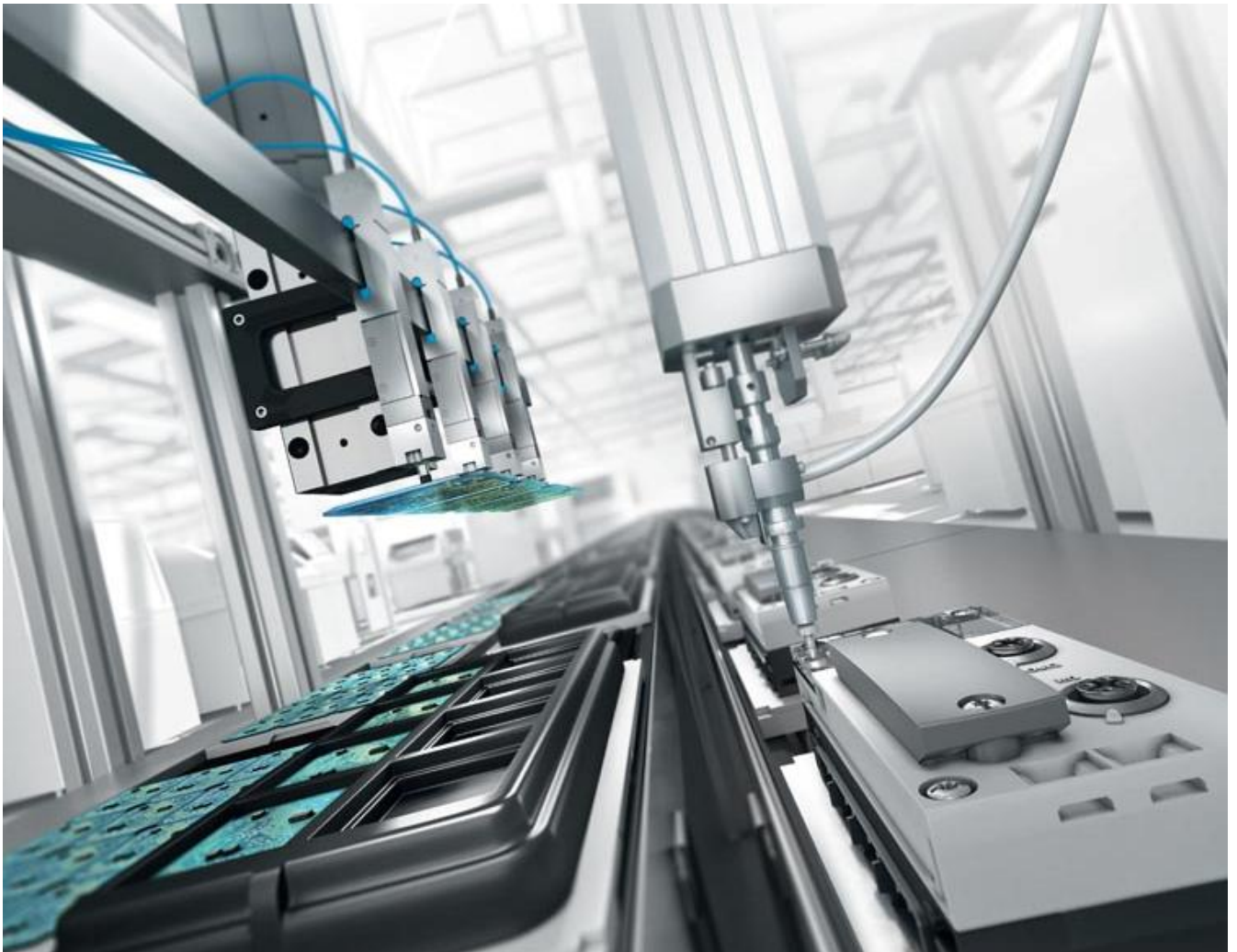


The “magic triangle” of small parts assembly

Assembly and test processes under the conflicting pressures of quality, flexibility and costs



1971 saw the start of mass production of the first single chip microprocessor, the Intel 4004. This marked the beginning of the triumphant advance of microelectronics. Today, electronic devices with microprocessors have become a vital part of every aspect of daily life. What applies to all products is that they and the components used are becoming ever smaller and more intricate. Development cycles are becoming shorter and shorter, while at the same time the numbers of variants are constantly growing. The dominant factors in the marketplace are the huge pressure on prices and the high quality requirements. Achieving competitive manufacturing processes means squaring the circle or establishing a "magic triangle" which covers the competing parameters of process quality, flexibility and production costs expressed as total cost of ownership.

