

THE IMPACT OF INTELLIGENT TECHNOLOGIES IN THE CONTEXT OF INDUSTRY 4.0 ON THE PRODUCTION PROCESSES FOUND IN THE AUTOMOTIVE INDUSTRY. A CASE STUDY OF INVESTMENT.

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Abstract: This case study aims to analyse the impact that intelligent technologies have on production processes in the adaptation and adoption context of a series of applications designed to help certain automate steps in the analysed economic processes - supply, production, storage , sale. Intelligent technologies, part of Industry 4.0, have had over the years a significant impact on the companies that use such IT solutions, which have been adapted to the new requirements that came as a result of mankind's evolution. These intelligent technologies, which are part of Industry 4.0, provide those who use them, the possibility to have a critical perspective, which can have a major impact on innovation and research in the businesses they run. Regarding Industry 4.0, we can discuss a series of technologies that have helped and will help to implement this innovative concept, such as AI (Artificial Intelligence), RPA (Robotic Process Automation), iRPA (Intelligent Robotic Process Automation), IoT (Internet things), ML (Machine learning) or notions such as Big Data, Analytics or Cloud Computing. The case study presented by the authors of this article is intended to provide a suggestive image of the implementation of RPA technologies in a car subassembly production factory, related to the automotive industry, from Romania - the studied is found in the painting of multi-faced sub-assemblies as part of the work area.

JEL classification: C61, M15, M41, P41

Key words: Industry 4.0, ERP, SAP, RPA, AI, ML - Machine Learning, PP – Production Planning, AM - Additive manufacturing, economic development, investments

1. INTRODUCTION

The concept for this article came from thorough analysis of the effects that intelligent technologies have had and continue to have on the existing economic processes in companies inside the country. A way of companies' growth lies in investments and their financing, either using angel investors, banks or capital markets. The authors conducted a case study, discussing with all the participating actors involved in the implementation of automation related to the economic processes examined in the company that will be the subject for our next article. This company is a Romanian car subassembly production factory, more precisely situated close to Brasov.

This factory serves a chain of car manufacturing companies, the ones here, from Brasov, with the task of designing and developing a series of sub-assemblies necessary to equip the interior of the cars.

As we previously said, the process studied here will have multiple aspects related to objects painting, with several facets. We will create and use automations, which the authors will expose in this scientific article, using as a computer application, the associated UiPath software RPA (Robotic Process Automation). The implementation of software robots in this field, has significantly accelerated response times for process execution, particularly for the economic supply, storage and sale activities, that are components of the production itself.

An additional reason for the adoption and adaptation of intelligent technologies, such as AI (Artificial Intelligence), RPA or iRPA (intelligence Robotic Process Automation) was also the appearance of a series of turbulences in terms of the evolution of humanity, we recall here the covid-19 pandemic, the current wars, the lack of labour, the poor training of those who work in such high performing production lines.

An essential point that the writers of this article will highlight is the necessity training of existing factory workers on how to use these automated economic processes, a significant part in transferring the knowledge that is required, regardless of financial circumstances for future students, graduates or prospective learners and universities is playing a role here. We will also briefly discuss the adoption of the term Industry 5.0 and the consequences it brings with it. These topics will be part of the activities that each company will have or will adapt in the future. The automation of economic processes is part of everything that means the events chain that have been produced and will be produced in the context of Industry 4.0.

The purpose of this article is to present a thorough analysis of how current economic processes have been automated (the authors will describe a process related to the specialized production department of subassemblies related to a certain kind of machine, regarding on how a sale order received via e-mail is automatically processed by the created software robot, checking the existing information in the e-mail (key words), the e-mail topic and expeditor, whether it is malicious (security rules)), i.e. keywords that it remembers and will later take decisions to start the related processes – production if necessary, supply, delivery and subsequent sale. Although the company management wants to automate as many of the existing factory economic processes, through software

robot solutions, as we are discussed in this article, all of those processes will be executed automatically.

