

DOI: 10.37943/12UXAN3708

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INTRODUCTION AND EVALUATION PROBLEM OF BPM AND RPA APPROACHES IN MODERN LOGISTIC SYSTEMS

Abstract. Every modern business system tends to reduce production and management costs. There is a reason different management tools are actively introduced into different types of entrepreneurships, from the tiniest shops and online stores to global companies with thousands of employees. Such instruments optimize and ease many processes within every action which must be completed somewhere between the businessman and its customer. Except financial profit the approach may spill the light on previously hidden features of the business.

There are many ways of upgrading and automatization however most common is introducing Business Process Management. Although BPM is a holistic approach to optimizing and automating business processes from start to finish, this article represents Robotic Process Automation as a new form of workflow automation technology. Choice of the proper tool requires consequential analysis and overview of existing methodologies. It provides picking the proper notation as they differ based on a set of parameters and features. But not only methodology needs to be analyzed and known, it also requires full understanding of all the processes within the business itself. According to those representational analyses, the introduction methodology of the robotic solution technique is represented within the framework of a logistic business process. The author provides the work with a detailed description of BPM and RPA models integration highlighting their main features. Along with that, the literature analysis was conducted to define the problems of the logistic business automatization's current condition. The paper is a consequent comparison of BPM and RPA especially in logistic systems. Author provides methodological recommendations on the adoption of management and automation tools in logistic systems.

Keywords: automatization, BPM, RPA, business management.

Introduction

In general, our world can be described as a system of services and customers. Each activity, the work performed by any person with a job and salary, has the final recipient. These process-

es or activities are structured and defined as business. Every business, in turn, can be observed as a complex of processes, where each of them can be controlled using special tools.

Nowadays, the introduction and application of these tools have led to the development of the Business Process Management (BPM) concept. According to [1], BPM is a set of functions, instruments, and approaches that aid in design, project realization, control, and analysis. This approach observes business as a set of operational processes and has many advantages. For example, it delivers benefits in terms of cost, flexibility, time savings, quality, and operational sustainability [2]. Nowadays, there are many different approaches and systems that provide entrepreneurs with certain tools based on the type of business and its goals [3]. In general, they allow the business to scale easily and increase the volume of processed operations, which undoubtedly positively affects the total income, reducing the costs during production.

However, modern globalization processes and the instability of the market make business management very complex. Despite the abundance of innovative management products, their implementation and introduction still require a deep understanding of inner processes, which cannot be done without human intervention. Moreover, the use of different methods and automated tools does not provide any guarantee. Thus, business owners tend to find or create an effective and superior system of management.

In general, every business implementation can be divided into three components: process, people, and technology, and propitiously, based on [4], the BPM approach comprehensively includes all of them. It means that the process design must be aligned with the company's strategy and directed toward the achievement of process objectives. People in this chain are the key to implementing the proposed processes. They act as agents of change, while technology is just a tool to support operations.

Since industrial development has affected every area of daily life, it could not leave business systems unaltered. Many business processes were automated to reduce the cost and human factor. Recent pandemic period research has approved the effectiveness of this solution as it allows support and development of the business even under strict epidemiological restrictions [5].

Generally, the appliance of digital tools for business management is called Robotic Process Automation (RPA). This approach organizes working flows optimization, leading to the systems' flexibility, adaptivity, and scalability [6]. However, RPA adoption is also connected with unrealistic expectations and poor management communication [7].

The article considers different BPM methods and approaches in modern logistic systems, along with the introduction of automation tools, particularly RPA. In terms of logistic systems, one of the most common and complex problems is warehouse control and management, as it plays a key role in the whole process. The hypothesis of this paper is that the combination of both tools, BPM and RPA, will lead to a more rational and efficient adoption in complex logistic systems. In the following section, we will consider BPM and RPA for specific models and cases.

RPA in logistic systems

This article considers the adoption of Robotic Process Technology (RPA) in the automation prospect of BPM. It is better to observe both concepts as a part of the uniform automation approach to the business process. BPM must be examined as the foundation of automated business processes, while RPA can connect BPM processes with the same technologies deployed with other platforms and systems.

