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Improving target budgeting in a corporate performance management system

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Abstract

Currently the portrayal of the procedure for developing management actions during the planning process in the scientific and professional community does not align with the practice of systematic and consistent plan creation supported by an informational analytical system. Alternatively, the non-formalized decision-making activity of the planner, which involves a situational expert approach, becomes a dependency in the planning process. This study is aimed at developing an analytical approach for implementing the plan reconciliation procedure in the process of corporate performance planning. This will increase the utilization of capabilities of the corporate performance management system and formalize the task of generating managerial actions by adjusting targeted budgeting values using mathematical methods. For this purpose, the standard planning process is enhanced by analytical support units, including the algorithm of inverse calculations of individual key performance indicators (KPI) and an advanced module for scenario modeling. The improved model of target budgeting process presented here delivers automated formation of management actions of the budgeting department and subdivision management, guided towards accomplishing strategic goals. The application of inverse calculations provides a mathematical formulation of the task of calculating indicators of planned key values, and the Sense and Respond (SaR) system allows you to supplement the mathematical formulation with weighting coefficients of key performance indicators calculated algorithmically, relying on the manager's decisions rather than expert evaluation. The implementation of the approach we developed will improve the quality of planning by the highest priority criteria of operability, accuracy and adaptability due to the consistency and methodology of budgeting with the use of modern information technology.

Keywords: corporate performance management, budgeting, information model, inverse calculations, mathematical programming

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Introduction

The present-day economy is distinguished by shifts in economic and social models triggered by various crisis phenomena. This has led to greater emphasis on performance measurement, not only throughout the entire economy but also within individual companies and their structural units [1]. This factor stimulated the active development and gradual implementation of corporate performance measurement and management (CPM) systems, which are grounded in a systematic approach and perspective to ensure veracity in the measurement of economic phenomena.

Along the course of CPM systems' progression and utilization various challenges are encountered which hinder achievement of sustainable development and a competitive edge. In modern realities, a company's competitiveness is reliant on the high quality of its economic activity planning, which is assessed using various criteria, primarily accuracy, operability and adaptability. Achieving high scores in these criteria depends on the tools development (systems and rules) and management technology (models and methods). Management methods at the corporate level are crucial to the success of an organization, since they determine the organization's strategy and provide for its implementation [2].

The implementation and creation of CPM systems by companies are proving to be significantly challenging in terms of building and developing effective management tools and technology in the process of target realization. Development of management actions is generally a process of non-formalized activity of the manager based on an expert approach. At the same time, the methods and procedures employed by companies do not facilitate the systematic and methodical establishment of planned key indicators corresponding to the requirements of a unified strategic goal for all of the company's structural units. One reason for these issues is insufficient comprehension that translating corporate strategy into budget planning requires a distinct mathematical foundation for the company's performance management. The issue at hand has been pertinent in recent decades, as evidenced in studies by both national and international authors: Bourne, Maryška, Doucek, Zhang, Mari, Kitova, Bruskin, Odintsov, Nikishova [1, 3–9].

This paper presents an analytical approach to improving the standard budgeting process by designing and executing the inverse calculation algorithm. This algorithm facilitates the formalization and automation of the procedure of producing management actions on partially planned indicators. Additionally, the "Actual–Forecast" module broadens the scenario modeling capabilities. Therefore, the proposed approach streamlines the budgeting process and increases the organization's overall efficiency.

The proposed algorithm of inverse calculations performs the calculation of planned key indicators considering their priority on the basis of a manager's decisions. The algorithm utilizes both the theory of inverse calculations and the SaR methodology. The method of inverse calculations provides the mathematical formulation for calculating planned key value indicators, and the SaR system supplements it with weight coefficients of key primary performance indicators. These coefficients are calculated algorithmically based on manager's decisions, rather than expert evaluation.

The scenario modeling module allows for planning and economic management in parallel with the main budgeting process to develop management actions based on actual data from financial responsibility centers (FRC) and planned key indicators calculated using the algorithm of inverse calculations and SaR, forming budgeting scenarios as a result.

The advantages of the proposed approach are in improving the quality of the planning process across all critical quality criteria, including operability, accuracy and adaptability. Operational efficiency is achieved by reducing the time and labor costs of the planning and economic department (PED) to execute the procedure of managerial actions development. Moreover, the number of adjustments of planned budget calculations by the company's subdivisions is reduced. Increased planning accuracy is provided by methodical and systematic realization of the process, which assumes interaction of the developed analytical blocks, contributing to effective coordination of strategic goals and actions for their achievement. Adaptability of planning is increased by reducing the time for data adjustments for new planning steps and increasing the speed of system adaptation to observed changes in the external environment, since the algorithm includes the condition of approximating the behavior of the decision maker.

