BI Capabilities in a Digital Enterprise Business Process Management System

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Abstract. The paper is devoted to the study of business intelligence capabilities in the business process management system during the digital transformation of an enterprise. Information flows digitization of relevant processes is presented from the standpoint of a systematic approach based on functional and temporal decomposition. This approach to the digitized data management contributes to increasing the efficiency of designing a digital business and IT enterprise architecture.

Keywords: Digital economy · Architecture of system · Architecture description

1 Introduction

The "breakeven" of investments in the Business Process Management System (BPMS) arises with the beginning of the enterprise business processes system measurement with a view to their strategic improvement. This solution is especially important during the period of digital business transformation. Therefore, the task of developing analytical indicators of a business processes model is one of the most important and complex in the development of a BPMS.

The development of the Business Process Management System can be divided into three main stages [9]:

- "Organization" – the goal is to increase the coherence of actions of participants in business processes on the basis of rules for interaction and standardization of material and information flows;
- "Automation" – the goal is to reduce the complexity of performing routine operations and to increase the pace of work execution on the basis of the program prescription for unified actions;
- "Controlling and motivation" – the goal is to improve the quality of performance of tasks based on monitoring the parameters of the process, timely analysis of the causes and prevention of risks of their deviation from the target standards, as well as quality improvement based on the formation of motivational feedback and increasing the satisfaction of participants and consumers of the business-process.

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In the general case, the "analytics" can be considered as a process and the result of a logical analysis of the subject domain by means of its sequential decomposition in terms of solving managerial tasks.

If the activity of the enterprise (hierarchical system of business processes) acts as the object of analysis, then in this case the analytics can be presented with a set of data for solving managerial problems at the strategic, tactical and operational levels (decomposition).

2 Business Process System

2.1 Levels of Control (Decomposition)

A competence center for working with analytics in the organizational structure can be the following posts [1]:

- CDO (Chief Data Officer) – Director for the development and implementation of data management strategies, standardization of management technologies and data management;
- CAO (Chief Analytics Officer) – director for strategic analysis and use of (large) data for analytical forecasting and commercial activities.

Information service working with analytics is provided through BI-systems (Business Intelligence) – information systems of business analysis, combining analytical, monitoring and reporting tools to support the adoption of managerial decisions. BI tasks fall into three categories:

- exploring and analyzing data;
- monitoring ongoing data flows through dashboards;
- communicating insights to others, both inside and outside a company [6].

Technical means for visualization of analytical information are performance dashboards, which can be related by content and purpose to the following types [5]:

- strategic – "control" the achievement of strategic goals;
- tactical – "analysis" of the implementation of processes and projects at the unit level;
- operational – "monitoring" of the basic operations at the level of employees.

In accordance with the methodology of functional modeling [11], the "Activity" of an enterprise is sequentially decomposed into "Processes" (business functions) and then to "Operations".

Levels of control (decomposition) by analogy with the parameters of the optimization task have the following functions:

- the strategic level: "Activity" is a kind of "abstract" model for planning the vector of the goal and determining the priorities for the development of the business system;
- the tactical level: "Processes" (business functions) are designed to ensure the balance of the system (based on functional budgets) in the development process, as

well as for timely response and adaptation to the critical changes in the external and internal environment of the enterprise;
- the level of "Operations" is a "real" management object (based on strategic objective function and tactical budget constraints), where parameters of actions are measured and improved.

2.2 The Level of Decomposition "Activity"

The level of decomposition "Activity" is characterized by the following objectives:

- business strategy is ensuring the sustainable operation of the enterprise based on the preservation and development of competitive advantages in the long-term perspective;
- center of investments (by financial structure of the enterprise) is an achievement of targeted profitability of investments on the basis of an investment portfolio formation taking into account profitability, risks and the volume of the enclosed capital;
- profit center (by financial structure of the enterprise) is an achievement of the target profit on the basis of positioning "price-quality".

The strategic vector of the business goal can be represented in the basic strategic coordinates of Michael Porter and the "price-quality" coordinates of the corresponding positioning strategy (as it was proposed in [8]):

- cost leadership (quantitative growth due to business scaling);
- differentiation (qualitative development based on the best value proposition);
- focusing (concentration on a relatively narrow segment of consumers on the basis of service leadership in relations with the client).

