IMPROVING THE SUSTAINABILITY OF PRODUCTION PROCESSES IN THE CONTEXT OF INDUSTRY 4.0 THROUGH THE INTEGRATION OF ERP SYSTEMS AND RPA TECHNOLOGIES

Andreea Măldăreanu
PhD Student
The Bucharest University of Economic Studies
Faculty of Accounting and Management Information Systems, Bucharest, Romania

Andreea Gabriela Tănase
PhD Student
The Bucharest University of Economic Studies
Faculty of Management
Bucharest, Romania

Grigorescu (Stănescu) Andreea,
Ph.D. Student, Romanian Academy, School of Advanced Studies of the Romanian Academy, Doctoral School of Economic Sciences, National Institute for Economic Research "Costin C. Kirițescu", Institute of National Economy, Bucharest, Romania

Crețu Raluca-Florentina
Professor PhD. habil., The Bucharest University of Economic Studies, Faculty of Accounting and Management Information Systems, Financial and Economic Analysis Department, Bucharest, Romania

Viorel - Costin Banța
Lecturer Ph.D. habil., The Bucharest University of Economic Studies, Faculty of Accounting and Management Information Systems, Management Information Systems Department,
Bucharest, Romania

Abstract: Currently, economic entities are increasingly adopting digital solutions to improve operational efficiency, meet Environmental, Social, and Governance (ESG) requirements, and support the transition toward Industry 4.0. In this context, production processes require integrated management of materials, resources, information flows, logistics activities, and accounting records. This study examines how production-related processes within an Enterprise Resource Planning system can be

improved through Robotic Process Automation. The research focuses on SAP as the ERP environment and UiPath as the RPA platform used for designing the automation scenario. The paper proposes a conceptual model for automating ERP-based workflows related to production, purchasing, sales, inventory movements, and accounting entries. The findings indicate that ERP–RPA integration can reduce manual intervention, minimize errors, improve data quality, enhance operational visibility, and support sustainability by limiting paper-based activities, improving traceability, and contributing to a lower carbon footprint in modern, data-intensive business environments and increasingly complex, interconnected global supply chains.

JEL classification: M15, O33, Q56

Key words: Enterprise Resource Planning (ERP); Robotic Process Automation (RPA); sustainability; process automation; SAP; UiPath.

1. INTRODUCTION

The transition toward Industry 4.0 has significantly changed the way economic entities organize, monitor, and improve their operational processes. Digital transformation is no longer limited to the adoption of isolated software applications, but increasingly depends on the integration of enterprise systems, automation technologies, data-driven decision-making, and sustainable business practices. In this context, production processes occupy a central position, as they connect materials, human resources, equipment, logistics flows, financial records, and managerial decisions within a single operational framework. Modern production environments require a high level of coordination between planning, procurement, inventory management, manufacturing execution, sales fulfilment, and accounting. Any delay, inconsistency, or manual error in one area can affect the entire value chain. For this reason, economic entities need integrated digital solutions capable of ensuring process visibility, data accuracy, operational efficiency, and traceability. Enterprise Resource Planning systems play a key role in this transformation because they provide a common informational infrastructure for managing business processes across departments.

SAP is one of the most widely used ERP systems in complex organizational environments, offering integrated functionalities for production, purchasing, sales, inventory management, finance, and controlling. Through its modular structure, SAP enables organizations to connect operational activities with financial and managerial information. However, even when ERP systems provide a high level of integration, many operational tasks remain repetitive, rule-based, and dependent on manual user intervention. These tasks may include data entry, document processing, transaction execution, report generation, validation of records, and transfer of information between systems or departments. Robotic Process Automation represents a technological solution that can address these repetitive activities by allowing software robots to execute predefined sequences of actions. RPA technologies can interact with existing applications, read structured data, complete fields, validate information, and perform routine operations with greater speed and consistency than manual execution. In the

