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MODELLING OF OUTSOURCING OF BUSINESS PROCESSES OF IT COMPANIES

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A B S T R A C T

The object of research within the framework of this work is the process of outsourcing business processes of IT companies. In the context of this work, the problem of the lack of a complex of economic and mathematical models for determining the strategic advantages of IT companies, taking into account the wishes of its outsourcing partners, was solved.

An improved methodology for modeling the outsourcing of business processes of IT companies is presented in order to support decision-making in the field of information economy.

The analysis and formalization of the interaction of the IT company with partners was carried out, on the basis of which the goals and limitations of this process were formed.

The proposed procedure for choosing the strategic advantages of an IT company, taking into account the wishes of its outsourcing partners. Based on the optimization modeling toolkit, the procedure for calculating the comprehensive success rate of the entire chain of the IT company's outsourcing system is determined.

An experiment was conducted regarding the choice of strategic advantages taking into account outsourcing partners on the example of "Chameleon Soft" IT company.

1. INTRODUCTION

The growth of competition in the market of IT services puts companies in front of the need to find new ways to optimize production processes and reduce costs. Outsourcing allows companies to focus on their strategic tasks and core competencies by transferring routine or non-core processes to external service providers. Reducing costs and increasing efficiency is one of the main advantages of business process outsourcing, which attracts the attention of IT companies. The flexibility that outsourcing provides allows companies to quickly adapt to changes in the business environment and quickly scale their operations. The involvement of specialized outsourcing companies can bring a significant increase in the quality of the execution of business processes thanks to their expertise and experience. Risks associated with internal processes can be reduced through outsourcing, as

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companies can transfer them to service providers. With the help of outsourcing, IT companies can gain access to fresh ideas and technological innovations implemented by outsourcing partners. Outsourcing modeling allows companies to understand the potential benefits and risks of this approach and build an effective strategy for its implementation. Market analysis and evaluation of potential suppliers helps to find the optimal partner for outsourcing. Consideration of cultural, legal and other aspects of the agreement with the outsourcing partner is an important part of outsourcing modeling for IT companies. Integrating outsourcing into strategic planning and risk management is a key aspect of business process outsourcing modeling. Constant monitoring and updating of the outsourcing model allow companies to adapt to changes in the internal and external environment.

These aspects indicate the relevance of the research devoted to the modeling of business process outsourcing of IT companies.

2. SCIENTIFIC ELEMENTS OF RESEARCH

2.1 Analysis of literary data and formulation of the problem

The issue of research and modelling of business process outsourcing of IT companies was raised by a number of researchers. Thus, works (Nacer, Abdmeziem & Godart, 2023; "Outsourcing and Innovative Activity", 2014; Yanmaz Arpacı & Gülel, 2022) offer approaches to forming a strategy for the innovative development of companies based on the outsourcing of business processes. But there is no formalization of the IT company's interaction with partners in these works.

Studies ("Outsourcing Strategy", 2020; Juarez, Tosca & Jimenez, 2019) systematized the competitive advantages of outsourcing business strategies in companies. Approaches to determining the effectiveness of the organization are offered in view of outsourcing strategies. However, the research data does not provide opportunities to choose strategic advantages taking into account outsourcing partners.

The procedure for determining key business processes for the transition to business process outsourcing, as well as issues of outsourcing ethics, are considered in works (Saito, 2019; Ndubisi & Nygaard, 2018). However, these works do not include consideration of possible limitations of the IT company's commercial interaction with outsourcers.

The social, economic, and political consequences of companies' outsourcing processes are systematized in works (Cui, 2022; Drzewiecki, 2016). But in these works, there is no description of the factors of outsourcing in the conditions of the information economy.

Modelling of business processes in consulting companies is proposed in (Kiseleva et al., 2021). At the same time, the specific features of IT companies are not considered.

Studies (Varajão, Cruz-Cunhac & Fraga, 2017; Hrabovskyi, Kots & Szymczyk, 2022) are devoted to the consideration of economic and mathematical models that describe the introduction of new information technologies and related risks. But there is no description of the procedure for choosing a strategic outsourcing partner in these studies.