The manufacture, assembly and testing of small workpieces may involve numbers of identical components ranging from prototypes, with a batch size of one, through to small series production or mass production. The degree of automation will increase in line with the production volume.

Solution for small batch sizes

What does this mean for a typical medium-sized production company which manufactures, for example, customised printed circuit boards for industrial customers? With short production runs, automation of the manufacturing process appears at first glance to be uneconomical. However, even here, reproducible and thus at least partially automated process steps are necessary in order to be able to supply top quality.

In view of the small batch sizes, manufacturing processes must be flexible. What is needed is an optimal balance between flexibility and quality – together with a certain degree of automation. To be competitive companies need automation solutions that are both flexible and economical. And this is where manufacturers find themselves in the "magic triangle", between the factors quality, flexibility and costs.

Solution for mass production

In the case of mass production, the starting point is completely different. For manufacturers of mass-produced electronic devices such as smart phones, laptops or tablet PCs, the most economical solution at present is still to

manufacture in low-wage countries, using manual labour for almost everything.

The greatest challenge in this kind of manufacturing is the immense number of reject components which are produced each day. This wastage and the rapidly rising level of wages in previously low-wage countries are making this kind of manufacturing increasingly unprofitable. And so cost-efficient (partly) automated solutions begin to look more attractive.

Cost efficiency

Cost-efficient and flexible automation is almost completely independent of the production volume. For machine construction, the requirements are as follow:

- Flexible adaptation and scaling of systems
- Simple configuration and set-up
- Fast commissioning
- High reliability and precision
- Favourable purchase price and low maintenance costs

These requirements apply not only to machine builders but also to system and component suppliers such as Festo. Innovative solutions are required that can be used in as many applications as possible – with different types of machines, with different degrees of automation and in as many manufacturing and assembly processes as possible.

The importance of an axis system for handling small parts

In general, a distinction is made between two kinds of motion or handling sequences according to whether the process is moved over the product (e.g. screwing unit to screwing in positions) or the product is moved underneath the process (e.g. a workpiece carrier under a dispensing unit). Here we consider the first case (process over product):

- Possible machine types: desktop application, single machine or production cell or module in a continuous production line
- Degree of automation of the process motion: completely manual, partially automated, fully automated
- Possible processes: pick and place, joining, screwing, testing, metering etc.

A system solution or a component has the greatest chances of success if it meets the requirements of many different applications and can thus be used for a large variety of processes. It is therefore useful first to study a number of different applications and identify their common features (see Fig. 1).