context of ERP systems, RPA does not replace the ERP platform, but extends its operational efficiency by automating repetitive interactions with the system. This is particularly relevant for production-related processes, where accuracy, timing, and consistency are essential. The integration between ERP systems and RPA technologies is aligned with the principles of Industry 4.0. This integration supports the digitalization of operational workflows, reduces dependency on paper-based activities, improves data quality, and enables faster execution of standardized processes. At the same time, it contributes to sustainability objectives by reducing unnecessary manual effort, limiting process inefficiencies, improving traceability, and supporting more responsible use of organizational resources. Sustainability should therefore not be understood only from an environmental perspective, but also from an operational and informational perspective, where efficient processes, accurate data, and reduced waste contribute to better organizational performance.

This paper focuses on improving the sustainability of production processes through the integration of SAP ERP functionalities and UiPath RPA technologies. The study proposes a conceptual model for automating ERP-based workflows connected to production, purchasing, sales, inventory movements, and accounting entries. These workflows are relevant because production processes rarely exist in isolation. They are directly linked to the procurement of materials, the movement of inventory, the fulfilment of customer demand, and the recording of financial and accounting information.

The proposed approach highlights how automation can support economic entities in reducing manual intervention, minimizing processing errors, improving operational control, and increasing process transparency. By using UiPath robots to automate repetitive SAP-based tasks, organizations can ensure a more consistent execution of production-related workflows and can allocate human resources to activities with higher analytical and managerial value. The objective of this paper is therefore to examine the role of ERP-RPA integration in enhancing the sustainability and efficiency of production processes in the context of Industry 4.0. The study contributes to the discussion on digital transformation by showing that sustainability can be supported not only through major technological investments, but also through targeted automation of repetitive ERP-based activities. This perspective is especially relevant for economic entities seeking to modernize their operations while maintaining control, accuracy, and traceability across integrated business processes.

2. LITERATURE REVIEW

The digital transformation of businesses in the context of Industry 4.0 is supported by the integration of ERP systems with automation technologies capable of reducing manual intervention, improving data accuracy, and increasing the efficiency of operational processes. In this context, ERP systems, such as SAP, provide the information infrastructure necessary for integrating production, procurement, sales, inventory management, and accounting processes, while RPA technologies enable the automation of repetitive and standardized tasks carried out within these systems. The literature treats ERP as an integrated platform through which organizations can coordinate their business processes and data flows. Elbahri et al. (2019) conduct a comparative analysis of SAP, Oracle, and Microsoft solutions from the perspective of

cloud-based ERP systems, highlighting the importance of these platforms for the integration of organizational processes.

Similarly, Rahman et al. (2024) discuss the opportunities and challenges of using SAP in data analysis and in evaluating the performance of ERP software. These contributions are relevant to this article because they show that SAP should not be viewed merely as a transactional system, but as an important source of operational and managerial data necessary for controlling and improving business processes. In the context of manufacturing, ERP systems play an essential role because they connect activities such as resource planning, material procurement, inventory movements, production execution, sales of finished products, and accounting records. SAP Community (2025) provides an overview of the main SAP modules and associated business processes, which is useful for understanding the relationships between the functional modules. Although this source is more practical than academic in nature, it supports a functional description of how SAP integrates business processes. For a scientific analysis, however, such sources should be used with caution and supplemented with academic literature on ERP, RPA, and process automation. Robotic Process Automation is analyzed in recent literature as a technology suitable for automating repetitive, rule-based activities involving structured data. Issac et al. (2018) conduct an analysis of RPA tools, highlighting that these solutions can be used to automate tasks traditionally performed by users in software applications. Moreira et al. (2023) address RPA from the perspective of process automation, emphasizing its role in streamlining organizational activities. Furthermore, Costa et al. (2022), in a systematic review of the literature on RPA adoption, show that implementing RPA involves not only operational benefits but also challenges related to process selection, governance, scalability, and organizational integration.