1. The concept of corporate performance management

The concept of corporate performance management comprises information technologies and tools, management methods and processes, as well as human resources, and implies periodic measurement and analysis of key indicators to achieve specific goals [6]. The performance measurement system, according to the authors of the fundamental studies in this area, is a set of indicators used to quantitatively assess both internal (efficiency) and external performance (effectiveness) [10, 11].

The literature on corporate performance measurement describes a wide range of approaches to designing performance measurement systems that are categorized based on various factors. According to Bourne [3], two dimensions can be used: the underlying measurement procedure (needs indicators [12, 13], audit indicators [14], model indicators [15]) and the underlying approach in the perspective of the process manager's role (consultant's guide [16], facilitator's guide [11]).

Based on the concept of target management, key performance indicators can be categorized into three types [8]. Primary indicators designed to measure the costs and resource requirements necessary to achieve the set goals – they are stored in the accounting database. Integrated indicators intended to assess the efficiency of individual areas of the company's activities – they are calculated indicators. Complex indicators meant to measure the performance of the whole company and the level of achievement of strategic goals – they are derived indicators.

Target management comprises three levels: strategic, tactical, and operational. The strategic level corresponds to strategic planning carried out by managers, which determines the long-term (more than 3 years) direction of company development. This paper specifically focuses on the planning and economic department (or budgeting department), responsible for target budgeting. Target budgeting involves creating a budget aimed at achieving operational planning goals, which are defined by the values of key performance indicators from the company's strategic map. The budget serves as a tactical plan with a one-year horizon that reflects the outcomes of operational, investment and other activities carried out by the company [17].

Business performance management technology is a sequence with a closed cycle that includes at least four basic blocks, namely modeling, planning, monitoring, and analysis [18].

The modeling block operates outside of the general management cycle, since it is executed incrementally, contingent upon the pace of the organization's advancement and level of adaptation to the external environment. This block includes formulating a strategic map, building goal trees, setting key indicators and modeling business processes.

The planning block is enlarged and in the interpretations of various authors is often divided into several blocks [18]. Thus, according to Odintsov [8], the two stages that follow modeling are forecasting of key performance indicators and calculation of planned values of key performance indicators.

The planning block for key performance indicators is the most vital element of business performance management technology because it systematically provides target values of key performance indicators to the PED and other structural units for coordination of forecasts and formation of the final approved plan for the future period. This block encompasses actual–forecast analysis and calculation of forecast values of indicators during a rolling reporting period. Achievement of the operational goal specified by management for the subsequent period depends on the values of indicators obtained at this stage.

The remaining two components of the business performance management concept, namely monitoring and analysis, involve operational control of the company's financial and economic condition and comprehensive diagnostics of its indicators, correspondingly.

2. Research problem

As a basis for forming assumptions to improve the methodological basis of corporate performance management, we considered a typical solution of the closed-cycle corporate performance management system, which is common in many domestic and international companies. Its example demonstrates the bottlenecks of the algorithm, the solution of which is the focus of this study (*Fig. 1*).

The diagram illustrates the stages of the typical process of financial planning and forecasting the compa-

