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Internet of Things and Its Pros and Cons in Industrial Automation in Gurugram City Over the Next Five Years

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Abstract: The current study is based on the integration of the Internet of Things (IoT) with industrial automation in Gurugram city development. By analysing qualitative this study emphasizes significant advantages of integrating the Internet of Things with industrial automation e.g. improved operational efficiency, predictive maintenance, better resource management and data-driven decision-making. This research examines the opportunities and challenges that arise with implementation of IoT in the Gurugram city industrial sector. The research suggests that while IoT has the potential to provide a competitive edge, unlocking its full benefits will require focused support for SMEs, investment in development, robust cyber-security measures and policies that address the Gurugram city industrial sector.

Keywords: Internet of Things (IoT), Industrial Automation, Gurugram, Predictive Maintenance, Small and Medium Enterprises (SMEs)

1. Introduction

The following excerpts explain that the IoT represents an efficient tool for Industrial Automation, supports Industry 4.0, enables real-time communication among various devices/ machines/ sensors, contributes to making better/ faster and automated decisions for companies, and promotes efficient production through enhanced resource utilization, better maintenance planning and increased operational visibility. All these elements support maximized performance (reduced incidences of equipment malfunctions), increased competitiveness, and lowered production costs. However, as more connected devices increase the potential for IoT use, new and increased challenges are being created, namely: increased security risk; increased risk of loss of privacy; interoperability between different device types; and high set-up pricing and length of time required to install IoT; therefore it is more difficult to scale the number of devices connected to the IoT. A prime example of the previously referenced challenges, while still being an area of development, is Gurugram, Haryana India. Today in Gurugram, Haryana India, several industries are rapidly seeing the advantages and disadvantages of employing IoT in their operations and the need for additional research into how those industries/developments will evolve over the next five years in order to maximize profits, to minimize costs and to create a competitive advantage in the region. There is a majority of research examining the IoT impact on industrial automation from a worldwide or national perspective, which does not provide detailed information at the local level, including aspects such as the quality of local infrastructure, regulations, workforces' ability to adapt, and businesses' current preparedness for the adoption of new technologies. This research seeks to assess IoT's influence on industrial automation in Gurugram by analysing the potential benefits and obstacles associated with the technology and providing reliable findings for business executives, policymakers, and technologists to help them make informed decisions. The study will add value to academia and industry by locating a gap in available literature and providing a real-life case study of how IoT will be implemented in one of India's largest industrial regions in the near future.

2. Literature Review

The IoT (Internet of Things) is a fundamental component of the fourth industrial revolution (Industry 4.0), as it enables the integration of physical industrial machines with digital industrial systems. In numerous studies, the IoT has proven beneficial in terms of collecting real-time information regarding machine-to-machine communications and enabling smarter forms of automation, thereby allowing factory operations to evolve from traditional production methods to smart, networked-based approaches to producing goods. The findings from early research indicate that, with the aid of the IoT, it is easier for companies to determine how their production facilities are functioning and to gain insight into the overall production performance. According to the work of Xu, He, and Li (2014), the IoT consists of integrated systems of sensors, embedded devices, and communication devices that provide on-going visibility of all machinery and product output within a production setting, thereby providing more effective control and predictability to manufacturing operations. In subsequent research, the IoT is viewed as part of a larger system called Cyber-Physical Systems (CPS), which connect the physical elements of production processes with the capabilities of computing and data analysis. Following the CPS approach, Lee, Bagheri, and Kao (2015) present an innovative model for manufacturing using IoT data to predict when a piece of equipment will require maintenance. With the help of

these data predictions, it is possible to minimize unplanned equipment down-time and to maximize the lifespan of equipment, which is essential for a successful manufacturing operation todaySmart factories involve an interconnected and smart way of running a factory. According to a study done by Porter and Heppelmann in 2015, smart and connected products will change the way industries compete against one another because companies are now using data to help make decisions to innovate their businesses through new service offerings. As a result, the shift requires that companies adapt to the rapidly changing market. The particularly competitive marketplace in the Gurugram (Gurgaon) area is an example of a region where the need for companies to compete in a global environment continues to increase. The NASSCOM (2022) and the Confederation of Indian Industry (CII) reports show that although large manufacturing companies are utilizing IIoT solutions extensively, small and medium companies still experience barriers like high costs, lack of interoperability, and lack of skilled technical labor. and therefore have a difficult time utilizing IIoT. While Industrial Internet of Things (IIoT) is increasing in use within the National Capital Region, barriers to implementing IIoT at a larger scale still exist. Indian studies, including that of Sharma et al. in 2021, evaluate both the technological and the management aspects of implementing Industrial IoT and indicate that there are still many problems, including data management issues, network reliability, and creating systems that are secure from attack. Without an adequate management infrastructure and trained personnel, even advanced technologies will not be effective. Many researchers, including Misra et al., are investigating the reliability of industrial IoT implementations, including considering Wireless Sensor Networks (WSN), and the way we will design and implement Real Time Systems (RTS).