In terms of logistic systems, one of the common and complex problems is warehouse control and management, as it plays a key role in the whole process. The more the warehouse's logic is elaborated, the more effective the logistic system will be, reducing unnecessary costs and losses and being time and energy efficient. Modern technologies, such as artificial intelli-

gence, IoT, RFID, and others, are highly introduced in this field. In [8], the authors introduce IoT for smart warehouse management systems. The approach helps to increase the systems' real-time visibility, speed, and efficiency and to prevent inventory shortages and counterfeiting.

The experience of the artificial intelligence use for the warehouse control and management system is given in [9] with the proper description. Authors propose optimized solutions for stock planning, initial product placement, stock to picking zone transfer process, as well as order picking, transport, and tracking processes created using AI algorithms. The use of RFID tags in [10] helped to develop a system that reduced storage management and time costs, while overall management was highly improved by 40.3%. Moreover, this approach eliminated the mistakes caused by manual management and control.

In [11], the authors give an observation on the way modern tools can be used in Warehouse Management System (WMS). They conducted a survey for the estimation of RFID usage in the WMS. Up to 90% of respondents answered that they strongly agree with the usefulness of the approach. These works demonstrate the way modern approaches solve the common problems of any logistic system.

However, still, behind each of these efficient modern tools' introduction into logistic systems, the general automation model must be chosen. It can be done successfully with the proper understanding and, as follows, the representation of the different processes and functions of each system in modeling business processes [9-11]. There are great options for that, which can be individually focused on different facets of the modeling process, such as scope, flexibility, ease of use, understandability, and simulation. These features can be defined based on the proper definition of expectations from the business process management. Nevertheless, the specification of the business field can also help to define the best technique.

In the [12], some approaches and models are proposed and described to show how different approaches can be picked and regulated in order for better business management. The next part of the paper describes the correct approach of its completion.

BPM adoption methodology

Any business process management can be described as it is shown in Figure 1 below:

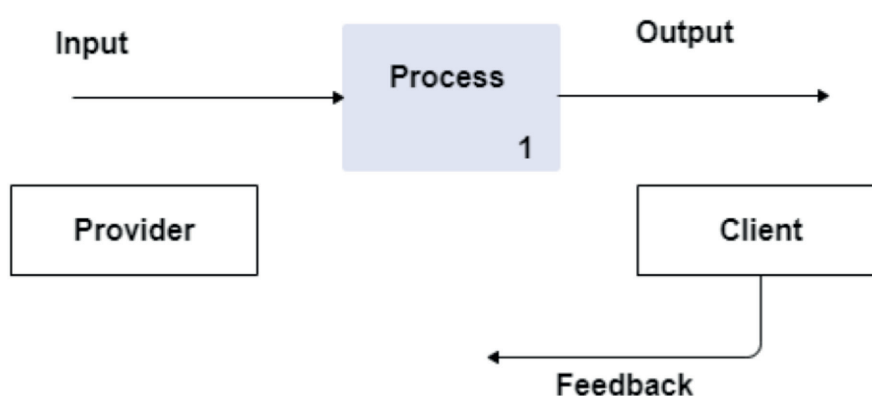


Figure 1. The basic scheme of BPM

Figure 1 shows that business process management generally is a system of relations and connections between the provider, client, and the required process with its input and output. However, BPM encourages organizations to view themselves as a collection of highly integrated processes and not just a collection of functions and departments [13]. Usually, the BPM process consists of the five steps listed below:

1. Design;
2. Modeling;
3. Execution;
4. Monitoring;
5. Optimization;

Each stage allows creating a list of requirements and expectations based on each business case. This subdivision provides the company management with the ability to analyze each aspect of the business. At the design stage, the employee must understand the problem and approximate the management's results and outcomes.

Then comes the stage of modeling containing three most common ways distinguished: functional modeling and process modeling. In the first case, the whole business is observed as a function. In the case of process modeling, the business is defined as a set of certain actions with their beginnings and endings.

The stage of execution launches the management process by tracking all the changes at the monitoring stage. After the preliminary results, the developed model can be optimized and then put back into the working process.