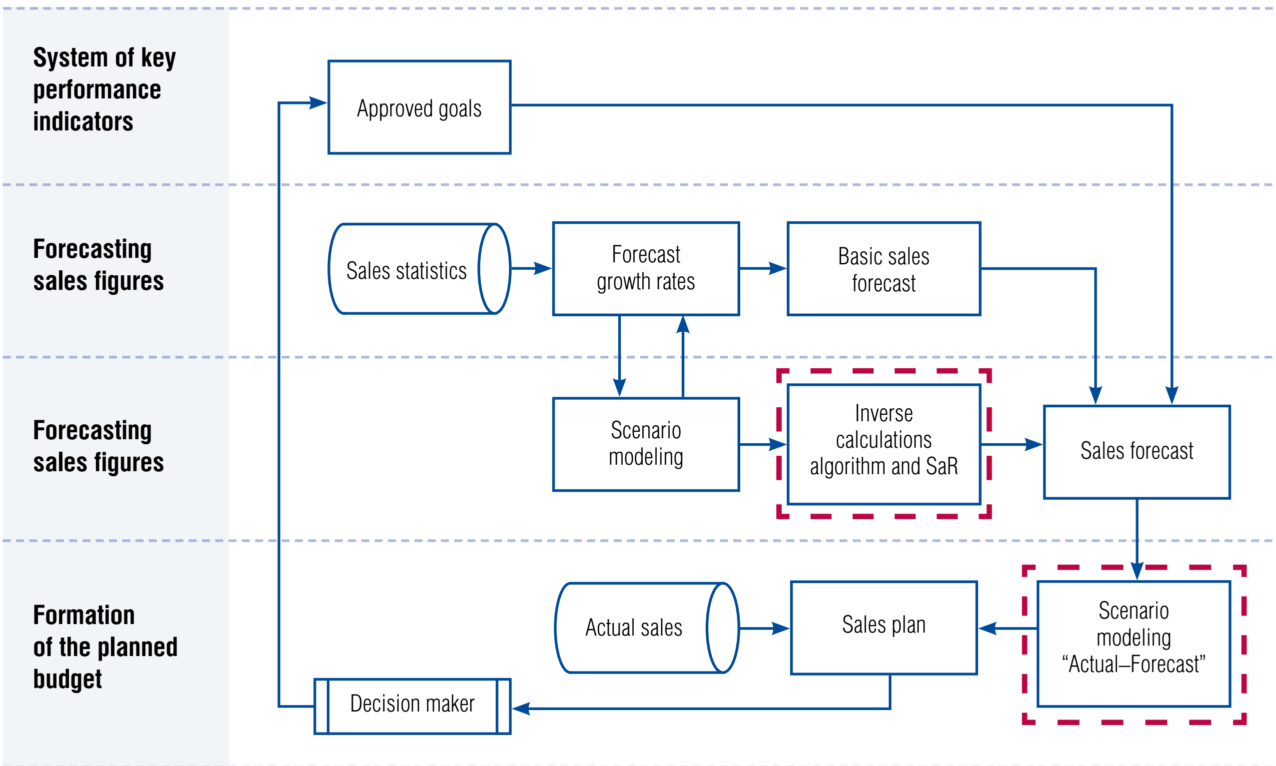

Fig. 1. Scheme of improvement of a typical planning process.

ny's sales performance. It incorporates blocks of analytical approach to determining forecast adjustments and harmonization of planning budgets (highlighted by dashed lines in the scheme).

In the depiction of the typical process of financial planning and forecasting of the company's performance presented here, several obstacles were observed. These "bottlenecks" curtail the potential systemic effects of impact on the process quality when using information system capabilities and analytical methods. Among all possible limitations of the model examined, the following have been identified as the target ones for this research:

1) use of expert assessments both at the stage of planning formation of indicators and at the stage of coordination and formation of the approved planning budget;
2) from the first point follows the lack of mathematical formalization of decision-making tasks regarding management actions on target indicators by adjusting partial indicators;
3) lack of flexibility in terms of analysis of forecasts of responsible persons at the stage of the approved planning budget formation, since scenario analysis does not provide sufficient opportunities for aggregation of various estimates, visions and forecasts for different sales directions, commodity nomenclatures.

The literature indicates that improving the quality of a typical process as a whole should be accomplished through information analytics support in each process zone, ensuring the orchestration of evolving information analytics methods while harmonizing corporate performance management with business process management [2, 19–21].

Systemic quality improvement in each zone of the process is achieved through various factors. According to Bruskin [7], the combined use of trend, information and scenario methods of predictive modeling can improve the quality of the planning process. In the planning zone – through the preparation of sales statistics based on actuals and recalculation of planned indicators by the incremental method, considering the adjustment of the rolling trend by expert evaluation. In the forecasting zone – through scenario analysis by using OLAP tools. The paper by Kitova [6] presents an attempt to overcome subjectivity and formalize the procedure of selecting multiple options for the company's strategic development according to various factors (KPIs, strategic initiatives, investment allocation) by developing a target planning model and an algorithm for selecting the optimal solution. The algorithm for selecting alternatives involves analyzing the shareholder value of the company and comparative assessment using the method of hierarchy analysis. In her work [9], Nikishova describes the use of artificial intelligence technologies to overcome information asymmetry in decision-making by the board of directors. Although the results are aimed at the strategic level of management, their study is useful for the implementation of decisions at the tactical level, because the author offers an approach of analytical support of the process of developing management actions performed in parallel with the main process, not replacing the decisive role of the board of directors. The applicability of the concept of inverse calculations in the task of corporate performance management was considered by Odintsov [8]. At the same time, the determination of the weights of partial indicators forming the integral key indicator in the author's work is carried out by means of expert methods.

The papers of some international authors are directed at improving the quality of the planning process, primarily its operability, by developing complex models and systems that combine business and technical aspects of the process. Thus, Maryška and Doucek [1] describe the REMONA model, the advantages of which are a reference model of CPM and BI design, definition of methodologies and models accompanying the system, definition of a system of indicators, measurements, implementation of the solution in the company. Prilianti and Hikmat [22] developed a platform called the Integrated performance management system (IPMS), which can translate the company's vision to a lower level of management, improving the company's performance by identifying the relationships between variables, evaluation methods and improvement priorities.