While the Internet of Things (IoT) has the potential to provide significant levels of benefit, security also represents a significant concern. Kagermann et al. (2013) pointed to the increased likelihood of cyber insecurity that arises from the use of many connected systems typically associated with, and enabled by, the fourth industrial revolution (Industry 4.0). As identified by PwC India (2022), it was found that the early stages of using IoT on the part of many manufacturers have primarily focused on capturing productivity gains, rather than consistency with security. In addition, as identified by the World Economic Forum's (2020) Future of Jobs Report and NASSCOM's (2020) Industry 4.0 Assessment, there exists a significant skills gap associated with the IoT, including the lack of people with expertise in using IoT technologies, Data Analytics and Industrial Security (see Appendix B). Overall, the findings of these studies indicated that the IoT has the potential for tremendous disruption to Industrial Automation Industries, however ongoing concerns remain with regard to the associated costs of implementation, security, standardization, and the availability of skilled workers who are qualified to effectively design and deploy Industrial IoTs. In addition, the majority of these studies focus on a macro level (i.e., global level or national level) and do not adequately capture the combination of factors that are interrelated at an individual industrial facility level. In particular, however, there is a significant gap in research related to how the IoT is leveraged within industrial zones located within Gurugram, which is rapidly expanding and is presently playing a central role within the broader context of Industry 4.0.

3. Objectives of the Study

This study is intended to meet followings objectives:

a. To understand how the Internet of Things is currently influencing industrial automation practices in industries located in Gurugram.

b. To identify the major advantages and challenges experienced by industries in Gurugram while adopting IoT-based automation systems.

4. Research Methodology

This research takes a qualitative, interpretive perspective to examine the relationship between the Internet of Things (IoT) and industrial automation (in particular, the manufacturing industry) in Gurugram through an analysis of existing data. While a quantitative method would not be sufficient to explore the wide range of factors involved with integrating IoT into the industrial automation eco-system, especially in terms of understanding the context of the organisation, and the technologies that are relevant to that particular industry, the qualitative approach will help the researcher better understand all these various factors.

The method for analysing the data is by conducting a Detailed Qualitative Literature Study (DQLS) that uses content analysis and theme identification.By repeatedly reading the texts, this analysis is performed to identify, determine, and group the main ideas, patterns, and stories regarding the adoption of IoT and its effects on Industrial Automation including the following categories: efficiency improvements, predictive maintenance, reduced costs, security risks, integration concerns, and workforce preparedness. These categories were then combined by means of Thematic Analysis to derive insights from both Academic and Business literature. In order to strengthen the analysis, the identified themes were also checked against the IoT Framework to understand the relationship between Technology Capabilities and the factors of an Organization impacting the way technology is adopted and employed in Industrial Automation.

By clearly explaining how sources were selected, comparing them to one another, and identifying recurring ideas from multiple types of literature, an enhanced and complete analysis of the adoption of IoT in Industrial Automation is provided

with both Practical and Academic insights, applicable to both Research and Industry.

5. Findings of the Study

The study uses secondary data, including peer-reviewed journals, industry reports, and policy documents, to provide an overview of the opportunities and challenges associated with the implementation of IoT technology for industrial automation in Gurugram.

IoT technology supports companies in maximising the effectiveness of their manufacturing processes by providing them with timely, accurate, and actionable information, enabling them to make better management decisions, operate machinery more effectively, and minimise downtime.

The benefits of this type of technology are illustrated with the help of representative examples from the automotive supply chain in Gurugram, which currently utilises sensor-based technologies for production process monitoring. Such findings are also consistent with Xu, He & Li (2014), who demonstrated that an approach to continuous monitoring of machinery enables manufacturers to detect production inefficiencies in a timely manner.