Out of these five stages, one of the most important roles is assigned to the modeling stage, which provides the proper subdivision and visual representation of all the business components that affect the last three steps. The model at this stage is observed as structured, that defines an external observer as the only one able to detect insignificant input parameters while the specific structure of the process is unknown. It means that the processes of the external environment are given as a list of "input" and "output". "Inputs" are used to describe the names of resources and constraints, and "outputs" are the results of activities.

As was written above, there are two main approaches: process and functional. The functional modeling observes the business as a function with entry and exit points. It helps to examine the business model from the point of view of performance and clearly demonstrates what was given as an input and the result gained in output.

In process modeling, the process is a sequence of events and actions, each with its own beginning and end. This is the main difference between these approaches: while functional modeling considers the business model in terms of resources available and desired outcomes, the process is based on a sequence of actions within certain boundaries. Despite the chosen modeling technique, they provide the user with detailed information for future execution. Different approaches and methodologies are explained and analyzed in the next section.

Business process modeling

Modeling of the business process allows to define and structure inner processes based on the main feature of the technique. The feature or focus may vary depending on the parameters that initially formed the approach (e.g., software development, systems engineering, etc.). However, it does not mean the ability of the technique to highlight all the hidden features, but still gives a chance to look from another point of view and get a new representation. The graphic representations or notation of the business processes ease the automation, improve the understanding of the whole system, demonstrate flaws and weaknesses. The most prevalent techniques or models are IDEF0, BPMN, and DFD.

Let's consider the process model IDEF0 in Figure 2. It represents a set of activities, a decision-making process, and the inner processes of the organization as a system:

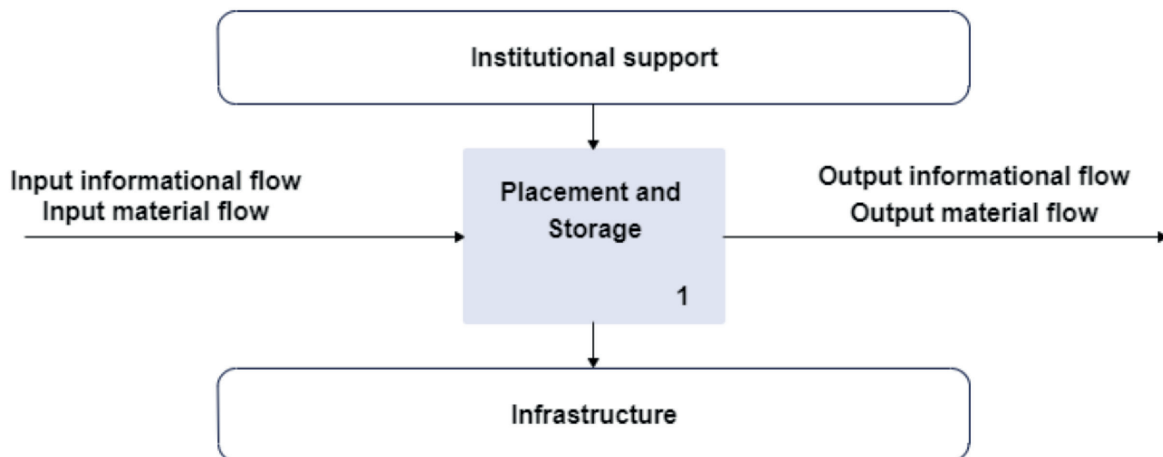


Figure 2. Basic warehouse business processes in IDEF 0 notation.

Employment of decomposition and tunneling can precisely document the processes of each block with input and output data, as well as its control mechanism, including the corresponding control object for a particular action. Communication between blocks (actions) occurs by type of different connections. The output event of an action block can be a control object, a control mechanism, or an input to the next action block.

It can be specified that the IDEF family notation is a descriptive language for reporting business processes. It was created for functional modeling, which means it is used for the demonstration of the flow of resources. However, this notation has a limited number of block actions in one decomposition, hence the need to adjust the business model according to this rule.

BPMN (Business Process Model and Notation) is used for detailed descriptions of tasks of business processes and is shown in Figure 3. It can be said that BPMN employs some process descriptions from IDEF and explores the possibilities for a detailed representation of the business process. The undeniable advantage of this notation is its simplicity and flexibility, which means visibility is given in the form of a diagram and flowchart.

