

Implementation of the Concept of Sustainable Development Through Digital Technologies and Proactive Management in the Economy

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Abstract— The purpose of this research is to advise and analyze well-defined improvement technologies and modern enterprise management methods, including application of sustainable development principles and the adaptive management system for any enterprise in a fuzzy environment. To increase competitiveness in the market, enterprises are forced to optimize costs and implement more efficient solutions in operations. In addition to this situation, unprepared and imprecise forced management decisions are often objectively observed in some enterprises. This subsequently leads to investment and operational losses, and in critical situations, it leads to the loss of an image of an enterprise in the market. As a result, the current situation creates an objective necessity to conduct research on the issues of improvement and application of existing modern management methods through innovative technologies and applied science, based on the principles of sustainable development and adaptation of management. The research results and the set of joint methods are universal in solving production problems, adapting management, optimizing operating costs, planning, sustainable development and achieving the economic and technological key performance indicators of any enterprise in the industry 4.0.

Keywords—key performance indicators, recurrent neural network, sustainable development, condition monitoring

I. INTRODUCTION

Currently, the risks of a global economic recession, including the instability of both supply chains and the cost of energy resources around the world, are affecting investments, financial institutions and the economy as a whole. These reasons change over time according to demand and supply, as well as market tactics and strategies of companies. On the other hand, in the production of recycled raw materials and materials, protection of biodiversity and water resources, increased social responsibility, increased safety of production for nature and personnel is required. By improving product quality, optimizing costs, improving planning, and applying modern adaptive management techniques in any production process or business, the above goals can be achieved more efficiently. It is known that one of the most important elements of planning is the results of forecasting. Planning requires especially the results of the forecasting problem which is the input based on the most accurate and proven technologies. It is the application of sustainable development methods in the improvement of traditional and adaptive production and

business management systems of an enterprise based on proven innovative technologies, for example:

- conducting economic forecasting using the fuzzy c-means method (Fuzzy logical inference system included in the MATLAB mathematical package);
- ANFIS, Adaptive fuzzy neural logic inference system,
- Analytical Hierarchy Process (AHP) - analytical hierarchy method of processes,
- computerized maintenance management system,
- computerized system for monitoring the condition of production equipment in real time;

A comprehensive production and economic analysis of the results of the application of modern computerized technologies and the concept of Sustainable Development were used to improve adaptive management methods. An improved method of direct cost savings in the operation of production and technological equipment was proposed and implemented by monitoring the condition of these equipment in real time and providing maintenance to these equipment in the cement plant. The methodology of modern forecasting of market prices and the volume of cement production on scientific basis was proposed and applied. A methodology for qualitative adoption of adaptive management decisions in planning and optimization was proposed and studied.

II. MANAGERIAL METHODS FOR ACCURATE REPORTS IN MODERN ENTERPRISES IN INDUSTRIES

A. Key performance indicators.

Here are some key performance indicators for a cement plant for example:

1. EBITDA (Earnings before interest, taxes, depreciation, and amortization) = Net Income + Taxes + Interest Expense + Depreciation & Amortization
2. Net Availability Index (NAI) [%] = $((\text{Working time [h]} + \text{Downtime [h]}) / \text{Calendar time [h]}) \times 100$
 - Net Availability Index Target (%) $\rightarrow \geq 90\%$ for all eligible assets
3. Maintenance cost ($\Delta\%$ of baseline)

Cost of service [%] = ((actual unit cost of service – reference) / reference)) × 100

- Target cost of service [%] → ≤ minimal possible %

4. Preventive Maintenance Procedures (PMR) %

$PMR [\%] = (\text{Actual Labor on Last Confirmed Operation from PM02 WO} / \text{Total Maintenance Completed}) \times 100$

- PMR % target → between 15% and 30%

5. PMR Efficiency [%] - Update target based on usage.

$PMR \text{ efficiency } [\%] = (\text{number of maintenance requests generated from PM02 WO} / \text{number of maintenance requests}) \times 100$

→ > 35%

6. Planning accuracy [%]

$\text{Planning accuracy } [\%] = 100 \times (1 - (\sum ABS(\text{calculated} - \text{actual}) \text{ hours of work for all confirmed planned} / \text{actual hours of work for all completed planned}))$

→ > 90%

B. Technologies

Within the framework of the thesis, the following studies were conducted and the following results were obtained:

1. A comprehensive analysis and improvement of adaptive management methods was carried out along with the synergistic effect of applying "sustainable development" principles and standards.