Another key benefit is predictive maintenance

IoT sensors track various variables such as vibration, temperature, and energy consumption in order to perform preventive maintenance before problems occur. An example of a Gurugram-based logistics facility indicates that as a result of using this technology fewer problematic/malfunctioning pieces of equipment occurred which correlate with both the findings of Lee, Bagheri, and Kao (2015), as well as reports from NASSCOM regarding Industry 4.0 (2021 - 2023). By improving efficiencies in the usage of energy, tracking the availability of materials and optimising the utilization of assets, IoT also provides valuable insight into resource and cost management at the same time. This is further illustrated by manufacturing plants located in Gurugram utilising energy monitor systems. This observation is consistent with the conclusions drawn by Porter and Heppelmann (2015) and evaluations provided by the Ministry of Electronics and Information Technology [MeitY]. Additionally, the ability to create enhanced decision-making opportunities due to IoT data is proved by the use of management tools such as Dashboards, Predictive Analytics and Benchmarking which further support the work of Deloitte India (2021 - 2023) and The Journal of Industrial Information Integration.

Even with these benefits, there are important challenges.

The high price of purchasing and establishing an IoT network is another barrier to adoption, particularly for small and medium enterprises (SMEs). The Ministry of Micro Small and Medium Enterprises (MSME) and various academic studies are among those that have provided this data. Cybersecurity and data privacy also pose serious risks with many companies experiencing system failures due to insufficient security measures, as referenced in the work of Kagermann, Wahlster and Helbig (2013) and PwC India (2022). Finally, the lack of skills required in IoT Design, Data Analytics and Industrial Cyber Security has limited how well companies can utilize these types of solutions. This has been supported by NASSCOM (2022) and the World Economic Forum (2020).

The study's main contribution is its focus on the specific industrial environment in Gurugram, which fills a gap in the existing literature.

While much research into IoT adoption has focused on a global or national level, this study has zoomed in on how IoT is being used within local industrial clusters, specifically, the industrial clusters in Gurugram. By combining findings from both academic research and real-life examples from the business sector, as well as publicly available policy documents, the study demonstrates that larger firms receive greater benefits from adopting IoT than do smaller firms (SMEs), whose ability to adopt IoT is inhibited by financial, structural, and human resource limitations. The findings help to clarify the ways that technology, organization, and context can interact when adopting IoT.

With respect to both policy and practical impact, this research supports prior research and provides additional utility by linking benefits and challenges of IoT with the unique industry climate in Gurugram (as a result of the recent economic boom). Therefore, this research is a useful resource for industry stakeholders, policymakers and future researchers to provide insights into opportunities and challenges of using IoT for the next five years. In essence, it links theory and practice, as well as policy, by providing an in-depth examination of how IoT is currently being utilized by the manufacturing industries in Gurugram.

Pros of IoT in Industrial Automation in Gurugram

Enhancing operational efficiency: By providing real-time visibility of production processes, IoT allows managers to be more informed about how they are using their machines and make better decisions, thus decreasing the amount of time that machines remain out-of-service. An example is a company located in Gurugram that improved scheduling and decreased delays by utilizing sensor-based monitoring systems (Xu, He, & Li, 2014; CII Reports, 2022).

Predictive maintenance capability: IoT monitoring systems have sensors that monitor temperature, vibrations, and energy consumption of equipment. This information can help identify when maintenance is needed prior to

it actually becoming necessary. A logistics company located in Gurugram experienced a decrease in the number of times its equipment went down unexpectedly through the implementation of IoT systems, consistent with findings

published in both Lee, Bagheri, & Kao (2015) and Sharma et al. (2021).

Optimizing resources and costs: By helping manage energy use, tracking materials, and optimizing asset utilization, IoT helps minimize wasted capital while protecting the environment. Reports from Meity state that several manufacturing firms in Gurugram have decreased electricity consumption as a result of adopting IoT monitoring systems.

Making data-driven decisions: Through IoT dashboards, analytics provide managers the ability to monitor operational performance, uncover trends, and make changes to production schedules. Deloitte India (2021-2023) and The Journal of Industrial Information Integration (published in 2021) demonstrated enhanced control over operations for companies utilizing IoT systems.

