

Unlocking Industry 4.0: Leveraging Academic Collaborations for Career Advancement and Insights

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Abstract: *The advent of Industry 4.0 often referred to as the Fourth Industrial Revolution has ushered in a paradigm shift across various industries. The current research explores the impact and adoption of Industry 4.0 principles in diverse sectors, highlighting its transformative effects on IT, manufacturing, and healthcare industries and to identify the industry insights on the development and services to academic institutions. The primary objective is to identify the industry and institutional adoption of industry 4.0 and with the mutual collaboration between the entities. A structured questionnaire is adopted as a tool for collecting the data. There were 82 questions framed under 09 constructs for collecting the data from the respondents of industry CEOs, Managers, principals, Deans and Heads of the departments of the Institutions. The collected data was analyzed by using simple frequency test to know the literal knowledge on Industry and institution adoption on Industry 4.0 and their mutual collaboration.*

Keywords: Industry 4.0 and its awareness, Infrastructure, Emerging Sectors, Curriculum Construction, Industry Collaboration, Training and Development, Work force skills and Global impact

1. Introduction

The world is being transformed by the fourth industrial revolution. It is being referred to as Industry 4.0 or I4.0. The fourth industrial revolution takes the digital revolution a step further in technology transformation. The technology at its center on large - scale, low - cost automation, and machine intelligence has the potential to affect how we learn, work, move, communicate, and interact. Industry 4.0 is described as the fusion of physical, digital, and biological technologies that are predicted to affect all industries, organizations, workplaces, jobs, and their skills. Industry 4.0 era follows the first three industrial revolutions. The first industrialized revolution (1784) was with the introduction of the steam engine and mechanized production process. The second industrialized revolution (1850+) was characterized by electric power and mass - production process. The third industrialized revolution (1960+) was with the introduction of automation and digital technology. The Fourth industrial revolution (2016+) is characterized with the evolution of cyber physical system, intelligent computers based on big data and artificial intelligence.

2. Industry 4.0 and emerging sectors

Industry 4.0 represents the fourth industrial revolution characterized by the fusion of digital technologies and traditional industries. It encompasses automation, IoT, AI, Cyber physical systems, Robotics, and data analytics to create smart, interconnected systems with minimum human support.

The **Information Technology industry** is at the forefront of Industry 4.0 transformation, exemplifying the integration of cutting - edge technologies into its own operations and serving as a key enabler for other sectors. The IT industry is experiencing a profound transformation driven by Industry

4.0 principles. Automation, data - driven decision - making, IoT integration, and cybersecurity are among the core elements reshaping the sector. As the IT industry continues to innovate, it not only advances itself but also serves as a catalyst for digital transformation across other industries, ushering in a new era of technology - driven possibilities. After the IT sector, Industry 4.0 is asserting its dominance in industries like healthcare, pharmaceuticals, and manufacturing.

In the **Manufacturing Sector**, Industry 4.0 represents a revolution in automation, connectivity, and data analytics. Smart factories equipped with IoT devices and cyber - physical systems optimize production processes, improve quality control, and reduce downtime. The integration of artificial intelligence and machine learning enables predictive maintenance and agile production, enhancing competitiveness on a global scale. The current transition represents a paradigm shift where traditional manufacturing processes are seamlessly integrated with digital technologies, automation, and data - driven intelligence. Today the large Manufacturers are leveraging smart machines, IoT devices, and real - time data analytics to optimize production, reduce downtime, enhance product quality, and streamline supply chains. This transformation not only improves operational efficiency but also opens doors to highly customizable and agile production processes, allowing manufacturers to meet ever - evolving customer demands with greater precision. Industry 4.0 is not just reshaping manufacturing. It is creating the milestone of setting the stage for a new era of innovation, competitiveness, and sustainability within the industry globally.

In the **healthcare and Pharma Sector**, Industry 4.0 is reshaping patient care, diagnosis, and treatment. The utilization of IoT sensors and wearable devices allows

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continuous health monitoring, facilitating early disease detection and personalized treatment plans. Robotics and telemedicine offer remote surgical capabilities and improved patient outcomes. Big data analytics empower healthcare providers with insights to enhance patient care while managing costs effectively. In the case of the Pharma sector, industry 4.0 is ushering in a transformative era. Advanced technologies such as data analytics, automation, and the Internet of Things (IoT) are extensively used for the process of optimizing drug discovery, development, and manufacturing processes. Adoption of the advancements lead to increased efficiency, reduced production costs, and improved product quality. Industry 4.0 allows the pharma companies for real - time monitoring of pharmaceutical supply chains, ensuring the integrity and safety of medications from production to delivery cycle. With its emphasis on data - driven decision - making and automation, Industry 4.0 is helping the pharmaceutical industry deliver innovative therapies faster and more reliably, ultimately benefiting patients and healthcare systems worldwide.

3. Literature Review

According to **MM Singh, Co - Chairman of CII**, The Government of India's push to manufacturing through the "Make in India" initiative has garnered considerable attention from the industry and brought the spotlight back on the manufacturing sector. It is now formulating a National Policy for Advanced Manufacturing, which would be one of the key tools to attain its objective of increasing the contribution of manufacturing output. Consideration is being given to the framework for introduction of Industry 4.0. There will be tremendous impetus towards modern manufacturing including advanced materials, advanced robotics and 3D printing, among others.

