Difficulties and opportunities for implementing automation inside industry

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Abstract. Automation inside industry is greatly related with Industry 4.0 innovations, bringing productivity gains for companies implementing it. However, it is important for the factories to analyse the variables of the cost-benefit ratio associated with its application, guaranteeing not only that the beneficial results will surpass the disadvantages of automation, but also the knowledge of these challenges and its effects on the operation. In that way, the main benefits and difficulties of automation were discovered by the analysis of scientific articles depicting industrial sectors during implementation of new methods and technologies related to automation. Moreover, the disadvantages for implementing automation were evaluated, being the most frequently appearing addressed with opportunities, which were the join of solutions observed in just one industry sector with wider scientific suggestions for improvement. As a result, there were discovered possibilities for overcoming the main challenges of automation inside industry, with its negative consequences reduced or surpassed. Taken together, the found of both opportunities and difficulties assisted industrial demands of improving operation productivity, allowing companies to have a better comprehension of the effects of automation. Additionally, addressing issues related to automation provoked a change in the cost-benefit ratio, making it more attractive for factories to implement automation and, consequently, contributing to the enhancement of industrial production.

Keywords. Industry 4.0, Automation, Manufacturing, Industrial Engineering, Smart Factory.

1. Introduction

Industry 4.0 is modifying the way factories work and its relation with society, improving productivity and bringing new industry practices with results unthinkable decades before. Following that, it's important to analyse these new paradigms guided by smart manufacturing innovations, specifically those related to industry automation.

Furthermore, inside Industry 4.0, automation can result in diverse benefits to the factory production, raising productivity and efficiency in general. Nonetheless, automation also has adverse consequences and challenges to overcome, bringing a competitive advantage to industries that have a better knowledge of automation and how to surpass its obstacles.

Therefore, our aim was to find the main difficulties related to the implementation of Industry 4.0 automation, searching for sectorial specificities and scientific ways to surpass these challenges. Some of these proposals were adapted between different industry sectors, resulting in scientific possible methods to address complexities found in manufacturing automation.

2. Methodology

Firstly, were analysed industries from different sectors, aiming to identify the opportunities and challenges related to automation adoption. The sectorial choice was based on the classification of Global Industry Classification Standard (GICS), made by MSCI and S&P Dow Jones, a framework commonly used for classifying industry sectors [1]. In total, all the eleven sectors selected were Energy, Materials, Industrials, Consumer Discretionary, Consumer Staples, Health Care, Financials, IT, Communication Services, Utilities and Real Estate, serving as a great picture of industrial companies where automation of Industry 4.0 can be evaluated.

In addition, articles related to automation in each field of industry were researched in Science Direct,

with reading evaluation being adopted sequentially to identify the biggest difficulties and benefits related to the implementation of automation inside the sector. Moreover, its relation with manufacturing is more prominent in some sectors than others, turning a numerical comparison analysis of automation adoption between sectors erratic, then focusing the research only on the evaluation of each individual sector. Additionally, the sectors Financial and Communication Service, without any manufacturing related sub-industry according to GICS, were discarded.

Finally, the research identifies the principal difficulties for automation related to smart manufacturing, finding possible suggestions for improving its application inside industries and overcoming obstacles. These suggestions are based on actual solutions described in scientific articles for factory automation problems, resulting in a broader view of automation level inside industries, its major difficulties and ways of ameliorating it.

3. Results and Discussion

This section presents and discusses the main difficulties and opportunities for the implementation of automation inside industry. The initial part describes the results of scientific articles analyses related to manufacturing automation inside different industry sectors, with the final part being composed of possible solutions for the challenges previously found.

3.1 Sectorial challenges and opportunities

Firstly, the Energy sector recorded some difficulties in implementing automation inside plants. Maintenance activities, besides abnormal events during production, still require human perception and validation, being difficult in terms of cost and design to totally automate this process [2]. Also, energy sector factories constantly change processes, offering more complexity to an automation project, being another sector-specific peculiarity.

However, the sector also has some opportunities related to improvement in process automation, like the contribution propitiated by the invention of new technologies. Meanwhile, in the current time, companies can invest in equipment that require less maintenance time, avoiding manual labour and high costs related to available automation technology [2].

The Materials sector is experiencing the advance of mining 4.0, which has automation as one of its central points [3], being already applied in some activities. These changes are bringing a reduction of costs and workforce, collaborating in higher productivity and efficiency in mines and resulting in better mining practices.

Besides that, the mining sector automation faces major challenges, like the difficulty for smaller mines to follow the automation level of great mine companies due to fewer resources [3]. In addition,

mines tend to be individual systems owing to geology conditions, being difficult to replicate the same automation process to other plants. Also, the training of mine staff workers for the new automation technology isn't sufficient to prepare them to deal with these advances [4], offering additional complication to automation.

The machinery industry, included into the Industrials sector, has a very important role for Industry 4.0 automation as a machine provider for smart manufacturing companies. Even so, the lack of financial resources for R&D added to the demand for highly customizable products impose several challenges to its operation [5].

Moreover, factories of the Industrials sector are experiencing some benefits of automation already implemented. In particular, the use of industrial robots that can move heavy loads easily, as well as inspection robots that eliminate human subjectivity and provide instant product quality feedback, resulted in a significant production increase [6].

For the Consumer Discretionary sector industries, the major opportunities related to automation are lesser errors and faults, a better product quality, production monitoring and a safer workplace [7], yet, there are still high risks involved with network vulnerability.

