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THE SPECIFIC FEATURES OF INDUSTRIAL ROBOTIC SYSTEMS TO BE USED IN MECHANICAL ENGINEERING PROCESSES

B. OZDEMIR, V. SHEMENKOV, A. STATSENKO
Belarusian-Russian University
Mogilev, Belarus

A robot is an intelligent machine. The intelligent machine would not be actuated by a human but by a computer and so operate automatically, not requiring a human to make decisions about what to do next but itself responding to signals from its environment [1]. An industrial robot is an automatically controlled, reprogrammable multipurpose manipulator, programmable in three or more axes, which can be either fixed in place or fixed to a mobile platform for use in automation applications in an industrial environment [2]. Traditional human-powered manufacturing systems have been transformed into systems whereby robots have taken over complicated manufacturing in mechanical engineering. Robot adoption in factories around the world continues at high speed: The new global average robot density, according to the World Robotics 2024 report, reaches a record 162 units per 10,000 employees in 2023 – more than double the number measured only seven years ago (74 units) [3]. This transformation has brought many benefits that can significantly increase performance, quality, safety, and overall competitiveness. These benefits include flexibility and adaptability, improved safety, increased efficiency, accuracy and precision, cost savings, better resource utilization, increased employee satisfaction, 24/7 production capability, scalability, quality control, and competitiveness.

One of the important cornerstones of the robotic transformation of industrial organizations is the precise specifications of robotic systems. This work aims to clarify what types of robots can be used in a particular industry, considering the scope of industrial robots being used in mechanical engineering, thus guiding the process of robotic transformation. This way, the systems installed will operate efficiently, reducing the depreciation period.

For this purpose, some specific features of industrial robotic systems to be applied were first considered under 5 main headings. The recommendations for robotic equipment selection were given and assessed as the most suitable to match those features. In this context, the manufacturing and assembly features of industrial robots were evaluated under high payload capacity, precision and accuracy, robustness and integration capabilities; the design and prototyping features were assessed under flexibility, high-speed operation, and advanced tooling; the maintenance and inspection features were assessed under non-destructive testing, mobility and

autonomous operation; the testing and quality control features were assessed under precise measurement systems, repeatability and data integration; and finally, the energy efficiency and sustainability features were assessed under energy recovery systems, sustainable materials and low-noise operation. Then, the difficulties of using industrial robotic systems and the reasons for slowing down robotization in terms of high investment costs, technical complexity, and compatibility of systems were assessed. Finally, assessments and recommendations were given regarding the future of industrial robotization.

To sum up, industrial robots have become a cornerstone of modern engineering, providing numerous benefits such as increased efficiency, precision, and safety [4]. Manufacturers can effectively use robotic systems to improve performance, safety, competitiveness, and sustainability if they can identify the robotic systems with the most appropriate specifications for their businesses. This work literally describes some specific features of robotic systems to be applied in mechanical engineering processes driven by the ongoing requirements of various industrial applications, considering optimum performance and cost-effectiveness.

Considering the advantages above, high investment costs, technical complexity, and issues of system compatibility remain significant obstacles to the widespread adoption of robotic transformation. Further development of robotics technology and its accessibility can guarantee strategic planning to integrate the current systems and processes. Therefore, the future of industrial robotization is bright and could lead to fundamental changes in industries, innovations, and global market competition. Thus, the right and precise investments in research and development can accelerate the path to successful robotic transformation for diverse uses in mechanical engineering.

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