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BUSINESS PROCESS OPTIMIZATION BEYOND REENGINEERING

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Abstract

As discussed in the previous section, business process modeling does not add value without further validation and analysis of the business process model. Similarly, process analysis is of little value if it does not help to improve or optimize the business process. Process improvement can occur using appropriate formal methods that support both modeling and analysis of business processes. A holistic approach to business processes should cover the business process (business process modeling), provide the necessary tools to identify bottlenecks and analyze performance, and - ultimately - generate alternative improved business processes in terms of specific goals. But often this last part (optimization of business processes) is overlooked - if not completely, then neglected - in the literature on business processes. This section discusses the differences between process improvement and process optimization, and provides a classification of existing approaches to optimizing business processes.

Keywords: Business process (BP), BP analysis, Petri nets, BP modeling, BP optimization, customer engagement, engineering.

Introduction

The improvement of business processes began as part of efforts to reorganize and/or reorganize business processes that promised exceptionally high results. B. Gunasekaran and E. Kobu (1) argue that the business process must undergo fundamental changes in order to significantly increase productivity. According to N. Soliman (1), the goal of business process reengineering is to improve business processes and reduce costs. Nevertheless, although most attempts to reengineer (or redesign) business processes in the literature claim that they support the improvement of business processes, there are rare cases that describe with sufficient detail the actual improvement steps that need to be taken. Jaeger et al. (2) is a typical case where business process improvement is limited to a broad description of the steps to be performed. The stages according to these authors are as follows:

1) specify the system.

2) identify performance bottlenecks.

3) choose one of the possible modifications to eliminate performance bottlenecks.

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These - almost obvious - guidelines are not sufficient to improve a structured process, because they do not provide the necessary understanding and level of detail of the actions that lead to process improvement. Another similar approach is presented by AIdowaisan and Gaafar (3), and it is based on observational analysis. Their technique has a set of options for reworking the process. This includes eliminating value-added operations (for example, redundant, returnable, and control), simplifying actions, combining operations, and increasing concurrency activities. But again, the improvement process is not transparent. This approach does not guarantee optimal redesign because it manually outputs alternative process maps starting from the current process map (4).

Methodology

A meta-analysis was conducted to analyze the research issues. The structural literature review was adapted in accordance with the guidelines for systematic literature review presented by Chechez-Kechmanovich (2015). The literature review was based on research papers that were available through Scopus, Academic search full databases. The initial criteria for selecting an article for inclusion in the review were based on the object of the presented research. The business process was chosen as the object of scientific research. Keywords for the search were constructed as a combination of words: business process, analysis, performance, evaluation. For the literature review, scientific papers related to the above keywords were selected. For the literature analysis, full-text articles written in Russian and English and published in journals that apply peer review were included.

Discussion

This article discusses business processes by introducing a new classification scheme for business process models and presenting current trends in the field of analysis and optimization. The article is organized as follows. Section II presents the most representative approaches to business process modeling and their classification into three groups based on their characteristics. Section III defines different types of business process analysis methods and classifies them in a similar way. Section IV substantiates the need to move from improving business processes to structural optimization and identifies approaches to optimization that are scarce in the literature. The last section provides an overview of all the classifications presented and highlights the current situation, a gap in research and directions for further development of modeling methods, analysis and optimization of business processes.

Optimization of business processes can be based on the methods of relevant disciplines. Researchers Gunasekaran (5) and Kobu (6) argue that in the context of business processes, there is a need for wider use of decision support systems based on artificial intelligence and expert systems. They also support the need to develop queuing systems, linear programming, and simulation models to represent business processes and select the optimal design. In this question, they identified two other disciplines with business processes: planning and evolutionary computing. Planning has a number of common themes with business processes, and evolutionary computing is already a successful approach to optimization in other areas (7).

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Other scientists in this field, Zhou and Chen (8) suggest that business process optimization should be aimed at reducing time and costs, improving product quality and increasing customer and staff satisfaction in order to maintain the competitive advantage of the organization. Another researcher, Ragers (9), suggests that the goals of optimizing business processes are often to reduce costs and flow time. However, Hofacker and Vetshera (10) emphasize that the concept of "optimality" of technological designs is not trivial, and the quality of processes is determined by many, often contradictory criteria. Both in applied and theoretical terms, great importance is attached to the optimization of business processes, mainly without explaining the criteria and alternatives considered for optimization (1). But Zhou and Chen (1) note that there is still no systematic methodology for optimizing business processes.

Results

Description of the "Customer Engagement" business process. Consider the route map of the business process "Customer acquisition". New customers appear at the company in one of two ways: they apply independently or are sales representatives. After the presentation has been made and the "Commercial Offer" has been prepared, the client refuses, agrees or demands a high discount. The approval of non-standard discounts is under the control of the head of the sales department (11).