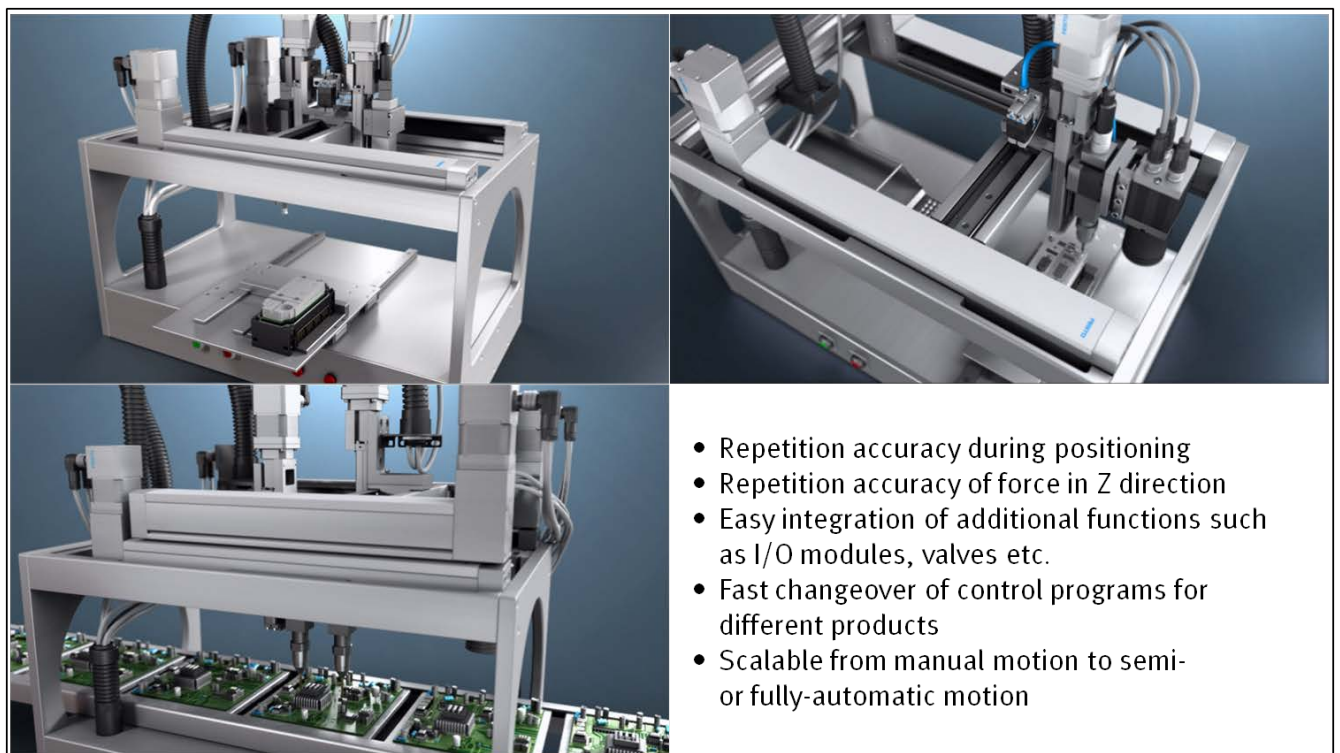


Fig. 1: Common features of pick and place, screwing and test applications

A promising system approach: the planar surface gantry EXCM

The small sized planar surface gantry EXCM from Festo is an example of a smart handling solution. It is a flexible and economical automation solution for a very wide range of handling tasks. The parallel kinematic belt drive concept means that the positions of the drive motors are fixed.

Advantage: the drive motor for the Y-axis doesn't have to be carried on this axis. The result is a compact and high-performance system as only a small mass needs to be moved. The EXCM represents a good base for an efficient automation platform for machine and plant builders. Material handling and process control can always be implemented on the same basis. Only the front-end device needs to be changed.