Besides that, the industry also faces challenges related to the high cost of technology, disadvantageous principally for small and midsize companies. Also, traditional markets, like the Bangladesh textile industry, are facing difficulties in implementing Industry 4.0 innovations, including automation [8]. To cope with this reality, the most affected enterprises can collaborate with external partners, like universities, to access less expensive technology [7].

Furthermore, the Consumer Staples sector manufacturers, participating in the advance of smart farming technologies, are experiencing a better production quality, added to a reduction of manual labour and a more sustainable process [9]. However, it's essential for the progress of sector automation to overcome difficulties related to lack of digital infrastructure in rural areas, few skilled workers, sensitive data security and high costs for technology implementation, principally for SMEs (Small and medium-sized enterprises) [10]. One named possibility for new technology efficiency improvement was a better collaboration between supply chain participants.

The Health Care sector normally has higher standards for production quality than other manufacturers, being submitted to strict regulations [11]. Therefore, automation can be well applied into quality sensors and medicine production tracking, avoiding costly quality deviations for the industry and bringing a gain in efficiency. Also, new technology must be implemented looking for the fulfilment of data security requirements from

factories.

Related principally to the electronics industry, the Information Technology sector manufacturers have some advantages in automation adoption, such as avoiding human error and better allocation of resources than processes where automation is a possibility [12]. However, related to digitalization between material suppliers and the factories, data security, technology available and costs are the major obstacles reported [13].

Furthermore, Utilities sector manufacturers are also experiencing some changes related to new process automation technology, resulting in a better production performance together with lower costs, a greater parameter control, and the automation of technical documents analysis [14]. In contrast, the sector's main challenges for a wider adoption of automation are the high customizability required and the need for a more skilled workforce to deal with the technologies correctly.

Moreover, Construction 4.0 represents the Real Estate sector, being referred as the use of robots and control sensors inside the construction zone [15]. Additionally, these technologies are capable of enhancing productivity, avoiding human injury inside construction zones, and provide more consistence in outputs, decreasing rework necessity while increasing reliability.

Conversely, the implementation of automation into the Real Estate sector also can cause unfavourable consequences, notably job losses of unskilled workers and high costs of technology, being also submitted to legal restrictions from government [15]. These listed factors impose serious difficulties for applying automation into the sector production, needing to be considered by companies looking for process automation.

3.2 Challenges and Suggestions analysed

Deterrents to implementing automation inside factories, generally, were found to be similar across the different manufacturing sectors analysed. In summary, the data shown at Tab. 1 represents difficulties recognized in more than one sector for smart manufacturing automation, with high costs of new technology undoubtedly being the most problematic issue.

Tab. 1 - Industrial challenges for automation

Difficulty	Sectors Affected
High costs	7
Network and data security	4
Individual processes	3
Skilled workforce	3
SMEs disadvantage	3
Legal regulations	2

Additionally, the fifth difficulty presented at Tab. 1 named as the disadvantage experienced by small and medium size enterprises is possibly also connected with technology high costs. For instance, if the automation technology implementation is expensive, as suggested by the Tab. 1, companies with a bigger equity, typically large business, would gain advantage compared to companies with few financial resources.

Especially for the costly technology problem, and consequently the SMEs weakness, it is suggested that companies should collaborate with education institutions, looking for the acquisition of a cheaper automation technology [7]. That cooperation would be beneficial to both enterprise and institution, promoting a closer relationship between industry and academia.

Besides that, network and data security are also considerable concerns for industry, impeding further automation advancements. In this case, blockchain technology could be an interesting way to increase information security, avoiding third-party participation and reducing the necessary documentation with smart contracts [16].

Furthermore, the scarcity of high skilled workers is another major challenge across a considerable number of industrial sectors. This problem involves directly some non-industrial departments like human resources, which is responsible for hiring and training the workforce. Particularly for this role, the HR department can promote partnerships between factories and universities, looking for workforce skill improvement [17].

Lastly, the difficulties related to individual processes inside some manufacturers, as well as legal regulations, are very specifically associated with the factory segment, product, political and geographical location, being difficult to address a wide solution. Therefore, a company aiming to solve these challenges for a specific plant, would have to make a research focused into its production characteristics and regulatory reality.

In summary, these suggestions address the main difficulties found for implementing automation inside industry, being capable of decreasing disadvantageous effects. Consequently, maintaining the beneficial outcomes of automated factories, the

cost-benefit ratio would become more favourable for the implementation of new processes and technologies. That change, then, would increase automation adoption, proportioning a surge of industry productivity in general.

4. Conclusion

Ultimately, automation has been a key factor inside Industry 4.0 innovations, improving industry productivity and already being adopted by several industry sectors. Nonetheless, its adverse results and challenges are problems needing to be overcome, requiring solutions based on scientific analyses like the ones presented in this research.

In light of these works, succeeding the listing of main difficulties found for industry automation in each of the nine sectors analysed, six challenges reported in at least two fields were responded according to scientific finds in sectorial analysis. Although individual processes and legal regulations couldn't get addressed in a broader manner, scientific solutions were found for the network and data vulnerability and to the need for a skilled workforce, which are capable of being applied into industries of different sectors.

Furthermore, the widespread problem of high technology costs, with implications on SMEs disadvantages compared to larger companies, was also addressed with partnership as a solution. Despite being a suggestion found in the Consumer Discretionary sector, it is applicable to all other sectors industries.

In conclusion, main challenges were addressed according to scientific solutions, which are able to be implemented in industries from several sectors. As a result, companies can enhance their industrial productivity, adopting methods from Industry 4.0 without suffering from the main challenges. Accordingly, that will help to increase enterprise competitiveness in the long term, contributing to a manufacturing that meets society requirements evolution.

5. References

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