The main service blocks of any business process model are functions, events and positions. A function is a task, operation, or action performed on an object to achieve one or more goals. A position is a type of organizational unit that performs functions. A business process is a chain of functions performed sequentially by employees holding various positions (12). As a result of each function, one or more events are generated in accordance with the priority of their occurrence and the logical operators that connect them. The start of a business process can be carried out by one of the starting events with a predetermined frequency.

One of the characteristics of each object of the "event" type, which is not a starting one, is the priority of the occurrence of this event. Thus, the moments of occurrence of all events, except the starting ones, will obey the route map of the business process and the priority of the occurrence of events at the branching points. The priority of all of them is the same.

The only characteristic of an object of the "position" type is the number of employees holding this position. In total, 11 employees holding 5 positions are involved in the business process. Employees are distributed according to positions as follows (5):

- secretary - 1;
- sales manager - 6;
- sales representative - 2;
- telemarketer – 1;
- head of sales department - 1.

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Table1 Characteristics of service units of the "function" type

Function	Min. lead time, h:m:s	Max. lead time, h:m:s	Personnelcosts, USD	Other costs, USD
Acceptance of the application	00:07:00	00:13:00	1,50	2,00
Finding out the needs of the client	00:10:00	00:25:00	4,00	1,00
Offer a meeting to the client	00:20:00	00:30:00	2,00	2,00
Customer Search	02:30:00	05:30:00	3,00	9,00
Checking the completion of the questionnaire	00:30:00	01:30:00	6,00	0,00
Departure for a meeting with a client	01:00:00	01:30:00	6,00	6,00
Preparation of a commercial offer	00:50:00	01:40:00	4,00	3,00
Preparation of the buyer's order	00:20:00	00:30:00	3,00	1,00
Finding out the reason for the refusal	00:05:00	00:10:00	1,00	0,50
Approval of the discount	00:20:00	00:30:00	5,00	1,50
Invoicing for payment	00:10:00	00:20:00	2,00	3,00

Table 2 Differences in the characteristics of the initiation models of the process "attracting a client" – "a request has been received from a client" and "departure to the facility"

Model	A request has been received from the client	Departure to the object
The beginning of the working day, h:m	09:00	09:00
Working day duration, hour	9	9
Number of working days per week	5	5
Frequency, days	7	7
Average number of processes per day	14	10

For each specific function, an estimate was obtained of the minimum and maximum time of its execution and the cost, which consists of the cost of paying for the time of the employee performing this function, as well as the costs of phone calls, using the Internet,

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the cost of gasoline, subway rides, etc. (5). A list of the cost of performing each function is given in Table 2.

The execution of each business process is initiated by one or more start events. Thus, the input streams for each business process are events, the frequency of occurrence of which is determined by some distribution law. To generate events with a certain frequency, each of the starting events has a nested model of the "process initiation model" type, which determines the order and cyclicity of event generation (13).

In the "attracting a client" model, two events are the starting ones: "a request has been received from a client" and "departure to the facility" (14). Both of these events have the same process initiation algorithm, differing in several characteristics. Differences in the characteristics of the initiation models of the process "attracting a client" – "a request has been received from a client" and "departure to the facility" are shown in Table 3.

Thus, in the "customer acquisition" business process, a certain number of instances of business processes are created during business hours of each day. This process is repeated the number of times corresponding to the number of working days in the week.

The results of the simulation of the business process "customer engagement". Running the model involves setting the modeling interval (in this case, the interval corresponds to a week) and adjusting the composition of the analyzed parameters (5).

Table 3 Statistics of time, quantity and cost of functions in the "customer acquisition" business process

Function	Number of processed functions	Processing time, d:h:m:s	Personnel costs, USD	Other costs, USD	Total costs, USD
Acceptance of the application	70	0000:11:55:58	105,00	140,00	245,00
Finding out the needs of the client	70	0000:21:18:38	280,00	70,00	350,00
Offer a meeting to the client	179	0003:02:58:31	358,00	358,00	716,00
Customer Search	50	0008:03:29:45	150,00	450,00	600,00
Checking the completion of the questionnaire	50	0001:15:00:05	300,00	0,00	300,00
Departure for a meeting with a client	147	0014:12:21:58	882,00	882,00	1 764,00
Preparation of a commercial offer	277	0014:08:19:40	1 108,00	831,00	1 939,00
Preparation of the buyer's order	277	0004:20:27:33	831,00	277,00	1 108,00
Finding out the reason for the refusal	94	0000:11:40:28	94,00	47,00	141,00