Scientific works (Dossani & Dossani, 2015; Yi & Xu, 2013; Grebić et al., 2025) give recommendations for decision-making modelling for the outsourcing of corporate content management business processes. However, in these works, there is no definition of the optimal values of the parameters as a result of the coordination of the IT company's and outsourcing partner's preferences based on a certain success rate.

The trends of the outsourcing process are systematized in scientific articles (Du & Miao, 2022; Könning & Westner & Strahringer, 2019). However, these articles do not contain a detailed consideration of the key outsourcing strategies of IT companies.

Studies (Potkány, Stasiak-Betlejewska, Kováč & Gejdoš, 1916; Kotlarsky, Oshri, Lee & Jarvenpaa, 2015; Ushakova, Hrabovskyi & Szymczyk, (2023) provide an opportunity to consider and systematize strategic innovations in the field of IT and business process outsourcing. An algorithm for making analytical decisions regarding company management is proposed. At the same time, in these studies there is no experimental forecasting of the overall performance of the IT company's business process outsourcing system.

Gopal & Koka (2013) presented an analysis of the influence of relational management on the profitability and quality of suppliers in the field of software outsourcing. However, the question of calculating the optimal values of the parameters of strategic advantages of IT companies in this paper remains open.

A theoretical-multiple approach to the study of complexity and contradictions in the outsourcing of information technologies is presented in a scientific work of Bui, Leo & Olayele (2019). However, this scientific work does not analyze the size of the IT company's investments to cover the cost of its participation in the outsourcing network.

A configurational approach to the analysis of the contradiction between cost-saving initiatives and the implementation of innovative initiatives to ensure stable productivity of the company with the help of outsourcing is proposed by Leo, Bui & Adelakun (2022). But in this scientific article there is no calculation of a

comprehensive indicator of the success of the entire chain of the outsourcing system.

A general shortcoming of the analysed studies presented in the specialized literature regarding the consideration and modelling of business process outsourcing of IT companies is the lack of calculation of the optimal values of the parameters that characterize the strategic advantages of the company in the process of interaction with strategic partners. In addition, as a shortcoming of the analysed works, it is possible to note the lack of software tools for experimental forecasting of the productivity of the IT company's business process outsourcing system as a whole. Therefore, there is a need to develop a set of economic and mathematical models for outsourcing business processes of IT companies.

2.2 The purpose and objectives of the research

The purpose of the work is to develop economic and mathematical models of outsourcing business processes of IT companies. This will make it possible to improve the decision-making support process by creating appropriate economic and mathematical tools.

To achieve the purpose, the following tasks were solved:

- analyse and formalize the interaction of the IT company with partners;
- to develop a procedure for choosing strategic advantages, taking into account the wishes of its outsourcing partners;
- to carry out an experimental implementation of the proposed economic and mathematical models in the conditions of "Chameleon Soft" IT company.

2.3 Research materials and methods

The object of the study is the process of outsourcing business processes of IT companies.

The following research methods were chosen:

- **generalization** – to highlight the factors that influence the amount of IT company investments to cover the cost of its participation in the outsourcing network. The choice of the generalization method is justified by the variety of such factors in the conditions of the information economy;
- **optimization modelling** – in order to formalize the interaction of the IT company with partners. The choice of this method is justified by the need to select the target function and possible limitations of the outsourcing process;
- **deduction** – for forming a list of strategic advantages of the IT company regarding the outsourcing of business processes. The deduction method is chosen based on its ability to identify key parameters of strategic advantages;
- **analysis and synthesis** – for the purpose of developing a general technology for building a software script for experimental forecasting of productivity in the IT company's business process outsourcing system. The choice of these methods is explained by the fact that analysis can provide a local consideration of specific stages, paying attention to small details, while synthesis can provide a global view, determining the overall structure;
- **game simulation** of the "player - inanimate nature" class – to determine the specific values of indicators of the IT company's strategic advantages in outsourcing business processes. The game simulation toolkit allows you to determine the optimal values of the parameters as a result of the coordination of the IT company's preferences and outsourcing partners based on a certain success rate;
- **linear programming** – to optimize the allocation of resources between different outsourcing projects. Linear programming allows for experimental forecasting of the overall performance of the IT company's business process outsourcing system.