In addition, examples of analytical support for the planning process using artificial intelligence have been presented in international literature. Zhang [4] in his paper applied principal component analysis and artificial neural network analysis to build the RMT-BP model for predicting the performance indicators of companies. Various financial and non-financial indicators characterizing the performance of companies are used as input parameters, and the corresponding weights of indicators are determined by the hierarchy analysis method. Mari et al. [5] show how key indicators can be efficiently determined using linear constraints, and then how managerial actions can be computed using mathematical programming methods.

Despite the significant advancement in research on CPM technologies and their supporting techniques, the literature still has open niches to explore and improve the planning process. The cases of artificial intelligence used in the planning process discussed in the literature are based on a "black box" model, which limits their applicability to business problems that require transparency, clarity and controllability by management decision makers. The usefulness of machine learning depends on many factors that have not been sufficiently studied yet, such as the type of problem, the stage of decision-making and the technology used [23]. At the same time, the fragmented consideration of different methods contradicts the authors' theses of exploratory and review papers about the necessity to harmonize methods in their interaction and with the peculiarities of the management process. As a result of analyzing scientific studies and the practical experience of companies, it can be concluded that scientists face the problem of creating effective approaches to the practical application of modern analytical methods to improve the quality of managerial decision-making in business.

The procedure of coordinating plans to match the company's strategy with the existing opportunities, considering internal and external constraints, is a labor-intensive but necessary task. This procedure is performed through step-by-step adjustment of target values of indicators. At each stage of adjustment, the current values of strategic indicators are reviewed and analyzed by the company's management. Following the results of the analysis, management determines operational goals, which are a compromise between the actual situation of the business unit and the company's strategic plan. Operational goals serve as a starting point for calculating planned key performance indicators for future periods. It is worth noting that this calculation is performed with consideration of the constraints set by the various business units involved in the budgeting process. For example, the forecasting department sets a target profitability limit based on the forecast, while the sales department sets a different limit for the indicator, given the volume of the company's resources. Therefore, the sales budget is supplemented with the elements: target value, forecast value, minimum and maximum values [24]. These elements are used as constraints in the inverse calculations of the values of planned key indicators.

Given the exceptional importance of the planning stage, the tasks related to the development of the theoretical and methodological basis for the procedure of plan coordination require high attention of researchers and practitioners. That is why this study is aimed at developing an analytical approach to the realization of the procedure of plan coordination in the process of corporate planning of indicators which will allow one to expand the use of CPM-system capabilities and provide mathematical formalization of the task of developing managerial actions when adjusting the values of planned key indicators.

Following the results of the previous authors, this paper proposes to supplement the typical planning process with the blocks "Inverse calculations algorithm and SaR," all of which allows one to formalize and automate the procedure of generating managerial actions on partial planning indicators, and "Scenario modeling Actual–Forecast," which provides extended capabilities regarding scenario modeling, multivariate analysis and modeling of PED plans in parallel with the main budgeting model.

The advantages of the proposed approach consist in improving the quality of the planning process by all priority quality criteria: operability, accuracy, adaptability. Operational efficiency is achieved by reducing the time and labor costs of the PED to execute the procedure of generating management actions, since the manager in this case has support in the form of a calculation algorithm, advanced tools of computer modeling of plans. Furthermore, the number of subsequent adjustments of planned values by the company's departments to the budget is reduced. Improving the accuracy of planning is achieved by methodical and systematic realization of the process, which implies interaction of the developed analytical blocks contributing to the effective coordination of strategic goals and actions to achieve them. The adaptability of planning is increased by reducing the time for data adjustments for new planning steps and increasing the speed of adaptation of the system to the observed changes in the external environment, since the algorithm includes the condition of approximating the behavior of the decision maker.

3. Budgeting process model

3.1. Development of the target management toolkit

Using the methods and tools of business process modeling, diagrams reflecting the essence of the proposed approach have been constructed. The diagrams below describe the process of so-called goal realization, which involves the development of a toolkit (system of goals and indicators, procedures for forming prescriptions, rules for adjusting indicators) and technology (chain of procedures and operations) of target management.

The first diagram (*Fig. 2*) shows the key changes in the proposed modification of the budgeting process model relative to the typical solution, which consist in the application of SaR methodology and the theory of inverse calculations to formalize and automate the procedure of managerial decision-making in the budgeting process.

The stage of the process preceding the algorithm of calculations in the model is the construction of hierarchical structures of goals. Work on the formation of the "goals-indicators" system is performed on the side of business analysts. Based on planning practice, the construction of goal structures covering various aspects of the company's activities and subsequent reproduction of their indicators require the use of more general structures (network structures) that do not have the property of strict node hierarchy. Nevertheless, such structures are of limited use for formal processing, since they generate significant difficulties and ambiguity in the interpretation of the results. Therefore, in the absence of explicit restrictions, the network structures of "goals-indicators" are transformed into hierarchical structures. The procedure of formal processing of the hierarchical structure is supported by the software tools of the CPM-system, where indicator measurements are presented in the form of hierarchies.