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Approval of the discount	95	0001:15:29:55	475,00	142,50	617,50
Invoicing for payment	140	0001:11:10:13	280,00	420,00	700,00
Total	1 449	0045:07:03:43	4 863,00	3 617,50	8 480,50

Table 4 Statistics on the use of employee resources in the "customer acquisition" business process

Post	Number of processed functions	Workinghours, d:h:m:s	Utilization factor	Number of people
Secretary	70	0000:11:55:58	0,07	1
Sales Representative	50	0008:03:29:45	0,58	2
Telemarketer	157	0002:17:42:45	0,39	1
Sales Manager	1 027	0030:02:38:09	0,72	6
Head of Sales Department	145	0003:19:17:07	0,54	1

As a result of the analysis of statistical data from Table 4 obtained after running the model in batch mode, it became obvious that the function "preparation of a commercial offer" is not only the bottleneck in the implementation of the business process, but also the most expensive center. The total cost of performing this function has reached 1,939 USD, which is the maximum value compared to other functions (5).

The analysis of the statistics on the use of employee resources, given in Table 5, allows us to talk about high workload coefficients of sales managers and sales representatives and a very low workload coefficient of the secretary.

Methods of optimization of the business process "customer engagement". Improving the efficiency of a business process can be done in several ways - gradual (engineering) and cardinal (re-engineering) methods of improving business processes (6).

Engineering and re-engineering as methods of improving business processes. In order to continuously monitor the business processes of companies for their subsequent management, the concept of business process engineering is applied. Business process engineering (or business engineering) is the creation of a business process model "as is", reflecting the current state of the company's functioning, and its constant updating, which means maintaining the model in a form appropriate to the changing circumstances of the company's actual activities. In accordance with the Deming cycle P-D-C-A (15), the engineering process, being a management process, is iterative in nature, successively passing through four stages: planning, implementation, control and analysis. This process, reflecting the current state of affairs in the company or supply chain, in terms of its innovation/creativity or rationalism is a reflection of current business practices.

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However, the very fact of the constant use of business process engineering as a tool shows a certain level of innovation in the management of this enterprise or supply chain.

Business process improvement began as part of a business process redesign and/or reengineering effort that promised exceptional results. Gunasekaran and Kobu (1) argue that the business process must undergo fundamental changes to achieve significant performance improvements. According to Soliman (16), the goals of business process reengineering are to improve business processes and reduce costs. However, despite the fact that most attempts to reengineer (or redesign) business processes in the literature claim to support the improvement of business processes, there are few cases in which the actual improvement steps that need to be taken are described in sufficient detail. According to some authors, this is a typical case when the improvement of business processes is limited to a broad description of the steps that need to be taken. The steps, according to these authors, are as follows (1):

1) Specify the system.

2) Identify the performance bottleneck(s).

3) Choose one of the possible modifications to eliminate performance bottlenecks.

When improving a business process, one of the following techniques or a combination of them can be used:

- automation of function execution;

- changing areas of functional responsibility;

- reduction of the share of inspection and control work;

- minimization of approvals.

Automation of function execution involves increasing the degree of informatization of the function and leads to a reduction in its execution time and standardization of output. According to the degree of informatization, automated, interactive, expert and non-automated functions are distinguished. Automatic functions are performed by a computer without human intervention, for example, drawing up standard reports or performing mathematical calculations. Interactive functions are performed by a computer and a person in an interactive mode, for example, the implementation of non-standard queries. Expert functions are performed by a person on the basis of recommendations (commands) prepared by a computer. Non-automated functions are performed by a person without using a computer (17).

Changing the areas of functional responsibility is the assignment of responsibilities for the performance of a function to another organizational unit. In a defective process, some functions may be too expensive due to the fact that they are unreasonably performed by highly paid employees. Such functions are called cost centers. The reasonableness of the costs of performing such functions is determined by the minimum necessary level of competence of the responsible employee. If the professional knowledge of the employee performing it is not required to perform the function, then such a function should be included in the area of responsibility of a lower-paid employee (5).

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Reducing the share of inspection and control work allows you to increase the speed of the business process. Traditional business processes are replete with verification and control operations, which are a kind of useless work, because they do not create any values, but, nevertheless, they are needed in order to ensure that there are no violations. All these checks require time and effort – in some cases even more than the business process itself. Minimizing approvals ensures consistency of work data, and also increases the speed of the business process. Coordination is another kind of useless work that a redesigned business process should minimize. This is achieved by reducing the number of external contact points available in the business process, which leads to a decrease in the likelihood of obtaining contradictory data, for which, in fact, coordination is required.

Let's consider the application of these methods for the "customer acquisition" business process. Analysis of the simulation results, which are shown in Table4allows to understand how much each of the employees is loaded with work, how much money and time is spent on performing each of the functions. Sales representatives and sales managers have the highest workload ratio (18).