It is assumed that in a "stable" state of the market the "best quality" has the maximum price (and vice versa). The choice of the direction of the strategic target vector (in these coordinates) is a managerial decision that can be adopted based on the results of the SWOT analysis (Strengths, Weakness, Opportunities, Threats) of internal environment of the enterprise, while:

- factors of the external environment are characterized by the parameters of the market situation, such as: supply-demand ratio; stability and cyclical state; development trends; level of business activity; level of commercial risk; intensity of competition;
- factors of the internal environment are characterized by functional components of the business strategy of the enterprise, including: commodity-market (width and depth of product supply, product quality level, demand level and coverage ratio of sales markets); technological (level of progressiveness and efficiency of technologies, capacity of production equipment, duration of the production cycle); resource (level of reserves and quality of raw materials, flexibility of relationships with suppliers); social (efficiency of organizational and role structure, level of specialization and qualification of personnel, involvement in decision-making, division of values and corporate culture of behavior, payment and economic stimulation of

labor); financial and investment (level of current assets, investment directions and level of investments, sources of financing, repayment period and cost of borrowed capital); management (level of maturity of project management and business processes, status and effectiveness of strategic, tactical and operational management).

Based on the internal environment factors, the Key Success Factors (KFU) are determined, with the help of which the Vision of the enterprise is digitized and the objectives of the strategic map are formulated.

2.3 Model of the Theory of Constraints

Financial analytics (the data and the result of a decision) of strategic level management tasks can be represented by a Theory of Constraints (TOC) model, which includes the following parameters [4]:

- T – pass (marginal profit = income – variable costs);
- I – investment costs in stocks (raw materials and infrastructure capacities);
- OE – operating expenses for maintenance (regular);
- NP = (T – OE) – net profit (activities for the reporting period);
- ROI = (NP/I) – return on invested capital.

The business strategy can be formalized with help of the Strategic Goals and Portfolio of Development Projects, while the "Finance" prospect is a consequence of the "Clients" perspective, the reasons for which are the "Processes" and "Personnel" perspectives.

The causal logic of the strategic goal map model has the following TOC justification [10]:

- "profitable" strategic goals (financial perspective) are achieved by the level of the formed demand of the consumer segment and the capacity of a certain type of products (client perspective), while:
  - the formed demand and capacity of the trade channel ensure the target sales volume and duration of the commercial transaction period, which in turn determines the requirements for the capacity and duration of the operational cycle of business processes (process perspective);
  - the volume of sales depends on the target level of margins (margins), which determines the requirements for the quality of business processes (process perspective);
- "expenditure" strategic goals (financial perspective) are due to the volume of investments in the reserves of the capacity of the business process infrastructure and the regular costs of ensuring the readiness and quality of the business process, while:
  - requirements for ensuring the availability of infrastructure and the quality of business processes determine the requirements for the qualification of personnel (client perspective).

The second component of the business strategy is the Portfolio of development projects, when forming the composition and time horizon of its realization (sequence

and priorities for achieving strategic goals), it is expedient to take into account 2 criteria [7]:

- "breakeven": long-term revenues from achieving goals - "Clients" should cover the costs of achieving the goals in the perspectives of "Processes" and "Personnel";
- "profitability" (in TOS-parameters): return on investment of the enterprise's activities "after" the implementation of the Project Portfolio should be no less than "before" its implementation.

Thus, the factors of the external and internal environment of the enterprise's activities can be assigned to and monitored by the strategic analysts (indicators) at the strategic level, and a qualitative (ordinal) scale of measurement of their aggregated values can be used.

2.4 The "Process" (Business Function) Level of Decomposition

Practically, the most difficult is the transition from the strategic to the operational level of management; it involves not only functional but also temporary decomposition. To implement this transition, the tactical level of budget management is used, which is a kind of "control amount" of the accuracy of translating the strategic objectives of "Activity" into the indicators of "Operations" through functional budgets [9].