3. STUDY OF MODELING OUTSOURCING OF BUSINESS PROCESSES OF IT COMPANIES

3.1 Research results regarding the modelling of business process outsourcing of IT companies

The initial stage of business process outsourcing modelling is the formalization of the IT company's interaction with partners.

The strategic advantages of an IT company regarding business process outsourcing can be described in the form of a tuple:

$$P = <BF, OK, RZ, KS>, \quad (1)$$

where BF is the number of business functions that are outsourced; OK – the amount of the company's investment (in monetary terms) for compensation for participation in outsourcing; RZ – the amount of available resources to support the main business processes; KS is the number of jointly implemented business processes.

The goals of commercial interaction of an IT company can be described in the form of the following expressions:

$$Q_1 = \sum_{i=1}^{n} BF_i \to \max_{BF_I}, \quad (2)$$

$$Q_2 = \sum_{i=1}^{n} RP_i \to \min_{RP_I}, \quad (3)$$

$$Q_3 = \sum_{i=1}^{n} RI_i \to \max_{RI_I} \quad (4)$$

subject to restrictions:

$$\sum_{i=1}^{n} vr_i^{вих} \le vr_0 \quad (5)$$

$$\sum_{i=1}^{n} PR_i^{вих} \ge PR_0 \quad (6)$$

Objective function (2) models the desire of the management of the IT company to increase the volume of business functions that are transferred to third-party contractors (in order to free up resources and achieve the ability to focus on core activities); criterion (3) is the maximum reduction of the risks of performing the RPi of the i-th business process, and criterion (4) is the desire of the company management to increase the size of the RI of relevant information regarding the infrastructure of the commercial environment (using OLAP, ROLAP technologies and Data Mining systems).

Equations (5), (6) take into account the need for the company to reduce the amount of output costs $vr_i^{вих}$ and the amount of profit $PR_i^{вих}$ according to the i-th business process to some values that are not worse than the acceptable values vr_0 and PR_0.

Solving the task of determining the constituent indicators of the tuple (1) should be carried out with the help of a game simulation model from the "player - inanimate nature" class. Outsourced IT company partners act as "inanimate nature".

This simulation game can be presented in the form of the following table:

Table 1. Game simulation model

IT company strategies	**States-strategies of partners by outsourcing**			
	CC_1	CC_2	…	CC_k
S_1	ψ_{11}	ψ_{12}	…	ψ_{1k}
S_2	ψ_{21}	ψ_{22}	…	ψ_{2k}
…		…		
S_u	ψ_{u1}	ψ_{u2}	…	ψ_{uk}

For the k-th outsourcing company, the following are given:

- set of states-strategies $CC_k = \{CC_1, CC_2, \ldots, CC_k\}$ k-th outsourcing partner;
- purposes of commercial interaction $S_u = \{x_1, x_2, \ldots, x_u\}$ outsourcing process;
- success rate $\psi(x_1, x_2, \ldots, x_u)$ implementation of the rational parameters of game strategies by the k-th player.

The purpose of this game model is to determine the optimal values of the parameters of the tuple (1) as a result of coordinating the preferences of the IT company and outsourcing partners based on the success rate $\psi(x_1, x_2, \ldots, x_u)$.

The initial stage of the game model is to estimate the size of the business functions that are outsourced and the number of projects, based on the effectiveness of outsourcing for all participants. The success rate for the k-th outsourcing partner is to maximize the total profit:

$$\psi_{1k} = \sum_{c=1}^{C} \mathrm{BF}_c \cdot VP_c \to \max_{\mathrm{OS_c}}, \quad (7)$$

where VP – amount of total profit; c is the index of the target segment.