The first step in the algorithm of formal processing of indicators is the scaling of measurement results. Differences in the measurement scales of individual partial indicators that determine the level of target indicators' achievability impose restrictions on their joint processing. Thus, the model solves the problem of converting individual indicators to a single measurement scale and forming a general integral indicator.

The scaling procedure includes preliminary normalization of initial data and calculation of individual weights of partial indicators. Initial data are transferred from the database of the information system, and the results of calculations are stored in a separate data warehouse linked to the SaR system.

3.2. The mathematical background of inverse calculations and SaR

At the initial stage of calculations, the values of jointly processed partial indicators are normalized to a unified measurement scale to obtain the target dimensionless integral indicator. The range from 0 to 1 inclusively is taken as the normalization interval to simplify data processing. For calculation of the integral indicator, an additive form of convolution is used, which is the sum of weighted values of unidirectional partial indicators. Normalization of the values of partial indicators to a unified scale is carried out by the method of linear data normalization.

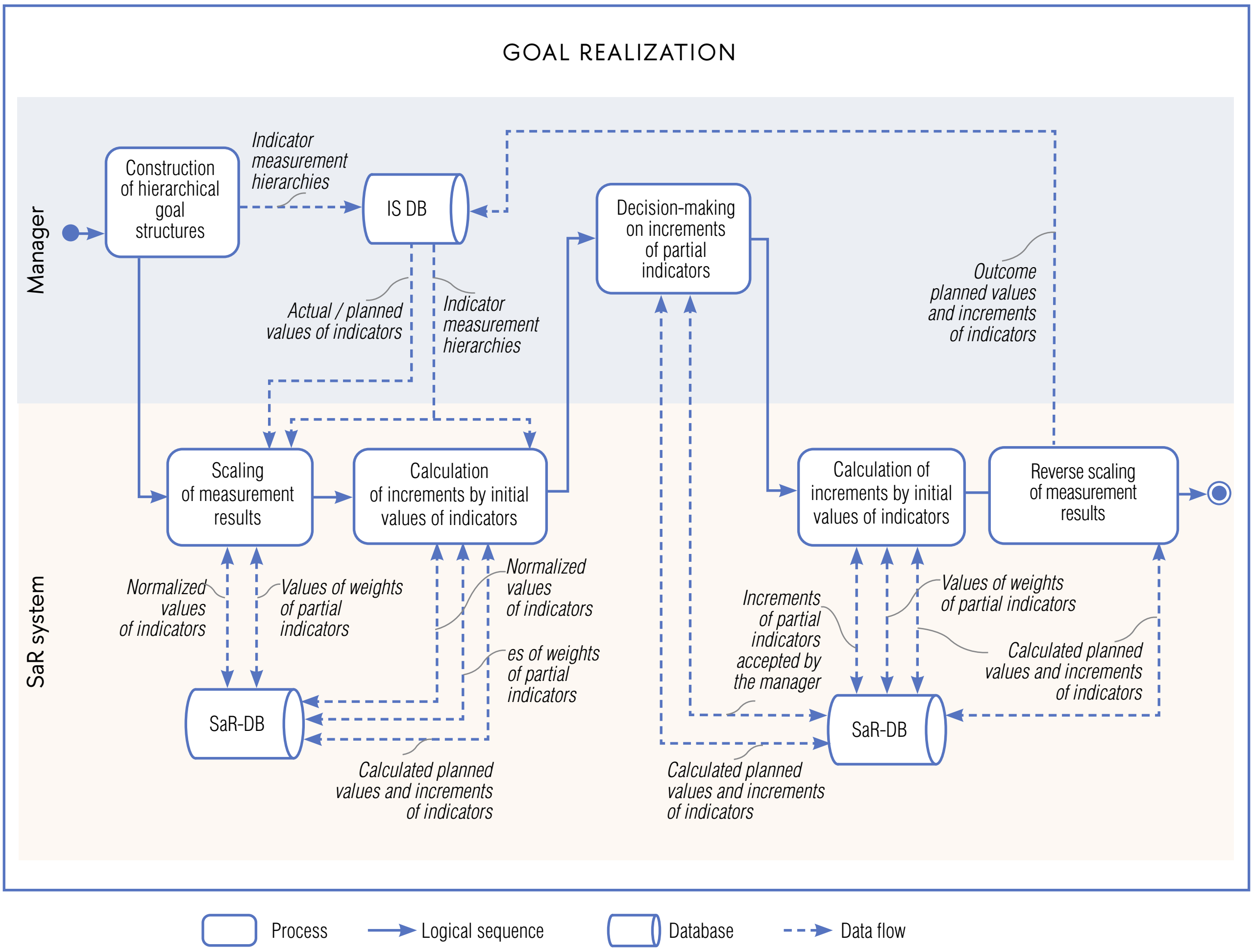

Fig. 2. Scheme of operation of the inverse calculations algorithm and SaR.

