

A SURVEY OF THE READINESS AND MATURITY LEVEL OF INDUSTRY 4.0 AT TWENTY COMPANIES IN PAKISTAN

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A survey-based analysis is carried out of twenty major industrial sectors in Pakistan to inspect and scrutinize how Industry 4.0 is developing and being instigated in production units as well as business. Existing technical aspects demonstrate that ancient manufacturing processes are not apt to produce components more accurately and precisely but less lucratively. The objective of this study is to assess the present implementation measures, readiness and maturity level with regard to Industry 4.0 as well as the elementary knowledge of workers and technical know-how of experts. This survey may provide a helpful guide for new and already existing enterprises seeking to precisely achieve requisite attributes of Industry 4.0. A questionnaire consisting of six questions was sent to various industrial businesses and feedback from production managers with a mean age of 34.56 ± 04.20 years and a minimum of 10 years of experience received. This is a qualitative survey examined by a quantitative method.

Keywords: Industry 4.0, Cyber-Physical Systems, readiness, maturity, survey

1. Introduction

Industry 4.0 has two main features; one is integration and the other interoperability [1]. Industry 4.0 is a set of nine digital systems that interlink the physical world of production with its numerical equivalent. This set of innovations controls machines which work autonomously by obeying commands within nanoseconds and with extraordinary precision [2]. It offers many business opportunities for small and medium enterprises. In Pakistan, due to a lack of knowledge, the majority of people are unaware of the concept of Industry 4.0. Therefore, industrial sectors are unable to implement this concept as the government has not made any fruitful decisions nor provided facilities for them. This development has drawn the digital and physical worlds close together through Cyber-Physical Systems (CPS) [3]. A CPS is a new group of systems with integrated computational and physical capabilities that connect humans to new modalities [4]. The ability to connect and spread the abilities of the physical world with the aid of computation and communication is an important enabler for upcoming industrial and technological developments worldwide [5]. Industry 4.0 is a tool to improve manufacturing capabilities and enhance efficiency in industrial sectors. To curtail old-

fashioned technologies and traditional methods, the implementation of Industry 4.0 technologies is likely to generate more revenue for the state, increase the quality of products and enhance the effectiveness of operating systems on the international market. Real-time data processing, monitoring and fault detection are all controlled through the Internet, thereby saving time as well as reducing labour costs and maintenance expenses. According to a report by Khan (2010), a huge decline in the textile industry has been witnessed as a result of Industry 4.0 [6] due to which the exports of textile in the future may drop, reducing its contribution to the gross domestic product (GDP) in Pakistan which was 4.24% in 2015 [7]. As the share of the GDP concerning the industrial sector is 12.4% 0, to increase the GDP up to its optimum level, the industrial sector must embrace Industry 4.0 in Large- (LSM) as well as Small-Scale Manufacturing (SSM) [8]. The industrial sector is struggling to adopt Industry 4.0 in Pakistan due to a lack of skills and knowledge [9]. Maturity models are generally used as a tool to measure the maturity of Industry 4.0 [10]. Readiness models are designated with the aim of securing a starting point and enabling the initialization of the development process [11]-[12], which have recently been proposed in the fields of energy, utility management and design [13].

Table 1. Questionnaire about the readiness and maturity level of Industry 4.0

| Questions | Categories | Details | Rating | | | | | |
|-----------|--------------------------------|--|--------|---|---|---|---|----------|
| | | | 1 | 2 | 3 | 4 | 5 | No info. |
| Q1. | Readiness of Industry 4.0 | Rate your knowledge about Industry 4.0. | | | | | | |
| Q2. | | Rate the current level of implementation of Industry 4.0 in your industry. | | | | | | |
| Q3. | | How many conventional methods of production are appropriate for manufacturing? | | | | | | |
| Q4. | Maturity level of Industry 4.0 | Do you implement Industry 4.0 in large-scale manufacturing? | | | | | | |
| Q5. | | Rate the quality of production as a result of Industry 4.0. | | | | | | |
| Q6. | | Rate the skill level of Industry 4.0 in your industrial setup. | | | | | | |

Industry 4.0 readiness is defined as the degree to which any organizations are able to benefit from Industry 4.0 technologies [14], i.e. it concerns how digitally equipped corporations are with regard to implementing Industry 4.0 technologies [15]. This digital revolution has reformed the software and hardware aspects of organizations [16]. For example, in engineering, three-dimensional simulations and printing have previously been implemented concerning raw materials, finished products and production cycles [17], however, Software-as-a-Service applications offer an additional window of opportunity in terms of Industry 4.0. These prospects can be better addressed under the umbrella of Industry 4.0 technologies that can then contribute towards Industry 4.0 readiness, which can also be considered from competitive, scientific, technical and organizational points of view [10]. Major studies regard Industry 4.0 as disruptive for the same reason. Numerous surveys have been carried out concerning Industry 4.0 and many websites generated for the purpose of implementing it [18]. Furthermore, many models have thoroughly assessed Industry 4.0 readiness with regard to its implementation and future perspectives of digitalization [19]. They were not only related to their readiness but also focused on digital enterprises, smart industries and small economies [20] by not only focusing on solutions to current problems but on the needs and design of existing setups. This is not the first paper addressing the readiness and maturity level of Industry 4.0 but the scope, depth and specifications discussed are different.

