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RPA TECHNOLOGY AS A TOOL FOR BOOSTING THE EFFICIENCY OF AN INDUSTRIAL ENTERPRISE UNDER DIGITAL TRANSFORMATION

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Abstract. In the conditions of modern economy enterprises need to respond to internal and external changes in time to ensure the required level of quality. The main condition for ensuring competitiveness of any enterprise is the quality of its products. Analysis and monitoring of effectiveness and efficiency of quality management system processes is necessary to assess the level of development of the system and its impact on improving the efficiency of the enterprise. In order to analyze performance of an enterprise, it is necessary to evaluate each process in terms of effectiveness and efficiency, to find critical points as a result of these processes, and to develop corrective measures for each sub-process of the company. One of the vectors of business process improvement is the use of information environment. Modern industrial enterprises on the way of continuous improvement of their business processes use different approaches and methods of management, most of which are associated with informatization, which includes the need to collect, accumulate, store and process large amounts of data to improve business processes. This study considers a number of basic, supplementary and managerial processes and standards that regulate them, and shapes a set of criteria for the transfer of processes into automated mode and simulation of processes in the functional models "AS IS", and "TO BE".

Keywords: sustainable development, innovative development, enterprise innovation potential, digitalization, automation, efficiency improvement, industrial enterprise, business processes, RPA

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ТЕХНОЛОГИЯ RPA КАК ИНСТРУМЕНТ ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ ДЕЯТЕЛЬНОСТИ ПРОМЫШЛЕННОГО ПРЕДПРИЯТИЯ В УСЛОВИЯХ ЦИФРОВОЙ ТРАНСФОРМАЦИИ

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Аннотация. В условия современной экономики предприятиям необходимо своевременно реагировать на внутренние и внешние изменения, чтобы обеспечивать требуемый уровень качества. Основным условием обеспечения конкурентоспособности любого предприятия является качество выпускаемой продукции. Анализ и мониторинг результативности и эффективности процессов системы менеджмента качества необходим для оценки уровня развития системы и её влияния на повышение эффективности деятельности предприятия. Для того чтобы проанализировать деятельность предприятия, необходимо оценить с точки зрения результативности и эффективности каждый процесс, выявить критические точки в результате функционирования этих процессов, и разработать корректирующие мероприятия по каждому из подпроцессов компании. Одним из векторов совершенствования бизнес-процессов является использование компонентов информационной среды. Современные промышленные предприятия на пути постоянного совершенствования своих бизнес-процессов используют различные подходы и методы к управлению, большинство из которых связанны с информатизацией, включающей необходимость сбора, накопления, хранения и обработки больших объемов данных. для совершенствования бизнес-процессов. В работе рассмотрен ряд основных, вспомогательных и управленческих процессов и стандарты, которые регламентируют деятельность этих процессов, сформирован комплекс критериев для перевода процессов в автоматизированный режим и произведено моделирование процессов в функциональных моделях «AS IS», «TO BE».

Ключевые слова: устойчивое развитие, инновационное развитие, инновационный потенциал предприятия, цифровизация, автоматизация, повышение эффективности, промышленное предприятие, бизнес-процессы, RPA

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Introduction

At present, in the context of macroeconomic instability, domestic industrial enterprises are facing new challenges caused by disruptions in the logistics supply chains, a sharp increase in purchases from the defense-industrial complex with strict monitoring of the volume and timing of shipments of finished products and the need to design their own developments in unrelated niches and market segments. The current situation allows domestic enterprises to develop actively, but requires a significant amount of resources, which companies often simply do not have. Under such conditions, increase of labor productivity and reduction of production time can be achieved through the use of RPA system. Technology of robotic process automation (RPA - Robotic Process Automation) is to perform operations, according to a pre-set sce-

nario - the robot. The robot can use elements of the user interface (GUI), and connects to information systems and other programs using a software interface (API). RPA can be used to automate the management of actions such as extracting information from scanned documents using optical character recognition (OCR) to create metadata and convert content into a format suitable for big data or machine learning (ML) processes (Disterer, 2013). The following prerequisites, shown in Figure 1, have contributed to the development and active adoption of RPA in enterprises.