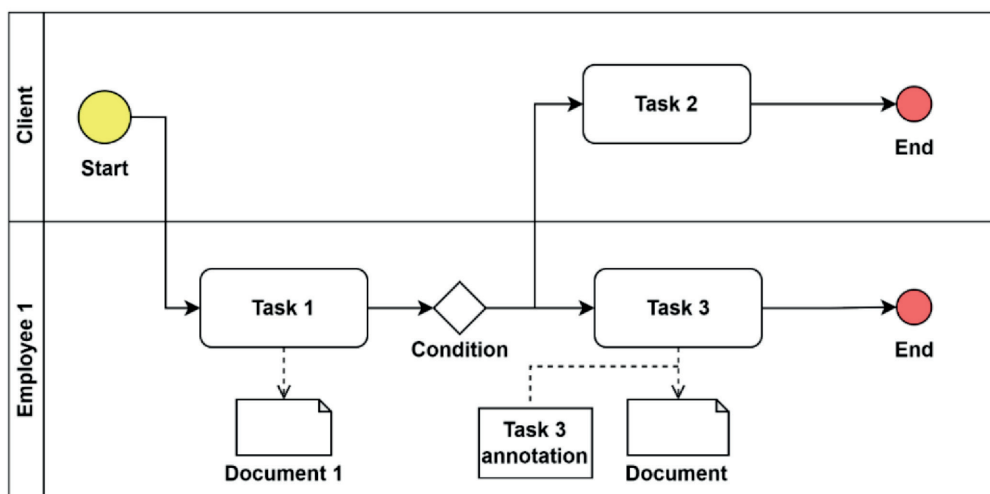


Figure 3. Basic warehouse business processes in Business Process Model and Notation

BPMN notation can be applied to describe the current state of processes, also known as “as-is” (current state). This approach helps automate the actions using visual indicators and other features of the notation. It leads to improved model generation, which is called “to-be” (future-state) [14]. This last stage, in fact, does not end—the created model will be constantly refined, considering internal and external changes. In general, BPMN notation has four main symbols helping to demonstrate the process: the connection objects; flow objects; swimlanes or sting rays; and artifacts. They allow representing different parts of the activities, roles and workflows in the process[15].

Unlike IDEF0 notation, in DFD notation in Figure 4, functional blocks contain the only movement of information between people and goods, not materials. The source of data is always some external entity.