2. Materials and methods

To assess the readiness, the viewpoints of workers obtained from different industrial setups were gathered and maturity levels of manufacturing enterprises in Pakistan determined. In doing so, one principle question arose, that is: “How can Industry 4.0 readiness and maturity models be measured and the maturity of

manufacturing enterprises assessed in Pakistan?” To answer this question, the operational views of innovation were gathered in terms of the social exchange and viewpoints of workers to study the maturity level of Industry 4.0 until now in the twenty industrial zones of Pakistan. Based on these aims and objectives, the research strategy was selected. The main goal of this paper is to adapt the factors on which Industry 4.0 depends before exploring them in the different local industries of Pakistan using the questionnaire. Data collection and analysis were accomplished through quantitative methods. To find a maturity model for assessing the readiness and maturity level of Industry 4.0 regarding manufacturing enterprises in Pakistan, *Figure 1* was adopted. It contains four steps to analyse the maturity level and readiness of Industry 4.0. The first was comprised of list of industries, suitable for survey and data collected. In the second step questionnaire was sent and data were accumulated, while in the third one, data were processed using MS Excel to assess readiness and maturity level. The fourth step consisted of results and deductions after receiving responses and feedback from industrial employees as well as factory workers through the questionnaire. Their replies, views and answers were processed by relevant software and the results automatically calculated as well as summarized in a compact maturity report. The questionnaire was answered by various actors, i.e. industrial workers as well as factory employees and managers. The entire questionnaire is presented in *Table 1* - which consists of

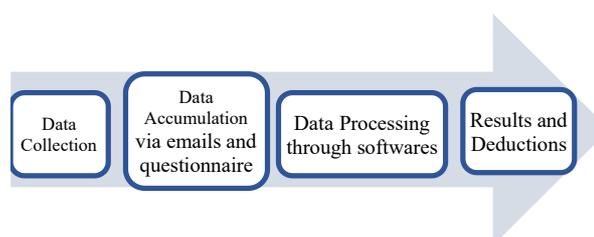


Figure 1. Block diagram – Readiness and maturity level of Industry 4.0

Table 2. Questionnaire results

| Question | Company | | | | | | | | | | | | | | | | | | | | Average |
|----------|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---------|
| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | |
| Q1. | 2 | 2 | 4 | 3 | 5 | 4 | 3 | 4 | 3 | 2 | 2 | 4 | 3 | 4 | 2 | 3 | 2 | 2 | 4 | 3 | 3.05 |
| Q2. | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 3 | 2 | 1 | 2 | 3 | 4 | 1.80 |
| Q3. | 2 | 3 | 4 | 2 | 2 | 1 | 3 | 1 | 2 | 2 | 3 | 3 | 2 | 1 | 3 | 4 | 2 | 3 | 5 | 5 | 2.65 |
| Q4. | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 2 | 5 | 2 | 3 | 3 | 3 | 2 | 2 | 2.20 |
| Q5. | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2.60 |
| Q6. | 4 | 2 | 2 | 4 | 2 | 3 | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 3 | 2 | 2 | 4 | 2.70 |
| Average | 2.50 | 2.17 | 2.80 | 2.50 | 2.30 | 2.00 | 2.00 | 2.50 | 2.30 | 2.30 | 2.17 | 2.70 | 2.50 | 2.70 | 2.50 | 2.67 | 2.17 | 2.50 | 3.17 | 3.50 | 2.50 |

Number of Questions = 6, Number of Respondents = 20, Maximum Score per question (rating) = 5, Mean score of 0 = least effective, Mean score of 5 = most effective

two main parts and various questions regarding how industries have developed smoothly and the latest technologies like Industry 4.0 adopted in Pakistan - and each question explained.