One of the ways to reduce the workload of sales representatives is to hire additional employees. The work of a sales representative is one of the lowest paid, so hiring additional employees will increase the efficiency of the process without significant financial costs. It should be borne in mind that hiring one additional employee will ensure a reduction in the workload of sales representatives and an increase in the number of customers found, which in turn will increase the low workload factor of the telemarketer.

In this case, it is possible to give only a probabilistic assessment of the increase in the efficiency of the process. Accurate calculations of the workload indicators of sales representatives after hiring an additional employee are impossible, since hiring an additional employee will entail an increase in the number of orders, and an increase in the number of orders will force the process to be modeled repeatedly with other sets of input data. It is possible to relieve the workload of managers in a similar way, but it is unlikely that it will be economically feasible. In addition, when analyzing the functions performed by the sales manager, bottlenecks were identified that slow down the business process (19). To relieve the workload of sales managers and optimize the business process of "attracting a client", techniques for automating the performance of a function and changing areas of functional responsibility can be applied. Analysis of modeling results suggests that a sales manager performs many functions that do not require his knowledge, which can be shifted to a secretary who has too low a workload factor. Such functions include "finding out the reason for the refusal" and "invoicing for payment" (6). Such a step is quite reasonable, since the cost of performing the functions of the secretary will be significantly lower than the sales manager, in addition, it will allow the secretary to load the working time in full.

One of the most expensive and long–lasting functions that require professional knowledge of the manager is "preparation of a commercial offer". The average time of its execution is 1 hour 15 minutes, the cost is 7 USD. This function implies the step-by-step execution of typical operations – opening a commercial offer template, correcting the client's details, calculating the parameters of the system being sold, saving the received file and sending

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it by mail to the client. Currently, this function is performed manually by employees, so it can be attributed to non-automated (5).

The development or purchase of special software that allows generating a commercial offer automatically, based on standard templates and calculating system parameters using a computer, will reduce the time and cost of performing this function and will transfer it to the category of expert, which implies interactive performance of the function by a person based on recommendations and commands prepared by a computer. Reducing the execution time of the function will lead to an increase in the speed of customer service in general, which should favorably affect customer loyalty.

Further analysis showed that a number of functions performed by a sales manager do not require his professional knowledge. These include "finding out the reason for the refusal" and "invoicing for payment".. The function of "finding out the reason for refusal" is to call the client and fix the reason for refusing to work with the company. The "invoicing for payment" function consists of filling out a standard invoice form with the client's details and sending this form by e-mail or fax. None of these functions requires professional knowledge of the sales manager, which means that it is performed unreasonably. Statistical analysis of the coefficients of utilization of employees to include these functions in the area of responsibility of a Secretary with too low factor load 0,07 (20).

Such modification of the functional areas of responsibility will be quite reasonable, since the cost functions of the Secretary will be significantly lower than the sales Manager Wages clerk on average 4 times less than that of sales Manager.

Formal/Mathematical Models. The need for formal semantics in business process modeling has led to the second generation of formal models. Formal models are those in which the concepts of processes are defined strictly and precisely, so that mathematics can be used to analyze a group of clients, extract knowledge from them and reason about them. The advantage of formal models is that they can be verified mathematically, and can also be checked for consistency and other properties (20). These models are consistent with the assumption of van der Aalst et al. (1) that business process models “should have a formal basis”, since formal models leave no room for ambiguity and increase the potential of analysis. However, formal methods of process design support are not enough (1), since the elements and limitations of the business process are mainly qualitative in nature, and it is difficult to characterize them in a formal way amenable to analytical methods (20). This explains the complexity of developing “parametric” business process models and the fact that only a few practical examples are found in the relevant literature (2).

The Petri net is an example of a business process modeling technology that combines a visual representation using standard notation with a basic mathematical representation. A Petri net is a graphical language that is suitable for modeling systems with parallelism (73). A Petri net graph is a directed bipartite graph consisting of two types of nodes called places and transitions. Petri nets have been modified and expanded by various researchers to provide more powerful business process modeling capabilities. Some of their variations include temporal Petri nets, stochastic Petri nets, color Petri nets, and hierarchical Petri nets (9).

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Conclusion

A comprehensive assessment of the obtained results of the simulation of the business process "attracting a client" made it possible to identify cost centers, bottlenecks in the implementation of business processes and uneven workload of employees. The goal of optimization was to find the most effective implementation of the business process and was achieved using such methods as the redistribution of the workload coefficients of positions, automation of the function and changing the areas of functional responsibility. Modification of functional responsibility zones has proved to be one of the most effective ways to reduce the cost of a business process. Moreover, reducing the cost of the process in this way allows you to leave the quality of execution.

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