Industry 4.0 has many facets to it including the upcoming trend of automation and data exchange in manufacturing technologies, cyber - physical systems, the IoT, cloud computing and lot more. It creates what has been called as smart factory. In smart factories, machinery, storage systems and production can carry out complex tasks, exchanging information and giving instructions to each other, without the need for human involvement. There is a need of a platform where different stakeholders can discuss the related issues and see how it may be used to the advantage of Indian Industry. Knowledge and timely adoption of upcoming trends is the key to success in this ever - changing and competitive environment.

The findings from **Sabai Khin and Daisy Mui Hung Kee, School of Management, University Sains Malaysia, Penang, Malaysia**, leads to Results demonstrate that driving, facilitating, and impeding factors play influential roles in a firms' decision - making to adopt I4.0. The major driving factors identified are expected benefits, market opportunities, labor problems, customer requirements, competition, and quality image. Furthermore, resources, skills and support are identified as facilitating factors and getting the right people, lack of funding, lack of knowledge, technical challenges, training the operators and changing the mindset of operators to accept new digital technologies are identified as impeding factors.

Sabir khin's Research limitations and implications are liable due to its qualitative design and limited sample size. His findings of the study need to be supplemented by quantitative studies for enhanced generalizability of his proposed model.

According to the study done by Abbasnejad et al 2011 and Cederholm, 2015, Practical implications are relying on the knowledge of the I4.0 decision factors identified would help manufacturers in their decision to invest in I4.0, as they can be applied to balancing advantages and disadvantages, understanding benefits, identifying required skills and support and which challenges to expect. For policymakers, the findings identify important aspects of the ecosystem in need of improvement and how manufacturers can be motivated to adopt Industry 4.0.

Organizational factors are related to its organizational structure also it depends whether the collaboration is formal or informal and if intended for a long or short term. The organizational factor includes financial resources, human resources, infrastructure, skills, trust and reputation of the partner. These would help in implementing and gaining to have a positive impact on the benefits of the collaboration.

According to Deepak Kumar Srivastava, Et AL, the manufacturing sector needs to focus on social, environmental and technological factors to integrate Industry 4.0 in production planning, logistics and supply chains. The findings also indicated that the technical education institutes can play a key role in achieving this ambition as they are responsible for the workforce of the digital future. His study shows that top management support, internal resources, and the capabilities of the teaching staff are vital for the adoption of Industry 4.0. Additionally, his findings indicate that significant differences exist between public and private sectors concerning the adoption of Industry 4.0.

4. Research Methodology

The data collection effort was aimed to assess the adoption and impact of Industry 4.0 technologies across three key industrial sectors: Information Technology (IT), Manufacturing, Healthcare / Pharmaceuticals.

The survey was conducted with a carefully selected sample size to gather insights into the current state of Industry 4.0 adoption in these sectors with the structured questionnaire. The questionnaire consists of two parts namely industry and institution biography and research - oriented questions. **The sample size for the present research in the industry was 22 and the institution was 36. The industry includes Information technology (IT), Health care / Pharma and Manufacturing.** A structured questionnaire was adopted as a tool for collecting the data. There were 82 questions framed under 09 constructs for collecting the data from the respondents of industry CEOs, Managers, principals, Deans and Heads of the departments of the Institutions. The collected data was analyzed by using simple frequency test to know the literal knowledge on Industry and institution adoption on industry 4.0 and their mutual collaboration.

5. Findings and Discussions

5.1. Industry Attributes

The results and findings are derived from the collected data by using simple frequency analysis and the table is exhibited in **Appendix - 1**. This analysis gives the first - hand information about the industry 4.0 adopted by the industry and their representation on implementations. Among the collected data, 95.2% represents the private organization and remaining 4.8% represents the government organization. The nature of the organization shows that 36% are Information technology, 41% are manufacturing and the remaining 23% were pharma industry.

The organization's geographical distribution exhibits a diverse landscape, with 64% of its presence in urban areas and the remaining 36% situated in rural regions in different versions of the data. This distribution suggests a mix of urban and rural locations, each potentially offering unique advantages and challenges in the organization's operations and outreach. **The age of the industry** is primarily composed of 36% for over a decade presence, and an additional 50% boasting 25 years of experience. In contrast, organizations with less than 5 years of experience make up just 5% of the total, while those with 6 to 10 years represent 9% of the industry segment.

Data related to **the collaboration** between the industries and institutions clearly indicates that 59% of the industries are collaborated with the institutions, whereas 41% do not have any tie - ups with the institutions.

Collaborative efforts with industries and institutions exhibit diverse patterns, with 59% involving less than 5 entities of institution, 14% engaging with 5 to 10, 9% establishing connections with 10 and above, and 18% operating independently without any collaborative partnerships.

