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MODERNIZATION OF THE FP-17SMN4 VERTICAL MILLING MACHINE AS AN ECONOMIC ALTERNATIVE TO NEW CNC MACHINES

Tadjiboev Rasul Karimovich

Professor at Fergana State Technical University tojiboyev55@mail.ru

Rakhmonov Zaylobiddin Obbosbek ugli

PhD student at Fergana State Technical University zaylobiddin1017@gmail.com

Abstract: This thesis discusses the modernization of the obsolete FP-17SMN4 vertical milling machine as an effective alternative to purchasing expensive modern CNC milling machines. In many machine-building enterprises, old milling machines are still used, although their control systems, mechanical drives, and working accuracy no longer fully meet modern production requirements. At the same time, the purchase of new CNC machines such as OPTI mill FP 1700 or DAH LIH MCV 1700 requires large financial investments. Therefore, modernization of existing machine tools is considered a practical and economically reasonable solution.

The FP-17SMN4 vertical milling machine, produced in 1987 at the Savelovsky Machine-Building Plant, was selected as the object of research. This machine had been used for a long time at Fergana Mechanical Plant. The modernization process includes the replacement of outdated control elements, installation of modern CNC control equipment, servo motors, special cables, and necessary hydraulic system components.

In particular, three servo motors for the X, Y, and Z axes and a digital CNC control unit were proposed to improve the movement accuracy and automation level of the machine.

The comparative analysis showed that modern CNC machines provide high precision, productivity, automation, and user-friendly operation. However, their price is significantly higher than the cost of modernizing an existing FP-17SMN4 machine. While modern foreign CNC milling machines may cost approximately 80,000–120,000 USD, the modernization of the FP-17SMN4 machine can be carried out at a much lower cost. This makes modernization especially important for developing countries and local industrial enterprises.

As a result of modernization, the FP-17SMN4 milling machine can achieve improved machining accuracy, reduced production time, increased service life, and better reliability. In addition, CNC retooling allows the machine to work with fewer errors and makes it possible to integrate modern safety and control functions. The study confirms that upgrading obsolete machine tools is a cost-effective way to increase production efficiency and reduce dependence on expensive imported equipment.

Keywords: FP-17SMN4, CNC milling machine, modernization, servo motor, CNC control, machine tool, productivity, accuracy, economic efficiency.

INTRODUCTION

The development of machine-building enterprises requires increasing productivity, improving machining accuracy, and reducing production costs. Modern CNC milling



"INNOVATIVE ACHIEVEMENTS IN SCIENCE 2026 "

machines are widely used in industrial production because they provide high precision, automation, and stable machining quality. However, the high cost of new CNC equipment creates difficulties for many local enterprises.

For this reason, the modernization of obsolete milling machines is becoming an important technical and economic solution. Instead of purchasing a new machine, enterprises can upgrade existing equipment by replacing outdated control systems, mechanical drives, and electrical components with modern ones. This approach helps extend the service life of machines and improve their production performance.

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The efficiency of modernization can be evaluated by the following formula:

$$E_m = \Delta P + \Delta C$$

where:

$\Delta P = P_2 - P_1$ — increase in productivity;

$\Delta C = C_1 - C_2$ — reduction in operating costs.

If $E_m > 0$, the modernization of the machine is technically and economically effective. This means that the upgraded FP-17SMN4 machine can provide improved productivity and lower operating costs compared with its previous condition.

To evaluate the economic feasibility of modernization, the annual economic effect can be calculated as follows:

$$E = C_n - C_m$$

where:

E — annual economic effect;

C_n — annual cost of purchasing and operating a new CNC machine;

C_m — annual cost of modernizing and operating the existing FP-17SMN4 machine.

If $E > 0$, modernization is considered economically effective. This means that the modernization of the existing FP-17SMN4 machine requires lower expenses than purchasing a new CNC machine while still improving accuracy, productivity, and reliability.

The technical and economic efficiency of modernization can be expressed by the following relationship:

$$E_m = (P_2 - P_1) + (C_1 - C_2)$$

Where:

E_m — modernization efficiency;

P_1 — productivity before modernization;

P_2 — productivity after modernization;

C_1 — operating cost before modernization;

C_2 — operating cost after modernization.



"INNOVATIVE ACHIEVEMENTS IN SCIENCE 2026 "

METHODS

The research is based on the comparative analysis of two modern CNC milling machines and the FP-17SMN4 vertical milling machine. The compared machines include OPTI mill FP 1700, DAH LIH MCV 1700, and FP-17SMN4 under modernization conditions.

The modernization of the FP-17SMN4 machine includes:

- installation of modern CNC control equipment;
- installation of servo motors on X, Y, and Z axes;
- replacement of outdated control and power supply systems;
- use of special cables and hydraulic system components;
- improvement of machine automation and motion control;
- possible integration of lubrication, safety, and measuring systems.

This modernization allows the old machine to perform milling, drilling, boring, and other machining operations with improved accuracy and reliability.

RESULTS

The analysis showed that modern CNC milling machines have high technological capabilities, including advanced control systems, automatic lubrication, strong machine structure, high spindle speed, and user-friendly interfaces. However, their cost is very high for many local enterprises.

The FP-17SMN4 machine, although obsolete, has a strong mechanical structure and can be modernized by installing modern CNC equipment and servo drives. The modernization cost is much lower than the price of new CNC machines. This makes it possible to improve the machine's performance without large investments.