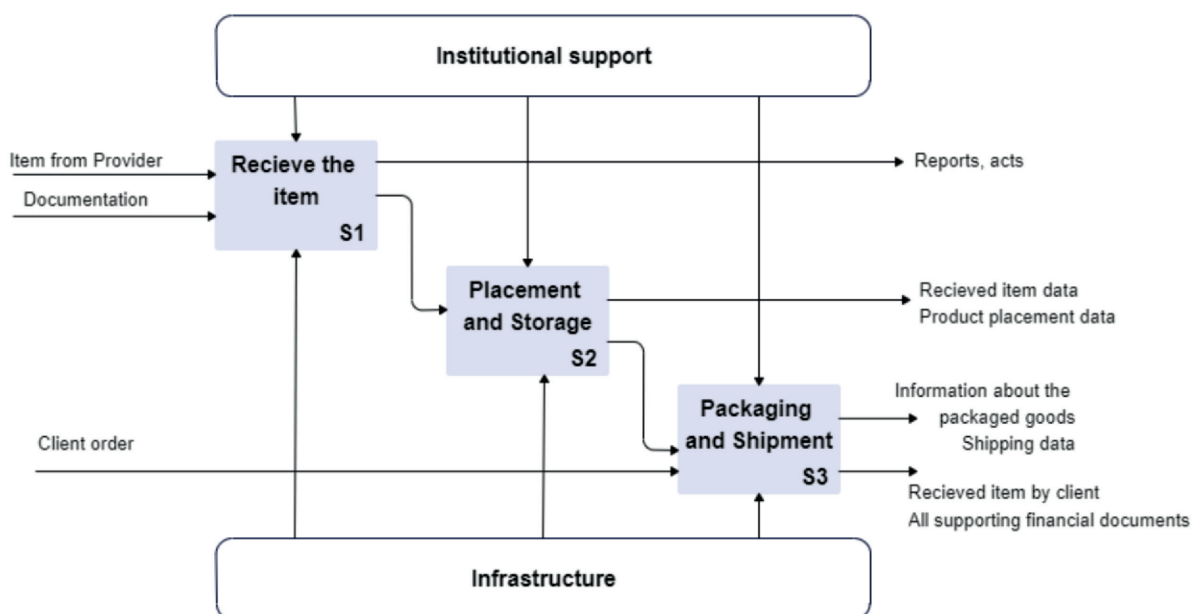


Figure 4. DFD diagram of warehouse business process

The processed information from the stages of the process should flow to the external entity in the end. Functional blocks are interconnected with documents and data sets. It is important to keep the borders between documents, functions, and data sets. DFD provides a graphical overview of the system’s functionality, with its underlying processes and flow of data [16].

The result of the comparative analysis of different models shows that none of the given approaches could entirely describe and solve the whole system effectively. It means that while the Activity Diagram defines the interconnection of different roles within the organization, Data Flow Diagram (DFD) focuses on the flow of data through a system [17]. A comparative analysis of each modeling technique of BPM is examined in the implementation of the same process. Each of them suits a special part of the system’s process. That leads us to the most thriving solution: the combination of BPM and RPA.

Results

The main problem in business automation is finding an appropriate approach and tool. For now, the most common are BPM or RPA. The analysis made in the work showed that there is no one common solution or approach that can fully automate the process efficiently and profitably. On the contrary, different approaches are better suited to a particular business process, depending on its area, on the processes occurring inside.

BPM, depending on the approach, correctly and comprehensively represents the system's inner processes; however, as the number of models, the complexity of automation, and the costs of its management increase, this does not always pay off.

RPA provides fast automation of simple routine tasks, reducing the costs and risks associated with the human factor. In addition, bots improve their work with each execution. However, their implementation in more complex tasks implies the complication of the bot system.

Based on the results that are given in [18], each business process can be dissolved and represented as a mathematical model. It helps to evaluate the result and get real numeric accountings to understand the success rate of business process automatization. For example, in the formula (1), the authors calculate the revenue from business process response over the following time period:

$$V = \gamma CT \quad (1)$$

where γ is the business process capacity and C is revenue from customer's response.

Thus, neither BPM nor RPA solves the problem of automating business processes. Each of the approaches is more focused on a specific stack of tasks. The analysis given in the previous section approves this as none of the models sufficiently covers all the processes within the business project. Although, automation of business processes often may lead to the additional results, as was shown in the case of automated logistics in container port terminals [19]. In this work, automation is used for the optimization of container handling at the port using Automated Guided Vehicles (AGV). One of the prior problems, in this case, was to reduce costs and increase efficiency and capacity of container management. Introduced AGVs have shown a 10% shortage in the distance and around an 18% increase in loaded goods. Moreover, this approach also affects the environmental impact of this logistic system because increased efficiency reduces energy consumption and carbon emissions, which have a strong correlation as shown in [20].

Every company or entrepreneur strives to be rational and optimize all the processes within businesses with increasing economic profit. For that, they can use some identifications such as economic value, budget, or completeness constraint, for example. In the following paper [21], authors demonstrate the way a proper RPA can be chosen using the proposed decision-making approach, as shown in the formulas of RPA's economic return maximization (2), based on the appropriate activity A , as well as a budget constraint formula (3) and completeness constraint in (4).

$$\max \overline{PA} * \bar{x} \quad (2)$$

$$\overline{FRC} * \bar{x} \leq B \quad (3)$$

where FRC – fixed cost of RPA.

$$\frac{-FLC_{im} + FRC_{im}}{VLC_{im} - VRC_{im}} * x_{im} \leq t \text{ for all activities}(i, m) \quad (4)$$

where FLC is the Fixed Cost of Human Labor (FLC), and Variable Cost of Human Labor (VLC) and Variable Cost of RPA (VRC) are VLC and VRC, respectively.