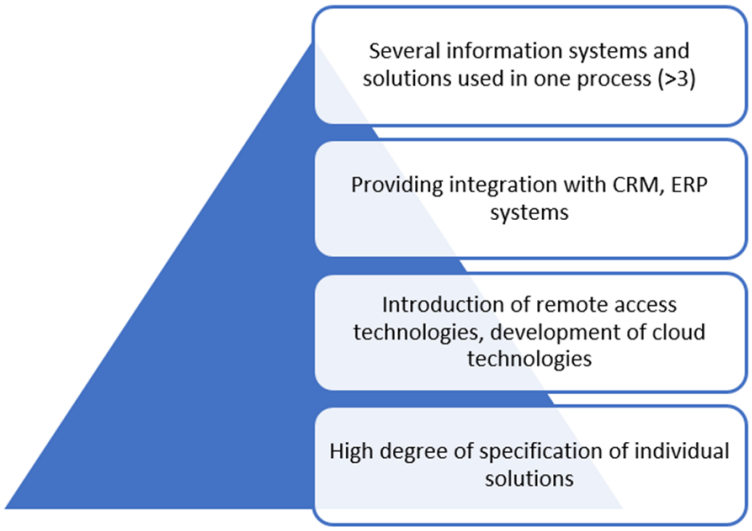


Fig. 1. Prerequisites for the development and implementation of enterprise-based RPA technology

Not only RPA technology can be used as automation tools for web applications, but also APIs. An API is a software interface through which programs can interact at the code level. The speed of interaction at the API level is faster than with RPA. However, RPA technology can communicate with both web applications and software products deployed in the company, which is an advantage when comparing with API (Glazkova, 2020). The use of RPA in data management processes greatly improves the efficiency of tasks such as data entry, collection, creation, and updating. All of these tasks are cyclical and tend to lead to errors, which reduces the quality of the incoming data. Data quality (QD) is the degree to which certain characteristics of data satisfy the stated and intended needs when used under specified conditions. Let's address the basic documents regulating quality of the data presented in the table 1.

Table 1. Data quality management standards

List of standards	Contents
1. ISO/TS 8000 "Data quality" (GOST R 56214-2014/ISO/TS 8000-1:2011	The ISO 8000 standards ensure the improvement of the quality of information used both independently, and as part of quality management systems (Glukhova, 2017).
2. ISO 9000 group, ISO 9001 "Quality management systems" (GOST R ISO 9000-2015, GOST R ISO 9001-2015)	SMK. Basic Provisions and terms; SMK. Requirements
3. ISO/IEC 25010:2011 "Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - System and software quality models"; (GOST R ISO/IEC 25010-2015)	Systems and software quality requirements and evaluation (SQuaRE). Quality models for systems and software products (Perez-Castillo, 2018).

List of standards	Contents
4. Group ISO/IEC 25012-2008 Software engineering - Software product Quality Requirements and Evaluation (SQuaRE) - Data quality model	Software Engineering. Software product quality requirements and evaluation (SQuaRE). Data quality model (Timerbaev, 2019).
5. ISO/IEC 27000 Group "Information technology - Security techniques" (GOST R ISO/IEC 27000-2012)	Information security management system. Overview and terminology.

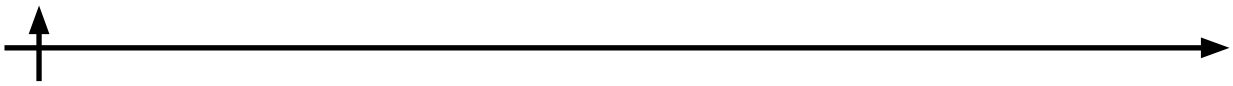
Turning to these standards, let's define the characteristics of software and data used in business processes. Product Quality - the extent to which the software satisfies the stated and implied needs when used under specified conditions. The characteristics of the software are shown in Table 2.