Indicator	New CNC machine	Modernized FP-17SMN4
Investment cost	80,000–120,000 USD	about 20,000 USD
Control system	Modern CNC	Updated CNC control
Drive system	Servo drives	Installed servo motors
Machine condition	New	Obsolete but modernized
Economic efficiency	High cost	Lower cost and practical
Service life	New machine life	Extended service life

The expected results of modernization are:

- increased machining accuracy;
- improved productivity;
- reduced production time;
- extended machine service life;
- reduced maintenance and operating errors;
- lower investment cost compared with purchasing a new CNC machine;
- improved economic efficiency for local enterprises.

The comparison confirms that modernization is a practical solution for machine-building enterprises where full replacement of equipment is financially difficult.

DISCUSSION



"INNOVATIVE ACHIEVEMENTS IN SCIENCE 2026 "

The obtained results confirm that modernization of obsolete milling machines using a modern monitoring and energy management system is technically and economically effective. The FP-17SMN4 milling machine example shows that it is possible to improve the performance of old equipment without purchasing a completely new machine.

Before modernization, the technical condition of the machine was mainly assessed through periodic inspections and the operator's experience. This approach is not always accurate because faults may develop between inspections and remain unnoticed until they cause serious problems. After modernization, the technical condition of the machine was monitored continuously using sensors. This made the diagnostic process more reliable and objective.

The 10% reduction in energy consumption demonstrates the effectiveness of the energy management function. Although this percentage may seem moderate, it can produce considerable savings in industrial production, especially when several machines operate continuously.

The fault detection accuracy of more than 90% is another important result. Early detection of faults allows the enterprise to prevent serious failures, reduce emergency repairs, and plan maintenance more effectively. This contributes to increasing the service life of the machine.

The increase in production productivity by 12–15% shows that modernization has not only technical but also economic importance. Higher productivity means that the enterprise can produce more products in the same amount of time, reduce delays, and use production capacity more efficiently.

Another important advantage of modernization is the extension of the service life of existing equipment. Instead of buying expensive new machines, enterprises can improve the performance of available machines by installing relatively low-cost monitoring and control systems. This approach is especially useful for small and medium-sized industrial enterprises.

The economic analysis also supports the practical value of the modernization. The annual economic benefit was calculated as 2,739,000 UZS. This result shows that the proposed system can reduce operating expenses and improve the economic efficiency of production.

CONCLUSION

The modernization of the FP-17SMN4 vertical milling machine is an effective way to improve the performance of obsolete machine tools. By installing servo motors, a modern CNC control system, and additional modernization components, the machine can be adapted to current production requirements.

The study shows that modernization reduces costs, extends machine life, improves machining accuracy, and increases production efficiency. Therefore, modernizing existing FP-17SMN4 milling machines can be recommended as an economically efficient alternative to purchasing expensive imported CNC equipment.



REFERENCE:

1. XVI International Scientific-Practical Conference "Actual Problems of Improving Farming Productivity and Agroecology" (IPFA 2024) "Analysis of comparison of CNC milling machine-tools" <https://doi.org/10.1051/e3sconf/202453804022>
2. Tadjibayev Rasul Karimovich, & Rakhmonov Zaylobiddin Obbosbek o'gli. (2023). PREPARATION FOR MODERNIZATION OF VERTICAL CNC MILLING MACHINE FP-17SMN4. Web of Scientist: International Scientific Research Journal, 4(04), 820–828. <https://doi.org/10.17605/OSF.IO/CYEGQ>
3. Tadjibayev Rasul Karimovich, & Rakhmonov Zaylobiddin Obbosbek O'gli. (2023). MODERNIZATION OF CNC MACHINES. European International Journal Multidisciplinary Research and Management Studies, 3(04), 107–113. <https://eipublication.com/index.php/eijmrms/article/view/740>
4. Rakhmonov, Z. O. o'g'li, & Jaloliddinova, S. O. qizi. (2023). GENERAL INSIGHT INTO COMPOSITE MATERIALS IN SCIENCE. SCHOLAR, 1(20), 20–28. Retrieved from <https://researchedu.org/index.php/openscholar/article/view/4476>
5. Xomidov, I. O. o'g'li, Rakhmonov, Z. O. o'g'li, & Xomidov, I. O. o'g'li. (2023). 16K20F3 LATHE CNC MACHINE UPGRADE TO MILLING CNC MACHINE. SCHOLAR, 1(20), 29–35. Retrieved from <https://researchedu.org/index.php/openscholar/article/view/4477>
6. Siddiqov, B., & Rahmonov, Z. . (2023). GAZ DVIGATELLARIDA SOVUTISH TIZIMINING NAZARIY TAXLILI. Молодые ученые, 1(13), 11–17. извлечено от <https://in-academy.uz/index.php/yo/article/view/20509>
7. ARTIFICIAL INTELLIGENCE IN MECHANICAL ENGINEERING. (2024). Western European Journal of Modern Experiments and Scientific Methods, 2(1), 7–12. <https://westerneuropianstudies.com/index.php/1/article/view/211>
8. Tadjibaev Rasul Karimovich & Rakhmonov Zaylobiddin Obbosbek ogli. (2024). 16K20F3 LATHE CNC MACHINE UPGRADE TO MILLING CNC MACHINE. (2024). International Journal of Advance Scientific Research, 5(12), 107–112. <https://sciencebring.com/index.php/ijasr/article/view/843>