2. New methods using macro-economic indicators have been applied while implementing the prediction algorithm with evolutionary learning using RNN technology - Fuzzy recurrent neural network (RNN), Fuzzy C-means method and ANFIS. Based on tools such as the MATLAB mathematical package, effective prediction results were obtained, as well as a comparison of the results of these methods was given. These technologies allow to qualitatively predict the production volume and demand, prices in the example of the cement industry in 2016-2022. [4] - [11].

3. A computerized method is proposed to improve production and economic planning and cost optimization in a cement enterprise to achieve economic and technological Key Performance Indicators.

4. Real-time CMS Condition Monitoring System and CbM method (Condition Based Maintenance) experimentally implemented for the Production and Technical Equipment in the cement plant. Practically the cost optimization was proven through condition-based operation, providing direct savings compared to traditional Preventive equipment. As a result, the above mentioned CbM and online CMS implementation ensured the prevention of unplanned downtime and breakdowns and the achievement of KPIs in the cement plant over a long period of time.

5. Experimental computer simulations were carried out for the improvement of adaptive control methods at the cement plant and effective results were obtained that were practically confirmed.

6. The application of the analytical hierarchy of processes in making quality management decisions and cost optimization is proposed and analyzed.

The research results and the set of joint methods are universal in solving production safety problems, adapting management, optimizing operating costs, planning, sustainable development and achieving the economic and technological key performance indicators of the cement enterprise in the industry 4.0. This research has been tested, presented to the public, also experimentally applied and confirmed with successful results in the example of the cement industry, especially Holcim (Azerbaijan), a member of the Holcim group. [3]. Applied tested methods can be used to improve production and economic management in any type of industrial and commercial enterprises in developed countries, including the Republic of Azerbaijan. The proposed approach enables predictions based on fuzzy information, eliminates prediction problems based on partially uncertain information, allows researchers to analyze their models and correct errors in the modeling process. For example, in fuzzy modeling, because the result depends on the membership function, the selected implication, and the logical inference method, a high-quality model can be obtained by changing the choice at these stages.

Fuzzy neural networks are more effective because they allow to overcome the shortcomings of fuzzy logic and neural networks, and their successful use in prediction has been confirmed in scientific literature, and the prediction values given in the work also show that this method is an effective tool. The prediction results obtained on the basis of the recurrent neural network and the evolutionary calculation algorithm prove the accuracy of the prediction and confirm the necessity of using artificial intelligence tools in the adaptive management of the enterprise. [1], [2].

III. SUSTAINABLE DEVELOPMENT VIA PROACTIVE MANAGEMENT TECHNOLOGIES

Preventing interruptions in the production process allowed the operation to be successful. Thus, early analysis allowed planned maintenance, which significantly reduced production and operating costs. Therefore, Garadagh Cement has also approved the use of an online management system as a modern technology to increase equipment reliability, ensure production availability and reduce maintenance costs.

In fact, before the installation of the online CMS, the total cost of maintaining the observed production equipment for five months was Euro 51803 (Figure 1).

The goal was to reduce costs to Euro 14500, which means a reduction of 3.6 times. In fact, maintenance costs amounted to Euro 2134, which means 24.3 times reduction in total maintenance costs over the next five months. As a result, maintenance costs were reduced by up to 4% compared to the reference [3].

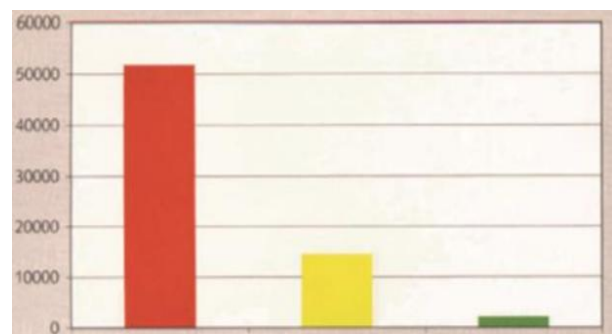


Fig. 1. Service cost savings.