Table 2. Software characteristics that affect quality

Group	Features
Functional suitability	– functional completeness; – functional accuracy; – functional correctness.
Performance	– temporal efficiency; – resource utilization; – power.
Compatibility	– integration with other IS; – maintaining versioning.
Practicality	– accessibility; – protection against user errors.
Reliability	– stability; – recoverability; – fault tolerance; – availability.
Security	– confidentiality; – integrity; – accountability; – authenticity.
Repairability	– modularity; – reusability; – analyzability; – modifiability; – testability.
Tolerability	– adaptability; – installability; – replaceability.

In order to identify a data management problem, it is necessary to determine the indicators that define data quality:

1. Completeness - information about components and attributes for a particular process;
2. Actuality - the consistency of the data provided at the current time;
3. Accuracy - full compliance with the set requirements for the values and filling;
4. Validity - data conformity to the established template, i.e. whether the data is correctly entered by object;
5. Consistency - the degree of logical relationship, considers the internal and external degree of data consistency;
6. Data availability and accessibility - accessibility refers to the time and effort it takes to obtain data in the required format.



Data quality management must begin with the development of methods and procedures to ensure data quality. The implementation of methodologies is necessary to ensure a uniform QD assessment process. What is more, to ensure the required level of quality, it is necessary to implement software solutions that meet certain quality metrics. Thus, when highlighting the main advantages of using RPA technology in industrial enterprises, attention should be paid to:

– Increasing the speed of routine operations by transferring to robotic mode (on average, the robot performs 3-4 times faster);

– No need to make critical changes to the current process;

– Reducing the probability of error in data entry into information systems and further processing (only errors related to the performance of information systems can arise, the influence of human factor is absent);

– No need to perform long and expensive integration of information systems, because robots can work with almost all software that has a user interface.

Materials and Methods

The study involved an in-depth analysis of international and interstate standards, in particular ISO/TS 8000 "Data quality", ISO 9000, ISO 9001 "Quality management systems", ISO/IEC 25010:2011 "Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - System and software quality models", ISO/IEC 25012-2008 Software engineering - Software product Quality Requirements and Evaluation (SQuaRE) - Data quality model, ISO/IEC 27000 "Information technology - Security techniques", the works of leading researchers on innovative technologies to improve the efficiency of industrial enterprises (Chapman, 1997). The information obtained was processed taking into account current trends in the management of industrial enterprises, on the basis of tools in the field of quality management, such as PDCA and PDPC diagrams, as well as by general scientific methods:

– Analysis and synthesis.

– Comparison.

– Classification.

Results

The use of breakthrough technologies, particularly RPA, is becoming a requirement for competitiveness. The enterprise needs to flexibly reconfigure internal processes in order to respond quickly to changing external conditions under the influence of the digital economy through the adoption of high-quality and justified data. Introducing RPA technology into an enterprise for subsequent automation is quite a complex task (Rafique, 2012; Mashtakov et al., 2023).

According to the level of automation, software robots are classified into:

– Attended Robots (serviced, or requiring human attention and participation). Users who need to automate their processes run these bots from their computers;

– Unattended Robots (fully automatic). These bots do not require human involvement - they run autonomously on the servers on a particular schedule;

– Hybrid. These bots are of the mixed type.

The major features that can be optimize with the help of RPA include:

1. Read the information from the screens;
2. Perform data entry via peripheral devices;
3. Manage the operation of applications;
4. Perform individual transactions using enterprise applications;
5. Automate query processing;
6. Search and collect data;

7. Send responses and confirmations;
8. Interact with external systems;
9. Initiate inquiries to counterparties;
10. Interact with workflow management systems (Workflow), business process management (BPM), business content management (ECM, EIM).

Processes that software robots can perform: the use of structured input data, the presence of formal rules and a strict sequence of operations, repeatability and high frequency, no need for human decision-making based on information that lies outside the context of the process being performed, high quality requirements for the result (Strubalin, et.al., 2019). Implementation of RPA should be considered as a project implemented on the basis of the enterprise. Like any other project, the project under consideration has deadlines, resources (Nixon, 1990). Let's consider the main stages of RPA implementation at the enterprise, starting from the initiation of the potential project to its implementation in the stage of execution (by developers/analysts) (fig. 2).