An important area of research in the literature is the direct link between RPA and SAP ERP systems. Nguyen et al. (2023) propose an RPA model for the fulfillment process in an SAP ERP system, demonstrating the possibility of automating certain operational activities carried out within the SAP environment. This contribution is relevant to the topic of this article because it shows that RPA can be used as an automation layer on top of existing ERP processes without altering the system's underlying logic. In a similar vein, Witjaksono and Kusumasari (2024) analyze the implementation of automated testing of the Order-to-Cash process in SAP using UiPath, which confirms the applicability of RPA platforms in concrete ERP scenarios, including integrated business processes.

UiPath is one of the RPA platforms frequently discussed in recent literature. Khan and Khan (2023) discuss the use of UiPath in the context of next-generation automation, highlighting its potential for automating repetitive processes. Jamithireddy (2025) expands on this perspective by analyzing the automation of SAP ERP processes using agent-based bots and the UiPath framework. This direction is important because it suggests an evolution of RPA from the simple automation of repetitive steps toward more intelligent solutions capable of supporting more flexible and complex executions in enterprise systems.

The benefits of RPA are analyzed more systematically by Denagama Vitharanage et al. (2020), who propose an empirical conceptualization of the advantages associated with robotic process automation. From the perspective of this article, these benefits can be interpreted in relation to production processes: reduced

processing time, fewer manual errors, increased traceability, standardized execution, and improved operational control. These effects are particularly relevant in processes where SAP activities are repetitive, dependent on accurate data, and interconnected with other functional areas, such as procurement, sales, inventory, and accounting.

ERP–RPA integration can also be analyzed from the perspective of sustainability. In the context of Industry 4.0, sustainability is not limited to reducing environmental impact but also includes operational efficiency, better use of resources, reduction of waste, improvement of data quality, and increased process transparency. Automating production processes and related activities can help reduce paper-based documentation, minimize unnecessary manual interventions, and accelerate information flows. Consequently, ERP and RPA can jointly support sustainability goals through more efficient, controlled, and traceable process execution.

The literature reviewed suggests that the success of automation depends not only on the technology used, but also on the proper selection of the processes to be automated. RPA is particularly well-suited for repetitive, stable, standardized processes based on clear rules. In the case of SAP systems, such processes may include data entry, updating records, verifying documents, running standard transactions, generating reports, and validating information. However, automation does not eliminate the need for human oversight, especially when exceptions arise, data is incomplete, or situations require professional judgment. Another important aspect is data quality. If the data entered into the ERP system is incorrect or incomplete, the robot may execute the process correctly from a technical standpoint, but the resulting output may be economically incorrect. Therefore, ERP–RPA integration must be accompanied by validation rules, control procedures, exception-handling mechanisms, and clear responsibilities for users. This observation is essential in production processes, where errors regarding materials, quantities, inventory, documents, or accounting records can affect the entire operational workflow.

Overall, the literature supports the idea that integrating ERP systems with RPA technologies is a relevant approach to modernizing business processes in the context of Industry 4.0. SAP provides the integrated information infrastructure for managing business processes, while UiPath and other RPA platforms provide the mechanisms needed to automate repetitive tasks. In production processes, this combination can help increase efficiency, accuracy, traceability, and sustainability. Based on these contributions, this article aims to analyze how the sustainability of production processes can be improved by integrating ERP systems and RPA technologies within economic entities.

3. METHODOLOGY

This study is based on qualitative research and presents a conceptual model of a solution that can be used to optimize business processes. It was demonstrated how technologies based on software robots, RPA, can be used to automate processes within an ERP system, in this case, SAP. The paper also discusses the benefits that may arise from the integration of these two innovative technologies and how their use can contribute to increasing sustainability within economic entities.

The first part of the study provides a brief review of the relevant literature on the usefulness of ERP systems and RPA technologies and the correlation between them and sustainability. The second part covers the practical aspects, specifically the RPA

technologies used to automate workflows within an ERP system. This approach is also supported by other studies in the existing literature, such as, Nguyen et al., 2023; Jamithireddy, 2025; Witjaksono and Kusumasari, 2024, which use RPA solutions integrated with ERP systems.