For an IT company, the indicator of success is the reduction in the cost of functions that are transferred to the k-th outsourcer. This condition can be mathematically expressed as follows:

$$\psi_{10} = \frac{\sum_{r=1}^{R} SZ_r \cdot KS_r}{BS} \to \min_{KS_r}, \quad (8)$$

where SZ – amount of IT infrastructure service and maintenance costs; BS is the size of the budget of the entire network of companies involved in outsourcing.

The comprehensive indicator of the success of the entire chain of the outsourcing system is determined by the following characteristic function of the game:

$$\psi_1 = \frac{\sum_{r=1}^{R}\sum_{k=1}^{K}(\mathrm{BF}_{rk} \cdot VP_{rk} - SZ_{rk} \cdot KS_{rk})}{BS} \to \max_{\mathrm{BF}_r, KS_r} \quad (9)$$

Limitations of the model are:

$$\sum_{k=1}^{K} \mathrm{BF}_{rk} \le OT, \ \ r \in R \quad (10)$$

$$\sum_{r=1}^{R} KS_{rk} \le \frac{ER}{RK}, \ k \in K, \quad (11)$$

where OT is the size (in monetary terms) of business functions implemented by the IT company; ER – the size of the target segment (in monetary equivalent); RK - the amount of working capital (in monetary equivalent).

The size of an IT company's investment to cover the cost of its participation in an outsourcing network can vary significantly depending on various factors, such as the size of the company, the scope of the outsourcing contracts, the technology and services provided, etc. Usually, the cost of participating in an outsourcing network includes costs such as payment for outsourcing services, infrastructure and technical support costs, communication and communication costs, staff recruitment and support costs, etc. The exact amount of

investment will depend on specific circumstances and the company's outsourcing strategy. Investments can be calculated for short-term or long-term periods and can be defined as part of the company's budget for IT infrastructure and services.

The size of the IT company's investment to cover the cost of its participation in the outsourcing network should be determined as a result of solving the following non-antagonistic differential game.

The IT company seeks to reduce its investments to cover the cost of its participation in the outsourcing network, which can be mathematically described in the form of an objective function:

$$\psi_{20} = \frac{OK}{\mathrm{RK}} + \frac{\mathrm{RZ}}{VZ} \to \min_{OK,\mathrm{RZ}}, \quad (12)$$

where VZ – the total cost of the logistics system of IT outsourcing.

The k-th outsourcer seeks to minimize the expression:

$$\psi_{2k} = \frac{RZ}{BS} \to \min_{RZ}, \quad (13)$$

which reflects his desire to maximize the amount of his RZ reserve stock in a given proportion.

The efficiency criterion is:

$$\psi_2 = \frac{OK}{RK} + \frac{OZ}{\mathrm{VZ}} - \frac{RZ}{BS} \quad (14)$$

Limitations of the model are:

$$0 \le OK < BS, \quad (15)$$

$$0 \le OZ \le \sum_{r=1}^{R} OT_r. \quad (16)$$

The differential game within the framework of the proposed model, where the leading player is an IT company, has the following form. The IT company selects and communicates its positional strategy to its outsourcers OK' within constraint (15). Based on this, the outsourcer determines the RZ strategy from the condition of minimizing the function (13). The IT company's task is to choose such a strategy that expression (12) assumes a minimum value with the corresponding strategy of the outsourcer.

We will conduct an experiment of choosing strategic advantages taking into account outsourcing partners using the example of "Chameleon Soft" IT company (CHM software, Kharkiv, Ukraine).

The state-strategies of outsourcing partners are: CC_1 – implementation of joint activities based on contractual obligations; CC_2 – creation of a network alliance; SS3 – formation of a consortium.

The output data of the game model for determining strategic advantages are presented in the Table 2.