In the figure below (figure 1) we have indicated several necessary steps for the digital transformations that refer to here, in order for perspective optic and mentality change, adapted to current needs which the authors of this article refer at both organization and executive management level. The involvement of the related department to the projects as well as those from IT, must be maximum in such stages, in which the adoption and adaptation of intelligent technologies, part of industry 4.0, is desired. The maximum involvement of the related project department as well as those from IT is important seeking to adopt and adapt these technologies.

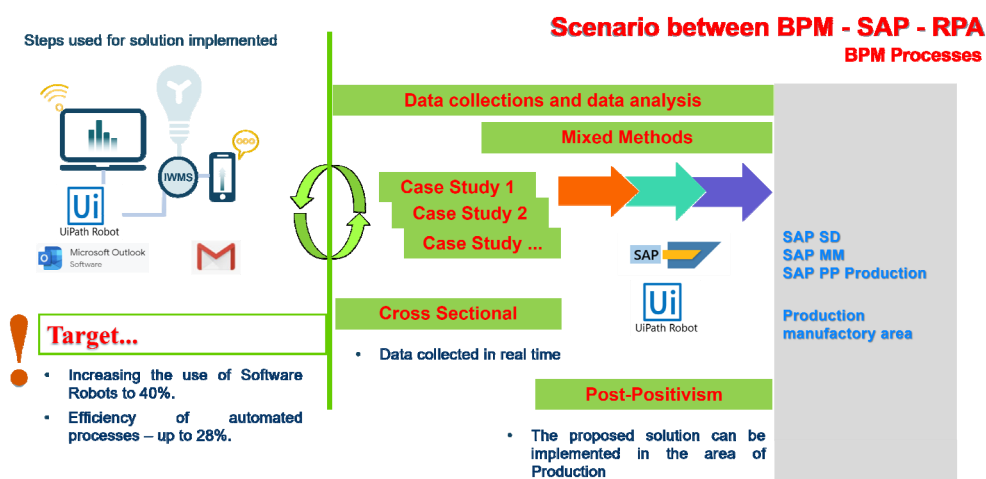


Figure no. 1 – Solution design implementation

2. LITERATURE REVIEW

The study of specialized literature, for the case that refers to Industry 4.0, is extremely diversified (***) , with a number of authors discussing this aspect in various forms of understanding. The spread of the industrial revolution in several countries made Europe the industrial pole of the world, Industry 4.0 represents the latest technology when we talk about innovation. The improvement of production processes in any of the industrial sectors has experienced a rapid evolution, requiring knowledge from several fields (knowledge management, organizational management, business process management, enterprise architecture, integration of industrial information, IoT, AI).

The main characteristics of Industry 4.0 are digitization, optimization and improvement of production, automation and adaptation. The need to implement this new technology - the abandonment of mass production (production in large batches) - "one for all" and its ultra-customization according to market demand, greater flexibility in terms of the integration of production processes, increased efficiency in the use of resources having an impact in the ecological context (Roblek V, Mesko M, Krapez A, 2016). As (Zhong Zhong RY, Xu X, Klotz E, Newman ST., 2017) summarized - intelligent systems use information from all relevant fields to become flexible, intelligent, customizable and meet the needs of a constantly changing market.

This new industrial technology brings together the digital and the physical world through cyber-physical systems with the help of IoT and it is expected that this fusion of technologies will have consequences on the industry, the economy by improving production processes and increasing productivity, creating new business models, changing the work environment and the restructuring of the labor market. Therefore, the concept of Industry 4.0 clarifies the implications and importance of this complex technological system (Chen B, Wan J, Shu L, Li P, Mukherjee M, Yin B, 2017).

3. THE ADAPTABILITY OF INTRODUCING AUTOMATED SOFTWARE SOLUTIONS - PERSPECTIVES

Beginning with a few technical and financial considerations the authors of this article conducted a company analysis that manufactures subassemblers required by the automotive industry, they started from certain technical and economic considerations, will be mentioned and further detailed when describing the implemented solution using the UiPath application – RPA software solution. A number of component elements of a required technical-economic architecture were taken into consideration to facilitate the economic process development, from all the needed perspectives for its development and use: economic, technical and functional. The implemented solution therefore takes into account the company's resources, the local working environment, as well as the management and employee's ability to implement and use specific IT technologies. Of course, there were various constructive discussions regarding the value and practical application of such innovative techniques.