5.2. Industry 4.0 awareness attributes

The **awareness of Industry 4.0** is derived from the collected data by using simple frequency analysis and the table is exhibited in **Appendix - 2**. Based on the derived data, the awareness is prevalent among 86% of the organizations, while 14% remain unaware of its existence. The data reveals the state of **readiness for Industry 4.0** within the surveyed population concerning a substantial majority of 56% have taken proactive steps towards readiness by attending relevant seminars and other training sessions. This demonstrates their commitment to acquiring the necessary knowledge and skills to thrive in the rapidly evolving landscape of Industry 4.0. However, there remains a significant portion of 44% who have yet to engage in such preparatory activities, signifying a potential gap in their preparedness for the transformative changes associated with Industry 4.0.

The collected data provides a comprehensive snapshot of how individuals perceive on awareness of **various components of Industry 4.0**. It's encouraging to note that a substantial majority, 86%, are well - aware of the significance of **Artificial Intelligence (AI)**, which is a

foundational technology in Industry 4.0. Additionally, a high level of awareness is observed for **IoT** (86%) and **automation and robotics** (91%), indicating that these crucial components are widely recognized and understood.

Data analysis, another essential aspect of Industry 4.0, is also well regarded, with 82% of individuals showing awareness. However, it's worth noting that nearly one - fifth of the respondents (18%) are not yet familiar with this critical element of data - driven decision - making.

Machine learning, a subset of AI, enjoys reasonable recognition, with 64% of respondents being aware of it. This suggests that there is still some room for improvement in terms of disseminating knowledge about machine learning, as more than one - third of the respondents lack awareness in this area.

In contrast, **Digital Forensics** emerges as the least recognized component, with only 36% of individuals being aware of it. This could indicate a potential gap in knowledge regarding the importance of digital forensic practices in the context of Industry 4.0.

6. Summary and Conclusion

The survey data indicates a varied level of awareness among respondents regarding Industry 4.0. A significant majority, comprising 56% of the respondents, display a strong awareness of Industry 4.0 and its associated concepts, technologies, and implications. This suggests that a substantial portion of the surveyed population is well - informed and likely prepared to engage with the transformative changes brought about by Industry 4.0.

On the other hand, 44% of the respondents lack any awareness of Industry 4.0. This highlights a sizable gap in knowledge and understanding within this segment, signifying the need for educational and awareness - building initiatives to bridge this gap and bring these individuals up to speed on the evolving industrial landscape.

The data underscores the importance of addressing the **awareness gap** concerning Industry 4.0. While a significant portion of respondents exhibit a strong understanding of Industry 4.0, 44% without any awareness represent a substantial portion of the workforce that may lag in adapting to the changing technological and industrial landscape. **Therefore, organizations, educational institutions, and policymakers should prioritize awareness campaigns and educational programs to ensure that a broader cross - section of the population is equipped to thrive in the era of Industry 4.0. Addressing this awareness divide is essential for fostering innovation, competitiveness, and inclusive growth in the evolving global economy.**

With reference to Industry 4.0 components are concerned, the data highlights that while awareness levels are relatively high for some key Industry 4.0 components, there are variations, with certain areas like machine learning and digital forensics warranting more attention in terms of education and awareness - building efforts.

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Appendix 1

Industry attributes		
Personal factor	Frequency	Percentage
Nature of the Organisation		
Information Technology	8	36%
Manufacturing	9	41%
Pharma Industry	5	23%
Total	22	100%
Type of Industry		
Government	1	5%
Private	21	95%
Total	22	100%
Location		
Urban	14	64%
Rural	8	36%
Total	22	100%
Age of the organisation		
Less than 5 Years	1	5%
6 - 10 Years	2	9%
11 - 25 Years	8	36%
25 - 50 Years	5	23%
> 50 Years	6	27%
Total	22	100%
# of collaborations		
Collaborated	13	59%
Not Collaborated	9	41%
Total	22	100%
Collaborated with institutions		
< 5	13	59%
5 to 10	3	14%
> 10	2	9%
No Collaboration	4	18%
Total	22	100%

Appendix - 2

Industry 4.0 Awareness attributes		
Characteristics	Frequency	Percentage
Awareness on industry 4.0		
Aware	19	86%
Not aware	3	14%
Total	22	100%
Readiness on for Industry 4.0		
Seminar/Workshop attended	12	55%
Not attended	10	45%
Total	22	100%

Awareness on Industry 4.0 components - Artificial Intelligence		
Aware	19	86%
Not aware	3	14%
Total	22	100%
Awareness on Industry 4.0 components - Data Analytics		
Aware	18	82%
Not aware	4	18%
Total	22	100%
Awareness on Industry 4.0 components - IoT		
Aware	19	86%
Not aware	3	14%
Total	22	100%
Awareness on Industry 4.0 components - Machine Learning		
Aware	14	64%
Not aware	8	36%
Total	22	100%
Awareness on Industry 4.0 components - Cloud Computing		
Aware	18	82%
Not aware	4	18%
Total	22	100%
Awareness on Industry 4.0 components - Digital Forensics		
Aware	8	36%
Not aware	14	64%
Total	22	100%
Awareness on Industry 4.0 components - Automation and Robotics		
Aware	20	91%
Not aware	2	9%
Total	22	100%