In the general case, functional budgets do not fully correspond to the standard functional processes (business functions) of the enterprise, so a direct estimate of the cost of processes can be carried out based on the principles of the ABC-costing method (by operating the calculation of indirect costs) by means of quantitative and temporary drivers coefficients) of transferring the cost of labor and infrastructural resources to operations of business processes and even to enterprise products [2].

The level of decomposition "Process (business function)" is characterized by the following targets:

- functional strategy is creating opportunities to achieve goals of the business strategy based on the effective performance of business functions and the resulting interaction in the system of business processes of the enterprise;
- the revenue center (the financial structure of an enterprise) is the achievement of target sales values based on stimulating the demand of consumer segments, ensuring the availability of products at a certain price and quantity;
- the center of costs (by the financial structure of an enterprise) is the achievement of target expenditures based on the effective use of resources and the reduction of losses.

Thus, the articles of income and expenditure of functional budgets and financial responsibility centers of an enterprise can be referred to the management analytics (indicators) of the tactical level.

2.5 The "Operation" Level of Decomposition

The following targets are typical for the "Operation" level of decomposition:

- the operational strategy is to create opportunities to achieve the goals of the business strategy based on the effective use of enterprise resources in the development, production and sales chain of competitive goods and services;
- effectiveness is to achieve target values by the quantity and quality of development, production and sales of goods and services;
- operativeness is to achieve target values for the duration of the operational cycle of development, production and sales of goods and services;
- resource intensity is to achieve target values for the cost of performing all operations necessary for the development, production and sales of goods and services.

The operational target vector can be represented in the "efficiency-productivity" coordinates, where:

1. Efficiency = Effectiveness/Resource intensity.
2. Productivity = Effectiveness/Operativeness.

The operational strategy is formulated with respect to the value stream, which is a set of completed docked actions that together create some products that have customer value for the client [3]. As part of the implementation of the operational strategy, it is advisable to present the value stream with a model at the level of the corresponding functional processes operations.

Operational indicators (quality) can be grouped by types:

- effectiveness (productiveness) is the compliance with the requirements and expectations of consumers;
- operativeness is the duration and timeliness of completion of operations;
- resource intensity is the cost of maintenance of readiness and performance of operations;
- controllability is the level of perfection of current management and improvement opportunities of an operational chain of value.

Indicators of the efficiency, resource intensity and manageability of business process operations can be assigned to and monitored by the operational analytics (indicators) of the operational level, and qualitative and quantitative scales of measurement of their values can be used.

3 Results and Discussion

An example of analytical indicators for different levels of management is shown in Table 1, while at the operational level the accomplishment of tasks for processes and project activities is assessed separately. Therefore, it is possible to identify the main indicators for levels to assess the effectiveness of the enterprise with the applied approach.

Table 1. Analytical indicators for different levels

Measurement (group)	Strategy (KSF)	Tactics (CFR)	Processes	Projects
Effectiveness	Market share	Marginal profit	Defect level	Degree of customer requirements fulfillment
Operativeness	Duration of the operating cycle	Period of accounts receivable	Order lead time	Share of timely completed projects
Resource intensity	Investments in customers' training	Cost of production	The cost of automated workplaces	Degree of compliance with budget constraints
Efficiency	Return on investments	Profitability by customers	Sales conversion	Profitability of the project
Productivity	Workforce productivity	Debt turnover	The proportion of time losses in the working cycle	Payback period
Dynamics	Growth rates in sales	Moving average price	Dynamics of inconsistencies	Dynamics of innovations

Business process management is one of the key tasks in a company development. Contrasting approaches to the description of business processes of companies is one of the main problems of modern business intelligence. The management system allows to use different approaches for different processes within one organization, not opposing them to each other. To identify the factors of systemic efficiency in further research, it is necessary to identify key success factors in each subsystem and determine indicators for their condition.

4 Conclusion

The business intelligence opportunities in the digital enterprise business process management system was reviewed. From the position of the system approach, digitized data management was considered on the basis of functional and time decomposition. The key performance indicators of the digital company were described and correlated with the main levels of the digital enterprise management.

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