The values of partial indicators in the calculation of the integral indicator should be unidirectional: either increasing or decreasing. In addition, the values of a certain partial indicator should uniformly fill the interval defined by the empirical range of its values. If the data contain outliers, normalization is carried out using calculations of the mean and variance.

According to the approach, each partial indicator is described by a real number $h_i(x, u) \in [0, 1]$, defining the value of action u in state x. The array of numbers $h(x, u)$ can consist of q possible indicators, so that $h(x, u) = [h_1(x, u), ..., h_q(x, u)]$. The labeled array induces only a partial order on the control actions in the case of multiple indicators. The total order is associated with the partial order through the manager's actions. This is equal to associating the weights of the relative importance of the indicators.

The next step is to reevaluate the weights of partial indicators in the calculation of the integral target indicator. Since the process of calculating the weights is assumed to be cyclic and continuous, at this step the decisions made in the previous cycle are considered, and at the zero point the system uses predetermined values of weights with uniform distribution. Thus, in case of rejection of the management actions proposed by SaR, the system revises the weights of partial indicators based on the management actions actually chosen by the manager. Then, using these values, the system calculates new weights to be applied in new iteration $(t+1)$.

Beginning at iteration t a sliding window of length k is defined such that $t - k + 1 \geqslant 0$. The values of the weights $w(t+1)$ depend on the values of the system state variable at iteration τ, denoted as $x(\tau)$, the values of the optimal managerial actions computed by the system at iteration τ, denoted as $u(\tau)$, the values of the managerial actions actually chosen by the manager at iteration τ, after rejecting $u(\tau)$, denoted as $u'(\tau)$, for $\tau \in [t-k+1, t] = \{t-k+1, ..., t\}$.

For each past iteration τ, the actions actually chosen by the manager in iteration τ $(u'(\tau))$ should be preferred over the actions computed by the system $(u(\tau))$, depending on the optimization criterion. This condition ensures that the new weights are consistent with the knowledge accumulated by the system during the sliding window. This condition is formulated mathematically as follows (considered the case of maximization of the integral indicator):

$$w(t+1)(h(x(\tau), u'(\tau)) - h(x(\tau), u(\tau))) \geqslant \delta \qquad (1)$$

where the value of δ must be small, but not zero.

An additional constraint is imposed on the difference between the new values of weights $w(t+1)$ and the values of weights at the current iteration $w(t)$. The difference between these values must be minimal to avoid fluctuations of weights that interfere with the convergence of the algorithm. This condition is formulated mathematically as follows:

$$W(t) = \sum_{\tau=t-k+1}^{t} \sum_{i=1}^{q} \left| w_i(t+1) - w_i(\tau) \right|. \qquad (2)$$

The mentioned features of the process of weighting partial indicators can be defined in terms of linear constraints in the MILP problem. The optimization problem, except for the additional conditions of a certain integral indicator, in this case will be given the form:

$$Z(\delta, w) = \delta + W(t) \rightarrow \min_{\delta,\, w(t+1)}, \qquad (3)$$

subject to:

$$\begin{cases} w(t+1)\big(h(x(\tau), u'(\tau)) - h(x(\tau), u(\tau))\big) - \delta \geq 0, \\ \delta \geq 0{,}001, \\ AbsVal\big(W(t), w_i(t+1), w_i(\tau)\big), \end{cases}$$

where δ, $w(t+1)$ are solving variables,
$\tau \in [t-k+1, t]$, $i \in [1, q]$.

After calculating the weights of partial indicators which form the function of the target integral indicator, there follows the phase of calculating the increments of the arguments of the function using the procedure of inverse calculations.

The target performance indicator is specified as a function $y = f(x_1(w_1), ..., x_q(w_q))$. The function uses weighting coefficients (priorities) received at the previous stage; their sum is always equal to one. The target function and its arguments may require positive increment or negative increment depending on the target settings. The sign of the increment in the target function in the system of equations depends on the pattern of change in the function y.