Below are the twenty main industries/companies evaluated in this research:

- 1) Hattar Group of Industries, Haripur
- 2) International Polymer Industries (Pvt.) Ltd., Islamabad
- 3) Elektro Control Industries (Pvt.) Ltd., Islamabad
- 4) Potohar Steel Industries Re-Rolling Mills, Islamabad
- 5) Dawn Electric Industries, Islamabad
- 6) Faisalabad Textile Mills, Faisalabad
- 7) Heavy Industries Taxila (HIT), Taxila
- 8) J.K. Spinning Mills Limited, Faisalabad
- 9) Poly Foils Pvt Ltd, Islamabad
- 10) Khalid Modern Industries, Hasilpur
- 11) Macter International Limited, Karachi
- 12) Heavy Mechanical complex (HMC), Taxila
- 13) Carriage Factory, Islamabad
- 14) The Indus Basin Company, ICT Islamabad
- 15) Rani & Company (Private) Limited, Karachi
- 16) Cherat Cement, Nowshera
- 17) Bestway Cement, Hattar, Haripur
- 18) Askari Fuels, Rawalpindi
- 19) Auto Industry Chaklala
- 20) Fibre Craft Industries, Lahore

3. Results

All the results addressing the readiness and maturity level of Industry 4.0 have been calculated 2.5 using a MS Excel worksheet which determined that the majority of industries in Pakistan are aware of Industry 4.0 and only a few are unaware, namely some cement manufacturing companies that require manual work using ordinary methods and an unskilled labour force with no need for digital manufacturing. This survey

examines the readiness and maturity level of Industry 4.0 as shown in [Table 2](#).

4. Discussion

In Pakistan, the implementation of Information Technology means work is done more easily and quickly, bringing about amazing changes in the industrial sector. Some of the original manufacturers want to adopt worldwide criteria and boost their productivity, while others have not adopted them yet for various reasons. In several fields, Pakistan must embrace Industry 4.0, e.g. in production, manufacturing, products and services, supply chains, etc. Pakistan should take urgent measures to bring about this development in industry, healthcare and agriculture as in other countries an increase in industrial development has resulted in GDP growth. Pakistan's readiness with regard to Industry 4.0 lags behind international industrial zones, which tallies well with results gathered by Khan et al. [21]. The mean score regarding its maturity level is also 2.5 out of 5 (50%), as shown in [Figure 2](#) and [Table 3](#), which tallies well with previous results [22]. Therefore, it can be stated that this maturity model is vital in terms of assessing Industry 4.0 [23] and is known as the novel model to expose the basic knowledge of the citizens and workers in various industrial sectors of Pakistan.

5. Conclusions

Our statistical analysis concluded that the awareness of Industry 4.0 in Pakistan is very low when compared to other neighbouring countries like India, China and Indonesia, whereas its readiness is facilitating new industrial paradigms in the country. Although the maturity level of Industry 4.0 has resulted in innovation, here in Pakistan it is only 50% to date, meaning the country is lagging behind in terms of the worldwide trend

Table 3. Final results – readiness and maturity level of Industry 4.0

| Questions | Categories | Average |
|----------------------|--------------------------------|-------------|
| Q1. | Readiness of Industry 4.0 | 3.05 |
| Q2. | | 1.80 |
| Q3. | | 2.65 |
| Total average | | 2.50 |
| Q4. | Maturity level of Industry 4.0 | 2.20 |
| Q5. | | 2.60 |
| Q6. | | 2.70 |
| Total average | | 2.50 |

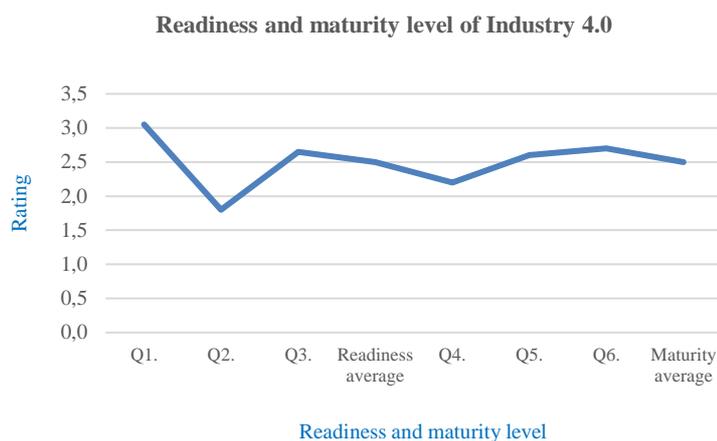


Figure 2. Readiness and maturity level of Industry 4.0 in Pakistan

regarding the Fourth Industrial Revolution. A new maturity model must be proposed in the future to ensure the maturity level of new technologies is raised in Pakistan.

Though this research assesses the readiness and maturity level in the industries of Pakistan, it can also be used to further assess Industry 4.0. It is the best technology to enhance productivity, reduce costs and waste generation, improve accuracy as well as ensure excellent precision, enabling this advancement to be implemented as soon as possible. Therefore, a survey like in this research paper should be conducted to assess the energy sector in Pakistan.

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