Pros and Cons of IoT in Industrial Automation in Gurugram

High Capital Costs and Implementation Fees - The initial costs for using IoT are very high due to needing to purchase hardware/software and pay for networking hardware/software, trained personnel, etc. This creates significant barriers to entry for Startups/Small and Medium Enterprises (SMEs) (Ministry of MSME India; IJAMT 2020).

Cybersecurity and Data Privacy Risks - When you connect lots of systems together, you create new opportunities for cyber-attacks (i.e., unauthorized access to or changing of data). Industrial companies that do not have adequate security will encounter significant system failures, highlighting how critical it is for companies wanting to use IoT technology to have a secure environment to operate in (Kagermann, Wahlster & Helbig 2013; PwC India 2022).

Workforce Skill Shortages - To successfully implement IoT solutions, there is a need for skilled workers with knowledge of System Design/Development and Automation, as well as Data Analytics and Cybersecurity. Unfortunately, there are not enough skilled workers in Gurugram to support the growing IoT industry that will slow down IoT implementation within Small and Medium-Sized companies (NASSCOM 2022; WEF Future of Jobs Report 2020).

Complexities of Implementation/Integration - Integrating new IoT technology with existing legacy systems and ensuring that disparate systems communicate with one another properly and efficiently are often complex and time-consuming. Thus, as a result of these complexities, implementation timelines are prolonged and the associated risks increase significantly.

6. Conclusion and Recommendations

In Gurugram's manufacturing sector, companies are increasingly using the Internet of Things (IoT) to connect devices and factory equipment to automate tasks, enhance efficiency, and reduce costs. This research has been conducted through multiple sources (including academic literature and scholarly articles, industry reports, government policy materials and case studies) and presents data demonstrating how IoT improves factory productivity. Examples include better production planning and scheduling, reduced downtime, higher utilization rates for machinery, improved resource management, and the maintenance of machinery and equipment at its peak capacity due to the implementation of predictive maintenance techniques. By utilizing real-time data, companies benefit by making informed decisions regarding their operations and using their operational resources optimally; therefore, companies that implement IoT will be able to achieve greater business success.

Although large firms gain from the adoption of Internet-of-Things (IoT), the high price of implementing IoT, the complexity of managing IoT, the potential security issues surrounding IoT, and the lack of available skilled workers are all reasons small-and-medium-sized-enterprises (SMEs) experience difficulty adopting IoT technology.

This research identified several key issues that are causing these difficulties: first, security concerns; second, a cost associated with the setup and continuing operation; third, the difficulty of connecting new IoT devices to older systems; and finally, the lack of skilled personnel.

The above items slow down the impact of IoT in the factories located in Gurugram.

This study is unique and important because it is among the few studies conducted on the local industrial companies of Gurugram. The majority of previous studies only focus on either a national or global context and did not include an analysis of the unique circumstances of an area such as Gurugram.

The results of this research indicate that large firms clearly experience significant advantages due to the adoption of IoT technology; the findings also indicate that SMEs experience unique challenges regarding IoT, which indicates a strong need for customized support solutions for those companies.

The study offers several suggestions.

Supporting small and medium enterprises (SMEs) financially and technologically promotes the adoption of Internet of Things (IoT) technologies. Additionally, employees require training on IoT technology, data analysis and security. To ensure against the risks associated with connected devices, there needs to be strong cybersecurity strategies, clear policies on security and local compliance structures in place. Companies must be supported in integrating IoT into their existing systems and ensuring that new IoT devices are compatible with each other and operate effectively to achieve meaningful results. Policymakers utilize data analytics from IoT systems to enhance resource management strategies, as well as to determine the future of industrial growth. Each locality is unique; therefore, strategies should be developed

based on the specific characteristics of Gurugram, such as the supply chain, the company size and the digital infrastructure readiness.

Overall, this study will benefit both academics and industry practitioners in demonstrating the potential for IoT to create efficiencies in Gurugram's manufacturing sector, as well as the obstacles that must be addressed in order to achieve efficiency. It also identifies a critical need for concentrated efforts on technology, financial support and retraining in order to create favourable conditions for IoT implementation to occur. Through the combination of a comprehensive analysis, associated case studies and a roadmap with actionable recommendations, this research establishes a solid base for future work in this area.

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