A solution method with the help of individual coefficients is used as a method of inverse calculations. According to this method, the manager's conditions for changing the values of partial performance indicators are expressed by specifying additional coefficients (k_q) when determining the required arguments of the target function:

$$x_q + \Delta x_q = k_q x_q. \qquad (4)$$

The sign of the increment of the arguments determines the values of the individual coefficients, which are calculated for each argument of the function: if the increment is positive, the individual coefficient is multiplied by its argument $(k_q x_q)$; if it is negative, the argument is divided by the individual coefficient $\left(\frac{x_q}{k_q}\right)$.

The number of additional equations in the system depends on the number of function arguments: the number of function arguments q will correspond to the number of additional equations $q - 1$. Constraints on the values of individual coefficients k_q are set up based on their semantics.

Therefore, the problem of calculating increments of partial indicators from the known increment of the target indicator in the case with three arguments and positive increment of both the target function and the arguments is described by a system of equations:

$$\begin{cases} y+\Delta y = f\left(k_1x_1, k_2x_2, k_3x_3\right), \\ \dfrac{k_1x_1 - x_1}{k_2x_2 - x_2 + k_3x_3 - x_3} = \dfrac{w_1}{w_2 + w_3}, \\ \dfrac{k_2x_2 - x_2}{k_1x_1 - x_1 + k_3x_3 - x_3} = \dfrac{w_2}{w_1 + w_3}. \end{cases} \quad (5)$$

Solving this system of equations regarding k_1, k_2 and k_3, it is possible to obtain the values of the incre-

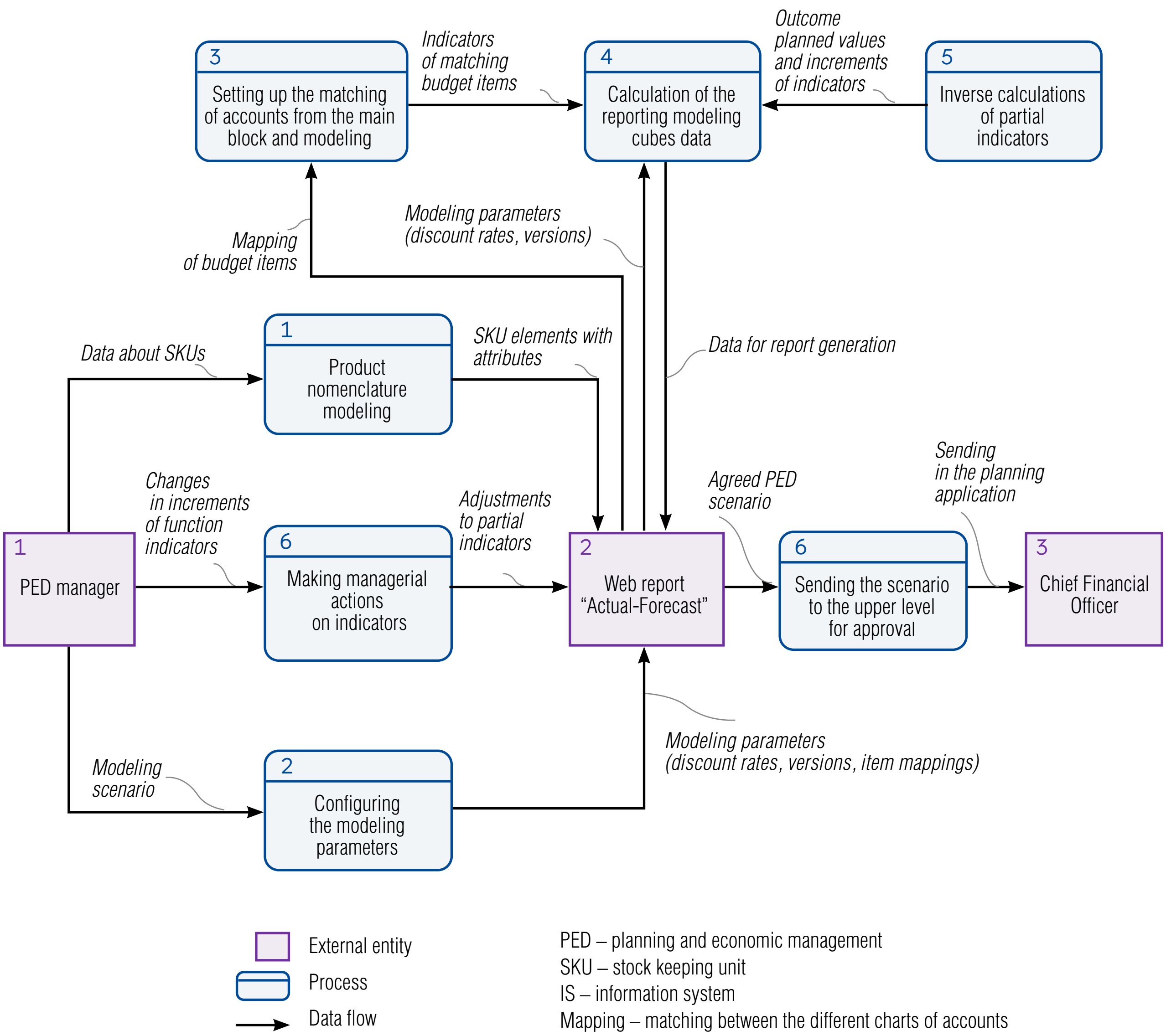

Fig. 3. Data flow diagram of the scenario modeling block "Actual–Forecast"

ments of the target function arguments x_1, x_2 and x_3. The results of the solution must satisfy the condition: $k_1, k_2, k_3 \geqslant 1$.

