Editorial
Volume 11:2, 2022

Journal of Industrial Engineering and Management

ISSN: 2169-0316 Open Access

Automatic Machine Tools for Mass Production

Wang Hui*

Department of Management Studies, University of Wolverhampton, UK

Editorial

Factory automation (FA) is a type of manufacturing automation that was created primarily for continuous mass production. As the number of parts to be produced grows, the machine tools used to make them become increasingly automated, increasing productivity and lowering unit production costs—economies of scale. High-level automation, on the other hand, necessitates a significant amount of capital investment. The usage of special-purpose machine tools limits the ability to react to market-driven changes in product requirements. On manipulation by the operator, general-purpose machine tools can produce a wide range of shapes and dimensions of components and products. Machining instructions, such as shapes and dimensions for components to be machined, tool selection and route, machine motion, and so on, are stored in the hardware and/or software of automatic machines and special-purpose machine tools. Except for initial setup, replacement of worn tools, and perhaps loading of bar stocks or workpieces, automatic machines are mechanized to create components continuously without requiring any manual intervention. During the initial setup, the products shapes and dimensions are changed. The automated lathe, also known simply as an automatic, is the most prevalent of this type. With a range of work-holding systems, single-spindle and multi-spindle automatics, turret, and multi-tool (placed radially around the machining region) types are available. The multi-spindle automatic is essentially a rotary-transfer type of machine.

Straight-line and positioning controls with a restricted number of control steps are limited in this sort of programme control. When compared to special-purpose machine tools, transfer machines, and numerically controlled machine tools, program-controlled machine tools are extremely accurate and less expensive for medium-sized and medium-volume manufacturing. A tracer follows each point on a template that mimics the shape of the product in Copying Machine Tools. A copying machine tool (lathe, milling machine) creates the product by using mechanical position control and a servomechanism to ensure that the cutting tool follows the same route as the tracer on the template. Special-purpose Machine Tools are mechanized to create huge amounts of similar components in a high-volume, repeatable manner using pre-programmed instructions - stationary machine, which processes a workpiece in a fixed location with tools approaching from several directions and the indexing machine, which holds workpieces on an indexing transfer table and machines them automatically as they are shifted from one place to the next.

The following two-time components are used to assess the efficiency of operating transfer machines:

1) Cycle time (maximum real machining time plus transfer and positioning times) is the time between successive completions of a machined component. The cycle time is frequently determined by considering the monthly expected production volume and operation time, as well as the machining methods, machining conditions, precision, and other factors.

2)Manufacturing lead time for a product-total unit production time to finish a component through all transfer line stations: sum of actual machining times on all machining heads, transfer, and positioning times. Ordinarily, in numerically controlled machining, the cutter path, machining conditions, and sequence of operations are constantly controlled by commands from a punched tape or a computer, which represent a 'fixed' set of instructions that cannot be easily changed even when the actual work situation has changed due to tool wear, increased tool forces and power, and other factors. When creating NC instructions, the programmer must calculate a 'safe' set of operating instructions to account for 'worst case' scenarios. It is desirable to quickly adjust and compensate machining control parameters (machining conditions) to changes in actual work situations (especially the gradual wear of the tool as machining progresses), so that a suitable measure of performance, such as production time, cost, or profit, is always optimized. Adaptive control is a system for automatically optimizing machining (AC). It provides a technique of quickly detecting changes in the actual work scenario and compensating for machining conditions. At short intervals during machine operation, the sensors measure dynamic work situations such as tool forces, spindle torque, motor load, tool deflection, machine and tool vibration, accuracy of the machined workpiece, roughness of the machined surface, cutting temperature, machine heat deflection, and so on. Tool wear and life are difficult to evaluate directly during machining, hence they are calculated indirectly using the following metrics. These inputs to the adaptive control system are evaluated in real time to determine the best machining conditions for the next instant, and the control unit finely adjusts the spindle speed, feed rate, or slide displacement velocity, resulting in real-time machining optimization [1-5].

Conflict of Interest

None.

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***Address for Correspondence:** Wang Hui, Department of Management Studies, University of Wolverhampton, UK; E-mail: w.hui.010@ms.edu*

Received: 05-Feb-2022, Manuscript No: iem-22-58187; **Editor Assigned:** 07-Feb -2022, Pre QC-No. P-58187; **Reviewed:** 12- Feb-2022, QC No. Q-58187; **Revised:** 17-Feb -2022, Manuscript No. R-58187; **Published:** 22-Feb-2022, DOI: 10.37421/2169-0316.22.11.336

How to cite this article: Hui, Wang. “Automatic Machine Tools for Mass Production.” J Ind Eng Manag 11 (2022): 336.