Table 2. Output data of the game model

Stand up environment	SZ_r, \$		OT, \$	ER, \$	RK, \$	VZ, \$
	Segment 1	Segment 2				
CC_1	1200	1980	21000	61510	18540	1937,5
CC_2	1850	2100	15800	27540	9020	1500
CC_3	1600	2110	11530	55000	17140	1230

In the process of commercial interaction within the technological chain, "Chameleon Soft" company can manipulate the values of the control parameters presented in the Table 3.

Table 3. Control parameters

Stand up environment		BF_r, \$		BS, \$
		Segment 1	Segment 2	
CC_1	S_1	1980	2500	2420
	S_2	2100	3420	3450
	S_3	1445	1610	2840
CC_2	S_1	3200	1980	2985
	S_2	1140	587	3010
	S_3	1010	975	1787
CC_3	S_1	1311	1040	4517
	S_2	980	420	3420
	S_3	1000	1115	2875

As a result of calculations of models (9) - (16) using the MS Excel add-on "Search for solutions", the following possible strategies of the tuple (1) were obtained.

For the condition CC_1:

S_1 = <2100; 2617,5; 3290; 3>;
S_2 = <6611,9; 1145,8; 4123; 2>;
S_3 = <3145,6; 2664,5; 2700; 2>.

For the condition CC_2:

S_1 = <1810; 2181,2; 3219; 2>;
S_2 = <7140; 1984,3; 765,4; 5>;
S_3 = <4213,5; 1579; 1123; 4>.

For the condition CC_3:

S_1 = <1023; 2412; 1540; 4>;
S_2 = <1145,6; 2540; 1002,1; 3>;
S_3 = <1176,7; 2020; 982; 3>.

Payment matrix PM_1 for the volume of transferred commercial operations and the number of projects, determined in accordance with criterion (9), has the form:

$$PM_1 = \begin{pmatrix} 3887{,}6 & 3141 & 532{,}4 \\ 10579 & 4096{,}6 & 469 \\ 3383{,}7 & 4680{,}3 & 865{,}6 \end{pmatrix} \quad (17)$$

Payment matrix PM_2 for the size of the company's investments and the volume of reserve stocks, determined on the basis of calculations according to criterion (12), has the form:

$$PM_2 = \begin{pmatrix} 0{,}480 & 1{,}310 & 1{,}051 \\ 0{,}995 & 0{,}475 & 0{,}670 \\ 0{,}587 & 0{,}295 & 0{,}575 \end{pmatrix} \quad (18)$$

As a result of the fact that the company in the technological chain has an idea about the partners' strategies, using the principle of indicator behavior in case (17), it chooses strategy S2, and in case (18) strategy S1.

The result of the experiment of practical implementation of business process outsourcing modeling of the IT company "Chameleon Soft" can be the use of linear programming to optimize the distribution of resources between different outsourcing projects.
“Chameleon Soft” IT company has several outsourcing projects, each of which requires a different amount of resources (human, technical, etc.) for implementation. The goal is to minimize costs or maximize profits in executing these projects, given resource constraints.

The script for implementing the mathematical model using linear programming based on the Python language and the PuLP library is shown in the Figure 1.

It should be noted that each project has its own resource requirements (presented in the script in Fig. 1 in the form of the resource_requirements dictionary), as well as restrictions on available resources (presented in the script in Fig. 1 in the form of the available_resources dictionary). The goal is to minimize costs, that is, the amount of allocated resources for all projects. After solving the linear programming problem, we get the optimal amount of resources for each project, as well as the total costs (or profit, if we change the function of minimization to maximization).

