50–70 	<ul style="list-style-type: none"> 20%–50%
Operations management — hospitals	40–54	<ul style="list-style-type: none"> 0–50 	<ul style="list-style-type: none"> 20%–40% reduction in time lost on tracking durable medical equipment; 250 hours a year saved for nurses
Health and safety — manufacturing	12–38	<ul style="list-style-type: none"> 50–70 	<ul style="list-style-type: none"> 10%–25%
Hospitals — counterfeit drug reduction	5–20	<ul style="list-style-type: none"> 20–50 	<ul style="list-style-type: none"> 80%–100% reduction for applicable drugs (30%–50% of all drugs)
Other ¹	22–65		
Total	216–627		

Figure 1. Source: McKinsey & Company Analysis.

fourth industrial revolution: the arrival of “Industry 4.0” [3]; [4]. Due to technological innovation and changing needs of customers, competition within the business intensified. This transformative change of the business ecosystem will profoundly affect the operating model/framework and management strategy to adapt to and integrate with new challenges in the evolving ecosystem [5]. Since the inception of Industry 4.0, more and more companies have adopted the principles and technologies of the new industrial revolution to improve performance and productivity [6].

The main advantage of Industry 4.0 lies in its enormous impact on many aspects of society. From the perspective of typical users, the influence of Industry 4.0 in the professional, family, and social fields has clearer visibility. Smart homes, smart cities, and offices, and electronic medical systems are just a few examples of the possible scenarios of how the new paradigm can completely change the world [7]. Similarly, the most obvious impact of Industry 4.0 is expected to be in the areas of Industry manufacturing and management, logistics, and business process management.

Digitization is a necessary condition for supply chain (SC) systems to survive in the current highly dynamic and competitive business environment [8], [9]. The company needs to embrace emerging technologies in its business process and manage the increasing flow of data in its value chain to effectively manage the next generation of digital SCs. With the development trend of Industry 4.0, there is a growing need to study the implementation of Industry 4.0 in the SC network.

Although there are some studies on the framework and roadmap for the transformation of Industry 4.0 [10], there is a lack of general methods for the system, including complex systems such as SCs. To make up for this obvious research gap, Research studied the adaptation and transformation of Industry 4.0 in the context of SC. A good starting point is to identify potential drivers, success factors, and barriers to this technological transformation [11]. Therefore, first, with the help of the literature, identified the main drivers and barriers to the adoption of the Industry 4.0 paradigm, and then they were divided into four business dimensions, namely: strategic organization, technology and law, and ethics [12]. The relationship between these factors is also evaluated and calculated with the help of two professionals. An analytical perspective is needed to provide a complete understanding of how these factors affect the implementation of Industry 4.0 and the key SC variables. Therefore, secondly, by including the influence of different obstacles and Industry 4.0 driving factors on the SC dynamics, the System Dynamics (SD) method is used to model the SC adapting to Industry 4.0. The results are explained by comparing traditional SCs with SCs adapted to Industry 4.0.

Radiofrequency identification device (RFID) and cloud technology are combined to check SC performance behavior. In addition to providing theoretical knowledge and various practical insights, review of literature from the SC perspective and quantifiable results of the model led to development of a general stage framework to successfully implement the Industry 4.0 SC network.

III. RESEARCH OBJECTIVE

- To assess the mindsets of the employee towards “Industry 4.0”.
- To evaluate the role of Industry 4.0 in enhancing industrial performance.

IV. RESEARCH METHODOLOGY

Sample for this study is 180 working employees at a manufacturing plant by using purposive sampling. The workers were requested to fill the form (Hard & Soft Copy). Responses of the respondents were taken on the 3 Point Likert Scale and the T-test Hypothesis (One-tailed test) using SPSS is considered. For this study, the Maruti Suzuki Manufacturing Plant of Manesar District of Haryana is considered.

Hypothesis for the study

Statement 1: To assess the mindsets of the employee towards “Industry 4.0”.

H0 = There is no significant impact of Industry 4.0 on the mindsets of the employees.

H1 = There is a significant impact of Industry 4.0 on the mindsets of the employees.

Statement 2: To evaluate the role of Industry 4.0 in enhancing industrial performance.

H0 = There is no significant role of Industry 4.0 in enhancing industrial performance.

H1 = There is a significant role of Industry 4.0 in enhancing industrial performance.