Using these formulas, it's clear that RPA is bound with budget B (3) and should be amortized with a certain time t (4). These tools can help and simplify the whole automation process in the planning stage and after the introduction into the business process.

Discussion

Business process simulation is a diverse field utilizing various approaches and starting

points to building and running simulations, including business process models represented in graphical and textual notations based on procedural (imperative) and declarative process modeling languages [22]. There are many languages in BPM that can be used for the modeling process, as described above. However, to integrate RPA into the modeling languages, it is required to define what tasks must be solved by a “robot” [23]. It means that the input and output points for the robot should be seamlessly integrated into the overall process so that there is no need to significantly increase the role of the robot or collect the results of its work. For example, there are several processes that do not make it suitable to robotize:

- with unpredictable external factors, where it is impossible to timely control the result.
- using non-formalizable features.
- based on an intuitive interpretation of the situation.

As a result, this article represents the methodology to combine BPM and RPA. Figure 5 demonstrates the proposed integration of RPA into the life cycle model of BPM.

Although all given modeling techniques can be used to define the business process, for example, the warehouse process in logistics, it is necessary to determine which process is eligible for adapting RPA there.

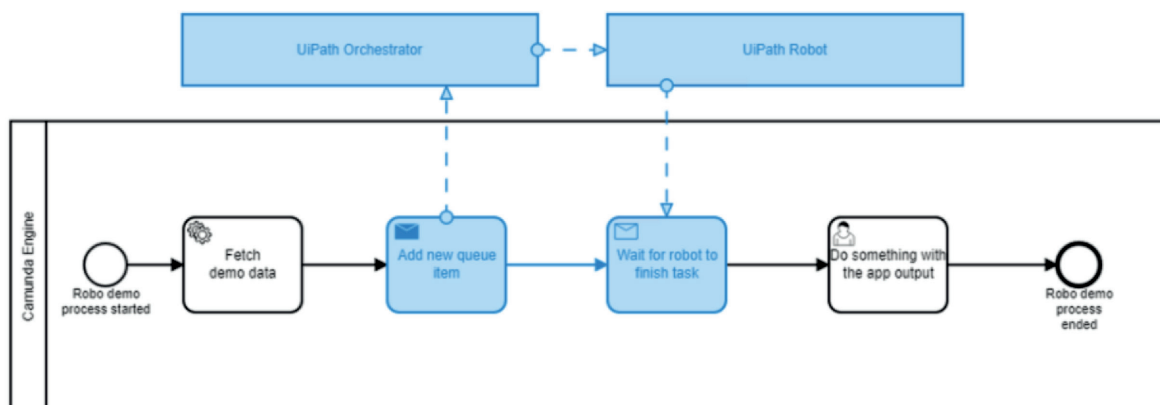


Figure 5. Integration of RPA into life cycle model of BPM

It can be used everywhere, depending on the demand for manual work replacement. As an example, a service call can be used. Instead of it making an external call, there can be created the RPA tool’s API, and the “robot” will do the action, and then the callback will be used as a trigger of the end-to-end process.

Conclusion

The widespread introduction of technology in business has simplified many processes, including logistics, reporting, and management in general. This led to a reduction in costs, reduced the risk of the human factor, and made it possible to optimize production. Over time, different approaches to automation have arisen, and the already familiar BPM models, complex and time-consuming implementations, and paybacks began to seem less effective compared to new methods, for example, RPA. Then the industry began to divide, as each of the methods had its own fans.

The analysis carried out in this work showed that the choice between approaches to business automation would not allow the effective implementation of one or another tool with maximum benefit since each has its own scope in which it is most useful. In order to determine this problem, the paper describes the process of analyzing various models that allow describing the business process. Their comparison showed that each of them separately has a limited

scope and only a combination of approaches makes it possible to make automation flexible, profitable, and useful while reducing the risks of BPM non-return and without complicating the RPA bot system.

The future work of the authors will be devoted to testing this solution in the field of logistics, in practice, in a warehouse. As the work shows, the use of systems automation makes goods management more sufficient, sustainable, and fast, as the resources are better organized, and the system becomes clear for the employee.

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