The implementation of a mathematical model to optimize the allocation of resources between different outsourcing projects is the basis for experimental forecasting of productivity in the IT company's business process outsourcing system.

```python
from pulp import *

# Creating decision variables
projects = ['Project1', 'Project2', 'Project3']
resources = ['Resource1', 'Resource2', 'Resource3']

# Number of available resources
available_resources = {'Resource1': 100, 'Resource2': 150, 'Resource3': 200}

# The amount of resources required for each project
resource_requirements = {'Project1': {'Resource1': 20, 'Resource2': 30, 'Resource3':
                         'Project2': {'Resource1': 15, 'Resource2': 25, 'Resource3':
                         'Project3': {'Resource1': 25, 'Resource2': 35, 'Resource3':

# Creating a variable for optimization
prob = LpProblem("ResourceAllocation", LpMinimize)

# Creating decision variables
project_vars = LpVariable.dicts("Project", projects, lowBound=0, cat='Integer')

# Adding restrictions
for r in resources:
    prob += lpSum([resource_requirements[p][r] * project_vars[p] for p in projects])

# Adding a minimization function (can be changed to maximize profit)
prob += lpSum([project_vars[p] for p in projects])

# Solving the task
prob.solve()

# Outputting the results
for p in projects:
    print(f"{p}: {int(value(project_vars[p]))} units")

print(f"Total cost: ${value(prob.objective)}")
```

Figure 1. Script for implementing a mathematical model to optimize the allocation of resources between various outsourcing projects

We will offer a general technology for building a software script for experimental performance forecasting in an IT company's business process outsourcing system:

1. Data collection. It is necessary to collect relevant data on the outsourcing of business processes of the IT company. This data may include costs, work volumes, lead times, service quality, and other metrics you consider important to performance.
2. Data processing: Refers to data pre-processing, including outlier cleaning, normalization and possible feature engineering.
3. Model selection. That is, you should choose a machine learning model or a statistical approach that corresponds to a specific task. Possible options could be: linear regression, decision trees, random forest, neural networks, etc.
4. Division of data into training and test sets. The data should be divided into a training set, with which the model will be trained, and a test set, on which the performance of the model will be evaluated.
5. Model training. It is necessary to use the training set for training the selected model.
6. Evaluation of the model. As part of model evaluation, a test set should be used to evaluate model performance. Appropriate metrics (such as root mean square error for regression or accuracy for classification) should be used to evaluate model performance.

7. Tuning hyperparameters (if necessary) to achieve better performance.
8. Forecasting the performance of the model in the outsourcing system based on new data.
9. Evaluation of results and improvement by answering the question: how well does the model work? Can the quality of forecasts be improved? If necessary, adjustments should be made to the model and forecasting process.
10. Deployment. After successful testing and configuration, you need to deploy the script to a productive environment for further use.

It should be noted that a separate aspect of productivity forecasting in the business process outsourcing system is the analysis of the company's information security. Issues of ensuring the company's information security are discussed in detail in the study of Pushkar & Hrabovskyi (2019).

Experimental performance forecasting of the overall business process outsourcing system of the IT company "Chameleon Soft" (Figure 2) can be carried out based on the use of a modeling and simulation tool, such as SimPy (Python library for discrete-event simulation).

This example defines some system parameters such as the total number of customers TOTAL_CUSTOMERS, the mean service time SERVICE_TIME_MEAN and its standard deviation SERVICE_TIME_STD. The outsourcing process function models the customer processing process by the outsourcing partner using a random service time with a normal distribution. The customer generator function generates customers that enter the system at fixed intervals.

```
import simpy
import random

# System parameters
TOTAL_CUSTOMERS = 100
SERVICE_TIME_MEAN = 10
SERVICE_TIME_STD = 2

# A function that simulates the stumping of a client by an outsourcing partner
def outsourcing_process(env, customer, service_time_mean, service_time_std):
    yield env.timeout(random.gauss(service_time_mean, service_time_std))
    print(f"Customer {customer} served at time {env.now}")

# Client generator
def customer_generator(env, total_customers, service_time_mean, service_time_std):
    for i in range(total_customers):
        env.process(outsourcing_process(env, i, service_time_mean, service_time_std))
        yield env.timeout(1)  # A new client every unit of time

# Starting point of the program
if __name__ == "__main__":
    env = simpy.Environment()
    env.process(customer_generator(env, TOTAL_CUSTOMERS, SERVICE_TIME_MEAN, SERVICE_T
    env.run()
```

Figure 2. Script for experimental forecasting of the overall performance of the business process outsourcing system of “Chameleon Soft” IT company

In this simple example, the service time of each customer is displayed. Additional event processing and statistics collection such as average customer wait time or average service time can be added to predict system performance.