Data Analysis

TABLE 1 -- DISTRIBUTION OF RESPONDENTS

Based on	Respondents	Percentage
Gender	Female	11
	Male	89
Education Qualifications	Certificate	7
	Diploma	35
	Graduation	22
	Post Graduation	16
	Others	20
Age	20-30	45
	30 - above	55

TABLE 2 -- RESPONSES TO THE STATEMENTS

C: Certificate, D: Diploma, G: Graduate, P: Post Graduate, O: Others

Statements	Agree					Neutral					Disagree				
	C	D	G	P	O	C	D	G	P	O	C	D	G	P	O
1. I clearly understood the purpose of Industry 4.0	8	19	10	5	7	2	3	4	3	2	6	15	8	3	5
2. The heaviest loss to a business is information loss	4	15	9	1	5	2	8	4	3	3	9	19	10	2	6
3. For the operating process we depend on technology	7	21	6	5	8	1	6	5	3	6	3	13	5	3	8
4. At the beginning of the program there was sufficient information to provide guidance	6	9	7	3	5	3	6	5	3	0	10	17	12	4	10
5. We use digital technology to enhance performance and profitability of our current products and services	8	16	4	2	9	4	9	7	2	5	9	4	12	1	8
6. My company created new digital technology based business models	14	19	17	2	5	1	2	2	0	1	7	16	7	2	5
7. I have the knowledge to manage information security at my workplace	9	18	10	4	7	3	4	3	0	1	8	15	9	3	6
8. I understand what cyber physical systems are	8	11	9	2	6	0	5	2	1	1	8	21	10	5	11
9. I understand what a data security risk is	6	22	9	2	4	1	3	0	1	1	6	23	12	3	7
10. Using password protected systems/ machines is in my opinion a good idea	10	20	11	3	9	2	3	5	2	0	8	13	7	3	4

TABLE 3-- STANDARD DEVIATION AND T-TEST CALCULATED VALUE (ONE-TAILED TEST) AT 5% LEVEL OF SIGNIFICANCE

Mean	201.5
Standard Deviation of Sample	15.785
Count (n)	10
Standard Error	4.99166
Degree of Freedom	9
Hypothesis Mean Value	120
T-Statistic Value	16.32723
T-Value at 5% Level of Significance (One-tailed test)	1.833

Data Interpretation

T-Test Calculated Value > T-Test Statistic value at 5% Level of Significance at the degree of freedom 9 *i.e.* 16.32723 > 1.833 Therefore,

For Statement 1: To assess the mindsets of the employee towards “Industry 4.0”.

H0 = Rejected, There is no significant impact of Industry 4.0 on the mindsets of the employees.

H1 = Accepted, There is a significant impact of Industry 4.0 on the mindsets of the employees.

For Statement 2: To evaluate the role of Industry 4.0 in enhancing industrial performance.

H0 = Rejected, There is no significant role of Industry 4.0 in enhancing industrial performance.

H1 = Accepted, There is a significant role of Industry 4.0 in enhancing industrial performance.

V. RESULTS

Based on Data Analysis and Data Interpretation, the result depicts that there is a significant impact of Industry 4.0 on the mindsets of the employees. Also, there is a significant role of Industry 4.0 in enhancing industrial performance.

VI. FINDINGS & CONCLUSION

The study is an attempt to understand the mindset of the employees towards industry 4.0 working in the Maruti Suzuki manufacturing plant of Manesar district of Haryana. As per the data analysis, 49 percent that is half of the population agree that they understand the purpose of Industry 4.0, whereas 37% disagreed with this. Losing information in a business is a small concern, 46 percent agreed to it. Majority of respondents agree that for the operating process, the plant is dependent on technology. More than half of the respondents conveyed that at the beginning of the industry 4.0 phase, sufficient information and guidance were not provided to them.

57% of the respondents agreed that the company uses new digital technology-based business models whereas 37% disagree with it. 41% of the respondents disagree that they have any knowledge required to manage information security at the workplace. 55% that is more than half of the respondents disagree that they understand about cyber security at the workplace. Near to half that is 43 % of the respondents agree that they understand what data security risk is.

Majority of respondents agree that using password-protected systems or machines is good in their opinion. The paper concluded that the employees are having a positive mindset for industry 4.0 but they need more training and guidance from their supervisors. It is depicted that the productivity and performance of the industry will be enhanced with industry 4.0.

VII. PRACTICAL IMPLICATIONS

The study is expected to benefit other manufacturing industries or other sectors like pharmaceutical industries, petrochemical industries, etc. in understanding challenges of implementing Industry 4.0 in their network. The results of this research study are utilized to develop a conceptual model for successful implementation and acceleration of Industry 4.0 in Maruti Suzuki Manufacturing plant of Manesar District of Haryana. Study presents that “Industry 4.0” plays a crucial role in enhancing the performance of industries. This study will be fruitful to understand the mindsets of employees towards “Industry 4.0”.

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