The current environment facilitates the related application development among individuals who are particularly proficient at undertaking a series of laborious and monotonous duties and the multitude of existing data from various sources, making it hard for them to be processed in the shortest possible time relying on the unique algorithms of each organization, the way such IT solutions are perceived, their purpose being one that is increasingly clear, namely the exclusion as much as possible of human errors, dead times, repetitiveness generators of stress and errors, of the slow way of working with an extremely large volume of data, of easy integration with a series of adjacent applications, from checking from different sources (ERP - Enterprise Resource Planning, BI - business Intelligence, etc.). The main idea behind the modeling of the production process entitled "Customer order processing and release to production - painting of multi-faceted sub-assemblies", in short "**PPVS**", started from how the taking of these orders can be done automatically, from e-mail. These will be transformed in excel format, to check if the raw materials are in the company, in stock, if not, to order (here there is another branch dealt with by the created software robot, namely informing the customer of the possibility of delivery delay or not the finished product to it), then the start of the production process and here there are several branches discussed depending on the availability on the workbench (physical robot that executes the painting of the object (subassembly) requested by the customer).

The actual production part as well as everything that means customer delivery will be debated in a future scientific article, but I also want to show other aspects regarding the automation of an economic process, here discussing the part necessary for production in the context of Industry 4.0 with trends towards Industry 5.0. A detail that was taken into account in the implementation of the RPA-type software solution, in the context of Industry 4.0, was that of including many disciplines and fields of knowledge studied, moving towards an efficient way of integrating intelligent technologies, you know that

some are more mature (we are talking here about the SAP ERP system - Systems Applications and Products), newer (UiPath), but also emerging, these finally being integrated in a context beneficial to the company that uses them.

4. INDUSTRY 4.0 - RPA IMPLEMENTATION – IMPLEMENTATION, WAY OF WORKING, RESULTS

The concept of Industry 4.0 is desirable to be adopted by as many companies as possible in the country and abroad, its role being to combine intelligent ways of working, possibilities to come up with decisions as quickly as possible and with great accuracy, from areas such as production, supply, etc. Real-time access to the data being worked with, more and more data from various sources, brings a plus to those who want to be informed, implicitly making the right decisions leading to an efficient and effective way of working, for the business we administer it. Regarding the automation of the PPVS economic process, which the solution developed by the authors has achieved, schematically it is composed of the elements found in the figure below (Figure no. 2), a detail of each component as well as the way of working is made in the following steps for this article.

