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«SIMULATION OF BALANCED SCORECARD FOR FORECASTING CYBERNETIC COST COLLABORATION OF ENGINEERING ENTERPRISES»

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Problem statement

• The problem of the research is to determine the approach to simulation modeling of the interdependence between the level of production efficiency of mechanical engineering enterprises (the resource potential of cybernetic cost collaboration) and the factors (robotic functions) of the balanced scorecard projections.

• The purpose of the work is to elaborate a simulation forecasting model of the resource potential of the cybernetic cost collaboration for further development of a simulation technology for adapting the balanced scorecard to the convergence of the processes of functioning of mechatronic robotic factors.
Solution methods

The research methods are criteria-based analysis (the method developed by the author), the Delphi method, the method of forecasting scenario, the analysis of causal relationships, empirical analysis, raster electronic mechatronic modeling of cybernetic contact zones using JSM-6490LV, elements of the analysis of ERP and PDM solutions.

The simulation model of the resource potential of cybernetic cost collaboration of mechanical engineering enterprises:

\[ I_{CC_{collab}} = R_{S_{ROP}}^{CC} + \alpha_1 R_{S_{EPO}}^{CC} + \alpha_2 R_{S_{MI}}^{CC} + \alpha_3 R_{S_{CEM}}^{CC} + \alpha_4 R_{S_{ESP}}^{CC} + \epsilon \]

- \( I_{CC_{collab}} \) — Indicator of the resource potential of cybernetic cost collaboration;
- \( \alpha_1, \alpha_4 \) — Regression equation ratios (parameters-ranks of cybernetic costs);
- \( R_{S_{ROP}}^{CC} \) — Resource of predominance of high-quality product sales by the main nomenclature group;
- \( R_{S_{EPO}}^{CC} \) — Resource of predominance of expensive production objects;
- \( R_{S_{MI}}^{CC} \) — Resource of motivational instruments for improving production efficiency;
- \( R_{S_{CEM}}^{CC} \) — Combinations of electronic modules for mutually beneficial collaboration;
- \( R_{S_{ESP}}^{CC} \) — Supply of expensive software packages without recycling.

**Figure 1.** The concept of simulation modeling of the interdependence between the cybernetic cost collaboration of mechanical engineering enterprises and the factors of the balanced scorecard projections.
Conclusions

Results, implementation

- The construction of the concept of simulation modeling of the interdependence between the cybernetic cost collaboration of mechanical engineering enterprises and the factors of the balanced scorecard projections allowed us to develop the simulation model of the resource potential of the collaboration and to forecast the efficiency of machine-building production;

- The balanced scorecard and simulation model developed using the author’s method of criteria-based analysis allowed us to expand the theoretical understanding of the role and functionality of mechatronic factors and processes in the comprehensive assessment and management of resource potential based on key reference indicators;

- The most important practical significance of the research results is the determination of the innovation mechanism for selecting key leading indicators using a single innovative criterion;

- The proposed tools for improving the strategic projections of the balanced scorecard and forecasting cybernetic cost collaboration of machine-building enterprises reflect the possibilities of their optimization and identification of prospects for sustainable development while transferring positive trends in production efficiency to the field of activity of other organizations.
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