3.2 Discussion of research results regarding the modelling of outsourcing business processes of IT companies

Within the framework of this study, an improved methodology for modeling the outsourcing of business processes of IT companies is proposed. In the process of creating this methodology, the goals of the IT company's commercial interaction with strategic partners were taken into account. The proposed method is a continuation of the authors' research on the development of economic and mathematical models of decision-making support in the field of information economy.

Probable areas of practical application of the proposed methodology are:

- optimization of business processes (in terms of analysis of current business processes of IT companies and identification of areas that can be optimized with the help of outsourcing);
- strategic planning (for making informed strategic decisions regarding the outsourcing of specific business processes);
- increasing competitiveness (for example, due to cost reduction, quality improvement or increased speed of tasks).

The proposed methodology closes the problematic part of decision-making support in the field of information economy in the aspects of determining the parameters of strategic advantages of IT companies, taking into account outsourcing partners. This is achieved thanks to the game simulation model developed by the authors from the "player - inanimate nature" class. In turn, this game model in its structure has a calculation of the complex indicator of success of the entire chain of the outsourcing system based on the optimization model with the objective function (9) and constraints (10), (11).

The obtained results of the research are adequate within the scope of determining the parameters of strategic advantages of IT companies.

A feature of the proposed methodology in comparison with scientific works (Kiseleva et al., 2021; Hrabovskyi, Kots & Szymczyk, 2022; Yi & Xu, 2013) is the complex use of game simulation modeling tools, optimization modeling, as well as a software script based on the Python language for experimental forecasting of the overall performance of the IT company's business process outsourcing system.

The advantages of the proposed method of modeling the outsourcing of business processes of IT companies are:

- taking into account the strategic advantages of

the IT company regarding the outsourcing of business processes (in the form of a tuple (1));
- determining the value of the IT company's investments to cover the cost of its participation in the outsourcing network, taking into account the desire of the outsourcer to maximize the volume of its reserve stocks (by solving the non-antagonistic differential game (10) - (14));
- availability of a software script for the experimental implementation of this technique (Fig. 1, Fig. 2).

Further areas of research may be:
- risk and security management of the IT outsourcing process. This may include developing data protection strategies, controlling access to information and identifying security threats;
- development of new outsourcing models. That is, research can create new outsourcing models that take into account the specifics of IT companies, such as outsourcing of software development, testing, data processing, etc.;
- analysis of the impact of global trends, such as digital transformation, globalization of labor markets, changes in policy and regulation, on outsourcing strategies of IT companies.

4. CONCLUSION

This paper analyses and formalizes the IT company's interaction with partners. As a result, the goals and limitations of the process of commercial interaction of the IT company with outsourcers were determined. The completed formalization became the basis for the further development of economic and mathematical models of business process outsourcing.

The proposed procedure for choosing the strategic advantages of the IT company, taking into account the wishes of its outsourcing partners. The resulting indicators of the proposed procedure are the number of business functions that are outsourced; the amount of the company's investment (in monetary terms) for compensation for participation in outsourcing; the amount of available resources to ensure the main business processes; the number of jointly implemented business processes. In addition, based on the tools of the non-antagonistic differential game, the value of the IT company's investments to cover the cost of its participation in the outsourcing network is also determined, taking into account the desire of the outsourcer to maximize the volume of its reserve stocks.

An experimental implementation of the proposed economic-mathematical models was carried out in the conditions of the IT company "Chameleon Soft" based on the use of the Python language and the PuLP library.

The developed script allows for the practical implementation of a mathematical model to optimize the distribution of resources between various outsourcing projects. In addition, a script was created for experimental forecasting of the overall productivity of the business process outsourcing system of “Chameleon Soft” IT company. The resulting indicators of this script are the total number of customers, the average service time and its standard deviation.

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