

Interreg
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QRM4.0

Flexible Manufacturing



TECHNOLOGY SHEET



Fontys

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ENGINEERING

Flexible manufacturing for lead time reduction

Flexibility in manufacturing is a key advantage which means the ability of handling mixed parts through the manufacturing process. By taking advantage of flexibility in manufacturing, it is possible to handle variation in parts assembly and variations in process sequence, change the production volume and change the design of certain products [1]. As such, a flexible manufacturing system is able to manage predicted or even unpredicted changes within the process. Flexibility in manufacturing can be classified into two main categories [2]:

- Routing flexibility: The ability of system to be changed to produce new product types or change the order of executed operations on a product.
- Machine flexibility: The ability to use multiple machines to perform a specific operation and the ability to handle large-scale changes, either in volume or capacity.

An important theme within Industry 4.0 is tailor-made productions, having the possibility to make a unique new product for each customer in an affordable way. This requires that the changeover time is minimized. To be able to produce flexibly, robotic arms have to perform different actions depending on the product they have to make or the component they receive. The robots will have to be able to automatically determine which action to perform. In general, flexible manufacturing systems consist of three main systems [2]:

- 1) Work machines: interconnected and automated machines in the manufacturing line
- 2) Material handling systems: different handlers to optimize the flow of parts in the manufacturing process
- 3) Supervisory control system: a central computer that controls the machines and materials flow.

Each of the above-mentioned systems enables a level of flexibility for the manufacturing procedure. The flexibility in managing of the manufacturing resources like time and effort to manufacture a new product is the main advantage of a flexible manufacturing system. Flexible manufacturing system:

- can adaptively handle (un)predicted situations upon request throughout the manufacturing;
- is able to perform multiple tasks by following multifunctional procedures;
- are easy for programming or even have zero programming;
- and are reconfigurable and modular, which reduce the lead time considerably.

Robots and lead time reduction

Time is money for manufacturing, hence reduction of the lead time is an important goal of the modern production systems. Flexible manufacturing systems can efficiently reduce the lead time as they minimize the setup time by using flexible robots performing different tasks such as pick and place, manufacturing processes, handling, packaging, etc. Flexible robots can be usually seen in different parts of the production line. For instance, Fig. 1 shows a mobile robot assembly which is a pick a place robotic manipulator to inserts the small products to their certain positions.



Fig. 1. Mobile robot assembly as a pick a place robotic manipulator, designed at Fontys University of Applied Sciences (www.fontys.nl/robotica)

Moreover, material handlers are important systems within the flexible manufacturing systems. Fig. 2 illustrates an automatic tool changer robotic arm that minimize the time to set up the proper tools on the robotic manipulator.

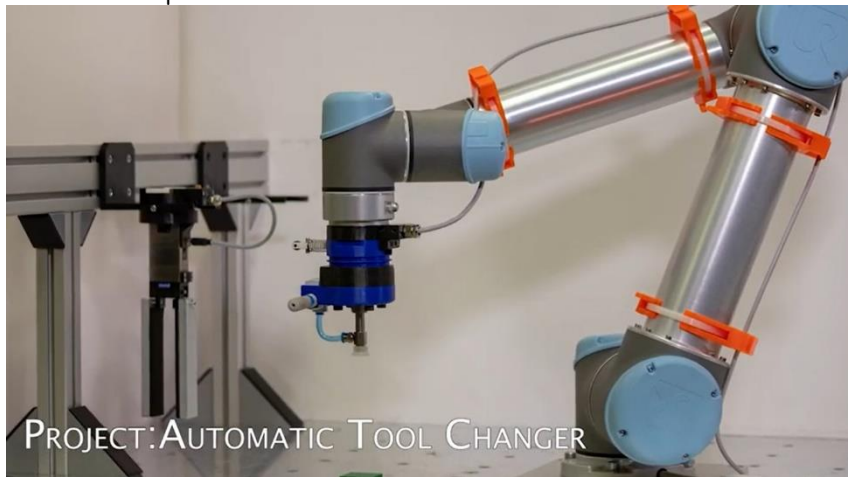


Fig. 2. An automatic toll changer robotic arm as a flexible toll handlers, designed at Fontys University of Applied Sciences (www.fontys.nl/robotica)

Bin picking is another important task in manufacturing, hence using a flexible bin picking system can reduce the lead time efficiently. Fig. 3 represents a bin picking robotic manipulator, designed at Fontys university of applied sciences, which is a combination of flexible grippers and arms, sensing and perception systems, and machine learning/artificial intelligence techniques.

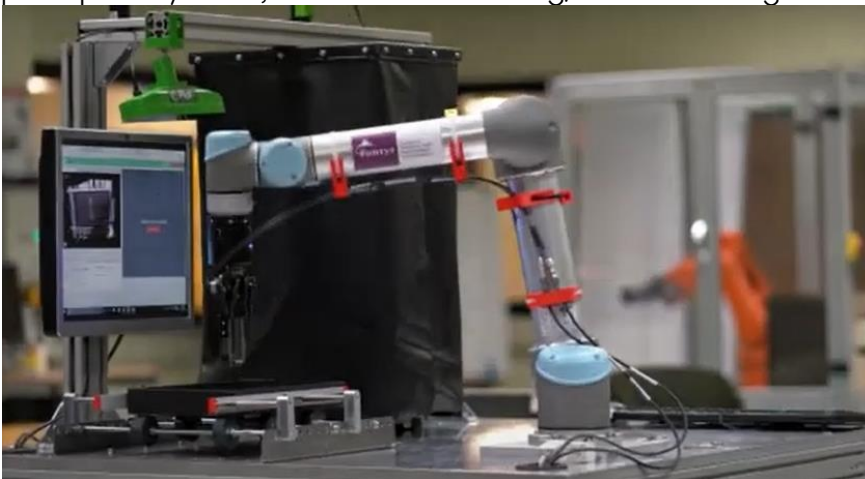


Fig. 3. Bin picking robotic manipulator to pick various objects with different shapes, designed at Fontys University of Applied Sciences (www.fontys.nl/robotica)

Need some help?

The Interreg project [QRM4.0](#) supports production companies in improving their lead times by providing practical advice and granting financial support to companies that want to take steps to implement digital tools on their shop floor. Would you like to know more? Contact michiel.vanosch@fontys.nl

References

- [1] A. De Toni & S. Tonchia (1998) Manufacturing flexibility: A literature review, International Journal of Production Research, 36:6, 1587-1617, <https://doi.org/10.1080/002075498193183>
- [2] Chryssolouris, George. *Manufacturing systems: theory and practice*. Springer Science & Business Media, 2013.