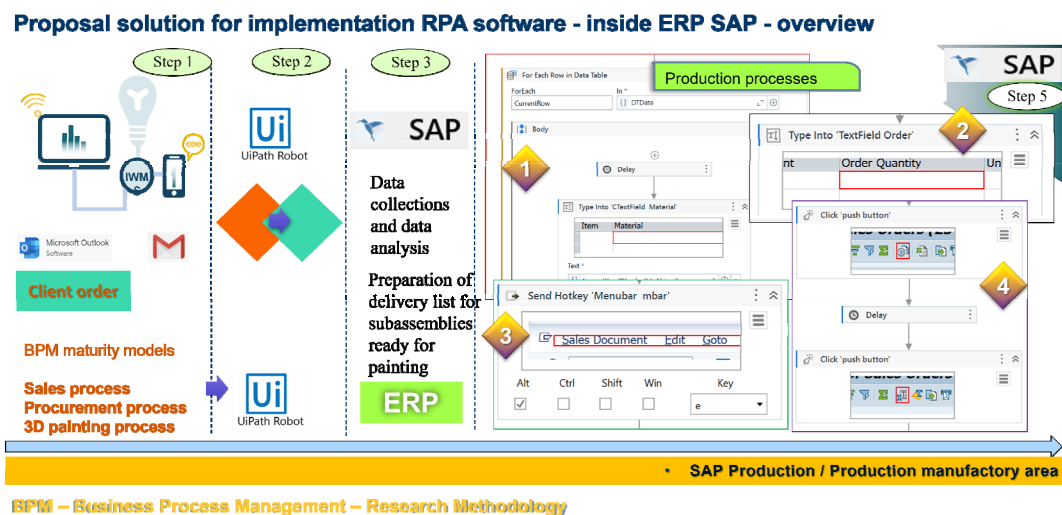


Figure no. 2 – Overview SAP – RPA – solution design

As can be seen in the image above, the adoption of intelligent technologies was useful in the processing of receiving data, here we discuss the use of AI, through the branch of NLP natural language processing - that is, the processing of orders received from clients and their transformation into firm, correct requirements.

The use of the software robot created to transform the requirement into a file prepared for uploading to the SAP ERP system, processing this in the sales process (automatic creation of the order), checking the stocks, with repercussions in the P2P process Procure to pay – supply, checking the stock of raw materials (paint, raw materials needed for grinding, design, processing), then the process is completed in production, by painting the finished product, we mention here products such as steering wheels, gear shifters, or ornamental components.

Through the introduction of intelligent solutions, the company had a series of reductions in the times of purchase and processing of sales-supply-production orders. Most of the processing was done in Excel, now most of the steps are automated, we mention here even the processing of a PDF order and its transformation into Excel format, for a very easy and simple import into the SAP system.

5. CONCLUSIONS

The conclusions drawn by the authors of this article begin with the fact that the period of time allocated for processing customer orders until resending the requested finished products, has been improved with more than 40%, this indicator can be seen on report sales, purchases, processing, production and distribution. Another aspect to point out would be how the modeling of production processes in the context of Industry 4.0 leads to a more efficient, automatic, clear way of working, eliminating repetitive steps, accuracy in receiving, processing, sending orders related to special types of work orders (the process reported and discussed in this article being one dedicated to painting in extremely toxic conditions), so a collaboration between software and physical robots is more than beneficial to the company. The third aspect that emerged from the process modelling implementation, referred to the employee's understanding of the way RPA works, having high expectation, after implementation, the management choose to invest in training-related RPA for employees.

REFERENCES

1. *** "https://www.energy.gov.au/business/equipment-and-technology-guides/industry-40
2. Jandyal A., Chaturvedi I., Wazir I., Raina A., Mir Irfan Ul Haq „3D printing – A review of processes, materials and applications in industry 4.0” -
3. Roblek V, Mesko M, Krapez A „A complex view of Industry 4.0.” SAGE Open 2:1–11, 2016
4. Posada J, Toro C, Barandiaran I, Oyarzun D, Stricker D, de Amicis R, Vallarino I „Visual computing as a key enabling technology for Industry 4.0 and industrial internet”. IEEE Comput Graph Appl 35(2):26–40, 2015
5. Zhong RY, Xu X, Klotz E, Newman ST „Intelligent manufacturing in the context of Industry 4.0: a review.” Engineering 3:616–630, 2017
6. Ghasemi M., Shafeiepour V., Aslani M., et al., „The impact of Information Technology (IT) on modern accounting systems”, Procedia - Social and Behavioral Sciences 28: 112-116, 2011
7. Taipaleenmäki J., Ikäheimo S., „On the convergence of management accounting and financial accounting – the role of information technology in accounting change”,

- International Journal of Accounting Information Systems 14: 321-348, 2013
8. Janvrin D.J., Weidenmier Watson M. „Big Data”: A new twist to accounting”, Journal of Accounting Education 38: 3-8, 2017
 9. Chen B, Wan J, Shu L, Li P, Mukherjee M, Yin B „Smart factory of Industry 4.0: key technologies, application case, and challenges.” IEEE Access 6:6506–6519, 2017