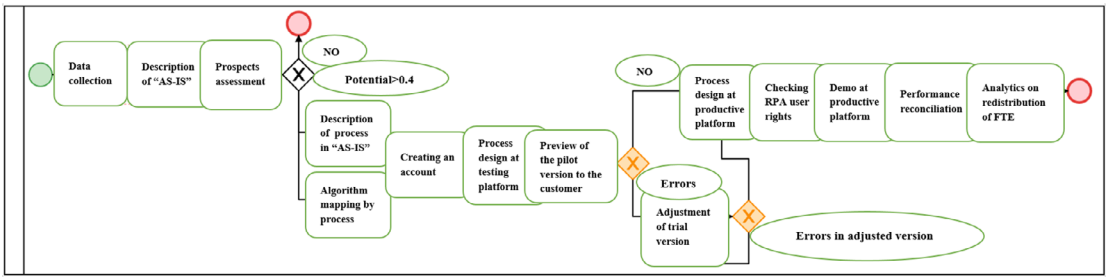


Fig. 2. Stages of RPA technology implementation at an industrial enterprise

The first block includes the stages (the collection of initial data, and the description of the business process in the AS-IS model). At these stages, the need to convert the process in question to robotic mode is determined. It is based on evaluation of the process according to the following parameters presented in Table 3.

Table 3. Process evaluation parameters for robotization

№	Parameter Name	Data type	Weight (j)
1	Number of repetitive actions during the process	Numerical value	0.125
2	Number of launches in the period under review	Numerical value	0.175
3	Number of IPs used in the process	Numerical value	0.2
4	Time required to perform 1 process	Numerical value	0.25
5	Complexity of automation	Selection from a list (directory)	0.15
6	Number of users waiting for the process to complete	Selection from a list (directory)	0.1
Total			1

Based on the results of the initial evaluation, which is performed by an analyst, the following indicator "Robotics Potential" (Ri) is calculated, which determines the need to transfer the process in question to the robotic mode. The distribution of the indicator "Robotics potential" is presented in Table 4.

Table 4. Distribution of robotization potential indicator

№	Indicator range	Description
1	0.1 < Ri < 0.4	Low potential for robotization - the process in question should not be moved to robotic mode, and other automation tools should be considered to optimize it and ensure the necessary quality of data used at the input and output of the process.
2	0.4 < Ri < 0.6	Average potential for robotization - the investigated process can be selected to be transferred to robotized mode completely or partially (with the allocation of the stages that are sources of time losses).
3	0.6 < Ri = < 1	High potential for robotization - the process in question requires conversion to robotic mode, since several information systems and process participants are involved in the execution of the process.

The reasons for the low value of robotization potential may include:

1. Additional mandatory confirmation of authorization in information systems, for example, by entering a code from an SMS message.

2. Unstable web applications, which will cause the robot to restart, and exceed the execution time.

3. Business processes that require a manual pre-check from the employee to run the next part of the process. With such limitations, the process cannot be converted to a fully robotic mode.

The next block includes compilation of the process algorithm in the TO-BE model, and creation of accounts for the IPs used. When a high level of robotization potential is established, the process is describes in a "As it should be" model and create accounts for the robot user in a productive and test environment (Geyer-Klingeberg, 2018). Creation of accounts for the robot is a prerequisite, as all actions implemented during the run must be performed under the name of the robot, so that in case of failure it is possible to revert to the previous version and undo the actions, otherwise a failure can lead to a violation of the data structure and quality (Zhigalov, et.al., 2020).

The development block includes the stages of development in a testing, demonstration of the test version to the customer, making adjustments if necessary, and then transferring to a productive environment and acceptance of the process (Belykh, 2020). Depending on the information systems used in the process, the development stages in the test and production environments can be performed in parallel. After that analytics is made based on the results of the process. Timekeeping at each stage is also performed, which helps free up some of the employee's time and redirect it to the tasks requiring more attention (Frantsuzov, 2020).