The RPA tools used are those provided by the UiPath platform. UiPath is considered a well-known platform for providing RPA tools, used to create applications for automating repetitive processes (Khan and Khan, 2023; Issac et al., 2018). This platform was chosen because of its integration capabilities with the SAP system. SAP is one of the most widely used ERP solutions globally for resource management, as the processes within the departments of economic entities are integrated into a single platform (Elbahri et al., 2019; Rahman et al., 2024). Various modules can be implemented, such as Sales and Distribution for sales, Material Management for procurement, Financial Accounting for financial aspects, and others, depending on the specific needs of each entity (SAP Community, 2025). In the current study, these are the modules that will be included in the conceptual model.

4. RESULTS AND DISCUSSION

As mentioned previously, process automation is a practice that economic entities today cannot afford to ignore, as it can bring operational benefits such as increased accuracy through the reduction of human error, a significant decrease in execution time, and standardized workflows; financial benefits, such as cost reduction; and, on a social level, increased job satisfaction, as employees are able to focus more on complex tasks than tedious ones (Moreira et al., 2023; Costa et al., 2022; Denagama Vitharanage et al., 2020). In addition, from a sustainability perspective, by adopting these two technologies, there will no longer be any physical, paper-based processes, as all activities will be processed and saved within the system. Efficiency is also improved by completing tasks much more quickly and accurately, which helps reduce the economic entity's carbon footprint.

Automating workflows within the SAP system using the tools provided by UiPath works as follows: the generated robot retrieves the necessary information, either from an Excel document where it is listed, or by reading it directly from a PDF document or an email using Optical Character Recognition (OCR) technology, or by extracting it from a database, and then automatically enters this information into the appropriate SAP windows.

In the SAP system, transaction codes are used to open the specific windows for creating documents. For example, transaction VA01 is used to generate a sales order, code ME21N for a purchase order, FB50 for accounting entries, and FB60 for posting invoices that are not included in a workflow. Of course, a complete sales or purchasing workflow involves several steps, and therefore several transactions, but the principle applied to automation is the same. The information retrieved by the robot and automatically entered into SAP varies depending on the workflow; for sales and purchasing, it includes details such as material names, dates, required quantities and amounts, customers or vendors, and any applicable discounts. For financial transactions, information regarding the accounts, amounts, date, and vendor will be entered. As a result, employees no longer have to enter all this information manually, since the robot can do it much faster and without any errors.

Figure no. 1 illustrates the idea behind the conceptual model and includes several examples taken from the robot.