Additional improvements have been made by reducing the costs of unscheduled shutdowns of controlled lines of process equipment (Figure 1). The frequency and duration of unscheduled stoppages and unscheduled work has been significantly reduced [1].

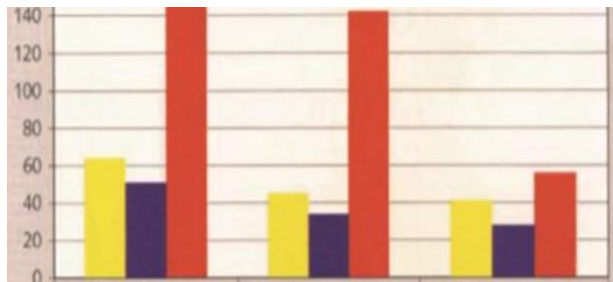


Fig. 2. Cost reduction in unplanned downtime.

In fact, in the example of a cement plant, there are criteria for successful application of modern technologies through adaptive management, priority, efficiency, feedback, improvement and rejection of complex methods. One of the main conditions for the successful implementation of adaptive management is the application of modern marketing analysis and planning through the Computerized Maintenance Management System (CMMS) [8], [9]. in the cement plant. This approach is useful for timely decision making by management.

IV. CONCLUSION

As a result of the synergy effect of applying the principles and standards of the sustainable development as well as technologies to solve objectives, the adaptive management method was improved including some applied methods of economic prediction of production volume, applying fuzzy recurrent networks for prediction, monitoring and control in any enterprise.

REFERENCES

- [1] Aliev, R.A., Guirimov, B.G., Fazlollahi, B., Aliev, R.R.: Evolutionary algorithm-based learning of fuzzy neural networks. Part 2: recurrent fuzzy neural networks. *Fuzzy Sets Syst.* 160(17), 2553–2566 (2009). <https://doi.org/10.1016/j.fss.2008.12.018>
- [2] Aliev, R.A., Fazlollahi, B., Aliev, R.R., Guirimov, B.: Fuzzy time series prediction method based on fuzzy recurrent neural network. In: *Lecture Notes in Computer Science*, vol. 4233, pp 860–869. Springer, Heidelberg (2006). https://doi.org/10.1007/11893257_95
- [3] Wirtsch.-Ing. Robert Schmaus, Nazim Huseynov: Garadagh Cement ensures production uptime using online Condition Monitoring System (CMS). Official Journal of: Federal German Association of the Lime Industry, Federal German Association of the Gypsum Industry, „ZKG INTERNATIONAL”, ISSN 0949-0205, No. 5-2010, pp.14-16. www.zkg-online.info
- [4] Huseynov Nazim Tofiq oğlu: Synergy of the University and Cement Industry Sectors in Application to Cement Market Price Innovative Forecasting in Azerbaijan. *International Journal of Modern Engineering Research, IJMER*, ISSN:2249-6645, October 2016, pp.79-86
- [5] Gardashova L., Huseynov N.: Cement Industry Overview and Market Price Forecasting in Azerbaijan, 2016, *Int.Journal of Engineering Research and Application, IJERA*, ISSN: 2248-9622, Vol.6, Issue 10, (Part-1) October 2016, pp.32-38
- [6] Huseynov Nazim Tofiq oğlu: Application of modern technologies for planning improvement and saving on costs in the enterprise of the industry 4.0. // "Advances in Intelligent Systems and Computing"

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- [7] Huseynov, N.T.: Application of a neural network for making management decisions in production. In: *XXII Republican Scientific Conference of Doctoral Students and Young Researchers*, pp. 22–23. Azerbaijan State Pedagogical University (2018)
- [8] Jones, P., Soper, Ch.: *Implementing SAP Business Planning and Consolidation*. SAP Press, Bonn (2018)
- [9] <https://www.sap.com/index.html>
- [10] <https://www.stat.gov.az/news/macroeconomy>
- [11] <https://www.stat.gov.az/>