Maintaining the necessary level of completeness, reliability and consistency of data for making quality management decisions is the main task of data quality management. The reasons for poor data quality can include:

1. Incorrect input data (input data is in the wrong format, for example, instead of date format comes the same value, but in a text format, respectively. Because of the incorrect type of data further steps in the process will not be performed.

2. Data distortion over time (when performing integration between two information systems, the data were recoded, and in the output we get the wrong format).

The development of data quality management systems and their integration with existing information systems will help to bring the information support of the enterprise to a new level:

– informed management decisions and risk management in the decision-making process;

– reducing the costs of (re)checking and processing data;

– consolidation of disparate business systems by normalizing data and unambiguous definitions;

– unification of business processes related to data delivery to information systems and automation of their routine operations.

Consider the application of RPA system at an industrial enterprise in order to improve the efficiency of business processes, and, as a consequence, to increase labor productivity and operational efficiency. The enterprise has implemented and operates a quality management system, which applies to all stages of the product life cycle and processes. The processes of quality management system are defined and functioning at the enterprise.

Processes are identified, people responsible for the process are determined, the sequence of process performance and resources (process documentation) are defined. All processes are documented. Input, output and criteria for definition of the process effectiveness are specified in the process documentation, process owners and resources are defined as well. All processes running in the company are divided into three groups: management processes, product lifecycle processes and supporting processes (Estdale, et.al., 2018).

Let's consider the automation process for the main QMS processes (the list of which includes the processes of execution, contracting and warranty maintenance of sales contracts) (Chernikova, 2020). When choosing the optimal solution for the automation of QMS processes, different factors were taken into account, and it was decided to deploy the RPA system on the basis of its own team, with the possibility of additional training from the platform owner. The advantages of this option are implementation and deployment of RPA system on the basis of own company and team, from the company's employees, with the possibility of further transfer of knowledge in case of departure of one of the key employees of the company. Subsequently, the release of time resource, will not only reorient the work of sales support group, but also improve the quality of data and processes in the enterprise (Belomyttsev, 2019).

The process was further assessed by the primary evaluation: description in the functional model "AS-IS" (fig. 4), calculation of the complex evaluation of the process in accordance with the defined criteria of robotization described above. The process under consideration consists of 9 stages (signing of specification, authorization in ERP system, transition to the required transaction, transition to the delivery item on the basis of which similar items should be made, performing a cycle of actions to form the delivery item in the project structure, sending the changes made for saving) (Viktorova, 2023). The overall process score was 0.6, which, according to table 3, is an average level of robotization potential, meaning the process can be selected for transfer to robotized mode completely or partly. Fig. 3 shows the sequence of steps "Forming specification file" (step 1) and "Entering data into ERP system" (steps 2-8). If the process is converted to robotic mode, the actions that do not require manual confirmation to move to the next step will be performed by the robot, while the remaining actions will be under control of the employee in charge.

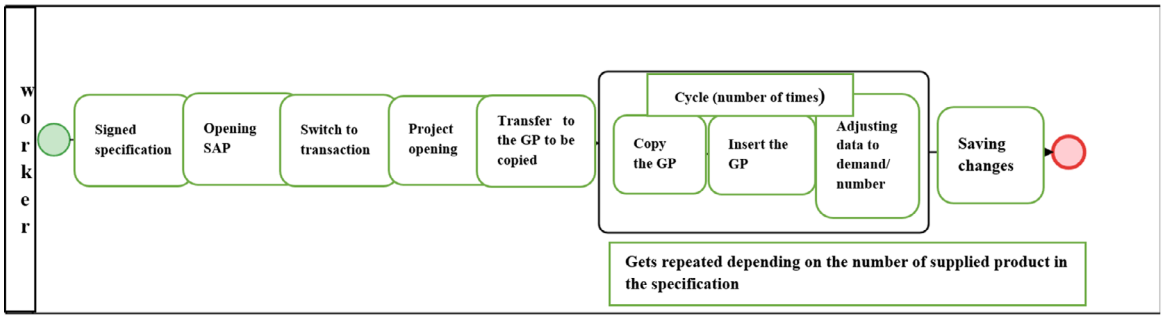


Fig. 3. Process description in the "AS-IS" model (Process #1)