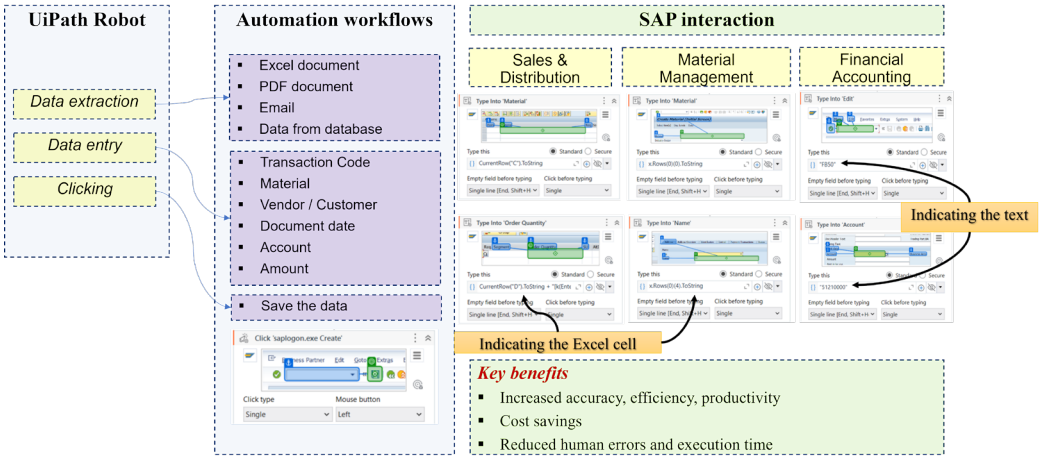

Figure no. 1 SAP workflows automation with UiPath tools

5. CONCLUSIONS

Nowadays, economic entities are trying to find various innovative solutions to process large volumes of data as quickly as possible, while being as environmentally sustainable as possible. This study presents a conceptual model for integrating RPA technologies with an ERP system to automate workflows, and also highlights the benefits that can result from such an approach. The focus is on the workflows within the Sales and Distribution, Material Management and Financial Accounting modules. Using these solutions, manual, repetitive, and time-consuming work is eliminated, allowing employees to focus on tasks where they can apply their expertise. Automation helps increase productivity, accuracy, and efficiency, standardize processes, and, at the same time, helps economic entities meet ESG standards.

The RPA technologies used are those provided by the UiPath platform, and the ERP system is SAP. In future studies, the conceptual model could be adapted by using other RPA tools and ERP systems available on the market, or by extending it to other SAP modules.

REFERENCES

1. Nguyen, T.D., Le, H.S., Ho, T.T., Nguyen, Q.H., Truong, H.P. Design an RPA model for the fulfillment process in an SAP ERP system. Journal of the Chinese Institute of Engineers, 46(6), pp.683-691, 2023.

2. Jamithireddy, N.S. Automation of SAP ERP Processes Using Agentic Bots and UiPath Framework. Research Briefs on Information and Communication Technology Evolution, 11, pp.62-81, 2025.

3. Witjaksono, Implementation Of Automated Testing: Order To Cash Business

R.W., Kusumasari, T.F. Processes On SAP Using Uipath Software. In 2024 International Seminar on Intelligent Technology and Its Applications (ISITIA), pp. 148-153, IEEE, 2024.

4. Elbahri, F.M., Al-Sanjary, O.I., Ali, M.A., Naif, Z.A., Ibrahim, O.A., Mohammed, M.N. Difference comparison of SAP, Oracle, and Microsoft solutions based on cloud ERP systems: A review. In 2019 IEEE 15th international colloquium on signal processing & its applications (CSPA), pp. 65-70, IEEE, 2019.

5. Rahman, M.A., Bhowmik, J., Ahamed, M.S., Rahman, R. Opportunities and challenges in data analysis using Sap: a review of ERP software performance. Global Mainstream Journal, 1(4), pp.50-67, 2024.

6. Khan, S.P., Khan, R. RPA using UiPATH in the context of next generation automation. Robotic Process Automation, pp.395-422, 2023.
7. Issac, R., Muni, R., Desai, K. Delineated analysis of robotic process automation tools. In 2018 second international conference on advances in electronics, computers and communications (ICAECC), pp. 1-5, IEEE, 2018.
8. SAP Community Exploring SAP ERP: A Complete Guide to Key Modules and Business Processes, available online: https://community.sap.com/t5/enterprise-resource-planning-blog-posts-by-members/exploring-sap-erp-a-complete-guide-to-key-modules-and-business-processes/ba-p/14097378, 2025.
9. Moreira, S., Mamede, H.S., Santos, A. Process automation using RPA–a literature review. Procedia Computer Science, 219, pp.244-254, 2023.
10. Costa, D.A.D.S., Mamede, H.S., Silva, M.M.D. Robotic Process Automation (RPA) adoption: a systematic literature review. Engineering Management in Production and Services, 14(2), pp.1-12, 2022.
11. Denagama Vitharanage, I.M., Bandara, W., Syed, R., Toman, D. An empirically supported conceptualisation of robotic process automation (RPA) benefits. In Proceedings of the 28th European Conference on Information Systems (ECIS2020). Association for Information Systems, 2020.