At the next steps of the target realization algorithm, the manager receives information about the calculated increments of partial indicators and decides either to initiate the action proposed by the system or to initiate another action. The decision made by the manager corresponds to the optimal solution at the current iteration and will be used by the system in a new iteration of calculations when updating the weights. Since data normalization was performed before the calculations, the next step of the algorithm involves a reverse scaling procedure using the inverse scale converter algorithm.

Indicators of the company's activity are the factors which form the basis for the formation of strategic indicators of the company's activity determined by the management. The growth of some indicators can lead to the growth of strategic indicators, and others to their reduction. Thus, using dynamic programming it is possible to obtain a balanced system of strategic indicators of the company's development, satisfying the requirements of management by changing the values of indicators of the company's activity. As a result, based on the strategic indicators of the company's activity, it is possible to determine its corporate performance as a convolution of these indicators.

3.3. Development of target management technology

The second part of the target realization process, the development of target management technology, is described in the context of information flow in the corporate performance management system. For this purpose, the data flow diagram is used, which demonstrates data flows between individual operations of the specialized block of scenario modeling "Actual–Forecast" included in the basic model of the company's activity (*Fig. 3*). This block allows the PED to develop management actions based on real data from the FRCs in parallel with the main budgeting process, forming budget scenarios as a result.

As the starting point of the budget modeling process for the next planning period, the PED manager's actions are considered to analyze and form the budget scenario in the interactive reporting form "Actual–Forecast" after entering actual and planned data for separate FRCs into the system. The outlined actions of the manager include: modeling of the nomenclature and relevant attributes of the products to be considered in the scenario; setting of modeling parameters – specifying the appropriate values of the discount rate, selecting the current version, specifying the matching between different charts of accounts to be analyzed and reported.

Both as the data in the reporting form is updated and at the manager's direct request (function launch), the rules in the corresponding multidimensional cubes of the system perform calculations of indicator values and output to the reporting form. The procedure of inverse calculations to update the calculation rules for launching requires a decision from the manager. The process of generating managerial actions on indicators means choosing between the values of adjustments suggested by the system and manual input of adjustments.

The output of the process produces a plan approved by the PED manager and is passed by the system procedures to the top level of approval – the Chief Financial Officer.

Conclusion

This paper presents an improved model of the target budgeting process, which enables automated generation of management actions of the budgeting department and subdivisions' management towards achieving strategic goals. In contrast to the findings of previous research, in addition to the parallel assessment of the company's state, the generation of management actions using artificial intelligence and rolling planning, the budgeting process model in this study includes a modeling block and aims to reduce the frequency of adjustments to operational goals that are set at the beginning of the planning period.

The second aspect of the theoretical contribution of the paper is the development of a methodological framework of inverse calculations in support of SaR methodology in the budgeting process of corporate performance management. The application of inverse calculations provides a mathematical statement of the problem of calculating indicators of planned key values, and the SaR system allows us to supplement the mathematical statement with weighting coefficients of primary performance indicators calculated algorithmically based on the manager's decisions instead of expert evaluation.

Applying the proposed approach in practice allows us to significantly reduce the value of transaction costs emerging at the stage of numerous adjustments of versions formed by the FRCs and scenarios formed by the PED from planning imprecisions and labor costs to identify and correct them. In addition, the approach we developed ensures improvement of the real quality of operational planning by the highest priority criteria of operability, accuracy and adaptability of planning due to systematic and methodical budgeting with the involvement of modern information technologies.

The directions of further research involve the integration of the developed information model of budgeting in the process of determining a comprehensive indicator characterizing the corporate performance of the company using the method of dynamic programming to calculate the strategic performance of the company based on the convolution of indicators.

Furthermore, as an area of future research on the problematic being studied, the design of the information infrastructure of the corporate performance management system is addressed to improve the efficiency of the development of managerial actions in the implementation of the company's strategic goals. Based on the methodology of Design Science Research, the blocks of analytical support are considered as an artifact that is described by designing information-logical schemes and evaluated through experimental testing of the approach in the work environment. ■

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