Let's describe the process in the "TO-BE" functional model and consider what it will look like after being converted to robotic mode. According to fig. 4. We can observe the conversion of up to 90% of the functions into robotic mode (8 out of 9 steps), the employee is left with the

activity of signing specification and creating a notification for the robot user to start the process, thereby freeing up the employee's time for the remaining tasks. Once the robot finishes the task, the user receives a notification and checks the data.

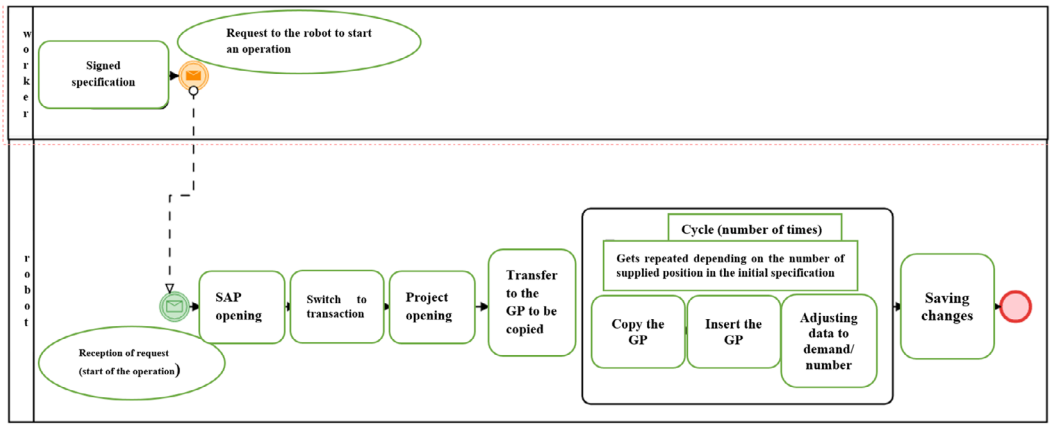


Fig. 4. Process description in the "TO-BE" model

Comparison of these models allows noticing that the transfer of functions to robotic mode has freed up staff time and reoriented them to other functions that require additional work. Freeing up time resources will allow reallocating to such important tasks as:

1. Increase in project contracting;
2. Increasing the level of control over the execution of projects (prevention of fines);
3. Releasing FTE to work with customer stations;
4. Reducing errors in project structure in the ERP-system, there by ensuring consistency and adequacy of data quality;
5. Increased data processing speed;
6. Creation of a single account to make changes to the process.

The presented process is a component of more enlarged processes of the sales block. Accordingly, the already implemented algorithm can also be adapted to other processes within the framework of the QMS project automation.

Conclusion

Process automation now takes place at almost every stage of the life cycle, and is an integral part in the process of continuous improvement of business processes. The company has also developed a standard for information technology support, which approves the procedure for licensing, installation, purchase of software, integration capabilities with other information systems of the enterprise. The standard also establishes requirements for the use of hardware and communication complex, networking, telephone and communications. To assess the effectiveness of this criterion it is proposed to consider the following performance indicator: the degree of coverage of the business processes of the company by the information technology for process automation (the ratio of the automated business processes of the company to all processes of the company).

Transfer of a part of processes into the robotized mode allows increasing the quality of data, which are the main source of information on the project and further processing. Together with the improvement of data quality, this technology will ensure the accuracy and transparency of processes, creating a single vision of the process, which in turn leads to improved quality of staff management. Thus, a mechanism was proposed to automate the business processes of an industrial enterprise in order to improve the efficiency of its activities in the conditions of digi-

tal transformation through the implementation of RPA technology. This technology allows not only to optimize the process, but also to improve the quality of data as an input resource for multiple processes, as it minimizes the level of human errors during data entry/transformation. The processes under consideration are presented in "AS-IS" and "TO-BE" descriptions.

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