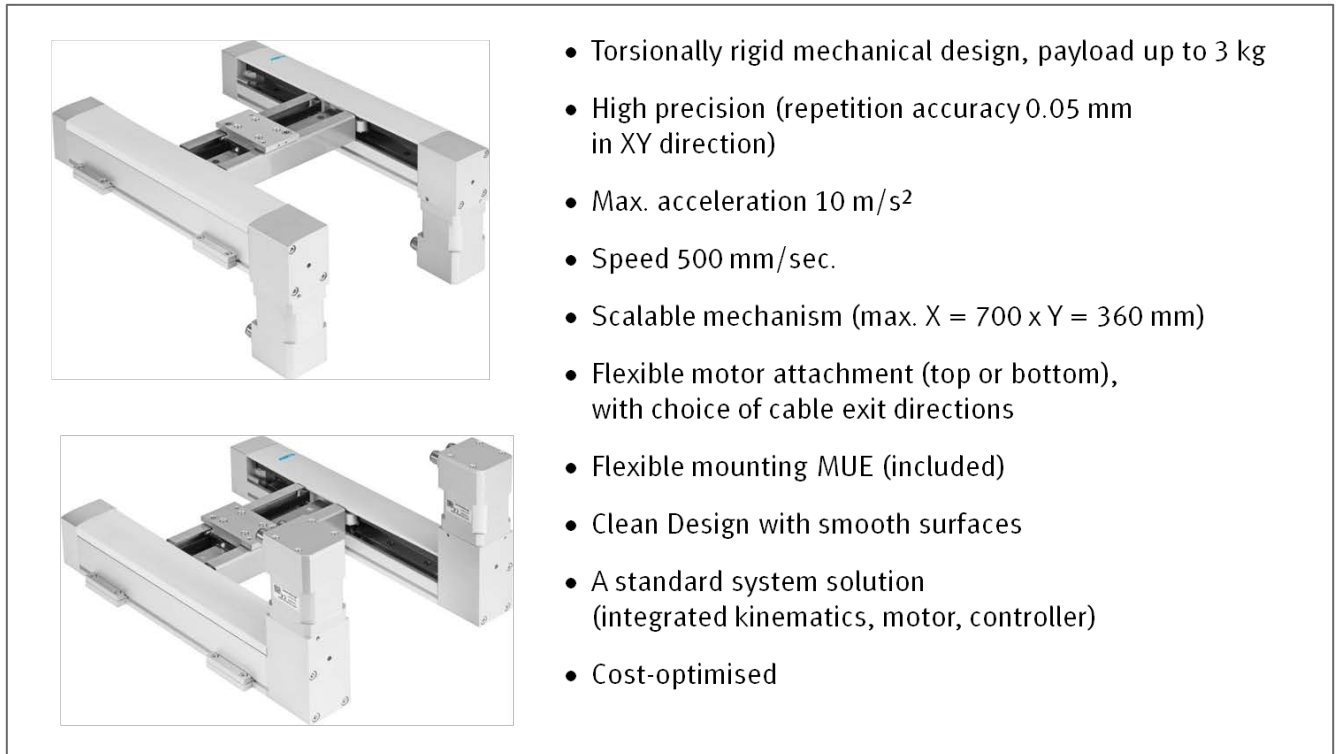


Fig. 2: Planar surface gantry EXCM from Festo

An example of an application: a cost-efficient and flexible flying sample test system

Visatronic GmbH, located in Mainhausen, near Frankfurt, specialises in the production of electronic modules. Its services range from development and design through to SMD or THT component fitting and final testing of complete modules. Small batch sizes and prototypes make the economical testing of printed circuit boards a real challenge.

Visatronic was looking for an economical solution to automate the test process. Given the small batches, it was important to have the flexibility to change between different variants.

Visatronic developed a flying sample test system based on its "Visatest" function test machine and a small sized planar surface gantry EXCM from Festo. The new test machine positions a test probe on the electronic modules. This checks that the module has been produced correctly. The module is function-tested fully automatically in just the same way as with mass production.



Fig. 3: Flying sample test system from Visatronic for quality testing of electronic modules

The small sized planar surface gantry EXCM is ideal for this kind of application as it is compact and has a low moving mass. Its dynamic response and precision are perfect for the application. Further arguments in favour of the EXCM are its purchase price, its ease of operation and the ability to control it via Ethernet.



Fig. 4: The compact planar surface gantry EXCM guides the test probe accurately to the test points on electronic modules.

The EXCM has thus made it possible to develop a slim, easily programmable and cost-efficient system with which all settings such as target positions and travel speed can be input directly. The two servo motors are controlled by a PC-based test system via the EXCM controller.

The motion sequences of the small sized planar surface gantry EXCM are therefore easily programmable in terms of target position, travel speed and direction. The EXCM with its simple realisation of X/Y positioning is thus an ideal system component for modular, compact automation of test processes.

Conclusion: automation has many benefits

Practical experience shows that partially or fully-automated solutions are being adopted more and more for manufacturing, assembly and test systems of small parts, both in small-series production to ensure that the required quality standards are met and in mass production as an answer to rising labour costs.

To have the greatest chances of success, however, automation solutions must be capable of being used in many different applications and production processes and allow end users to adapt their automation systems quickly and easily to handle different product variants. Wherever there is a need for precise and fast positioning and installation space is limited, the small sized planar surface gantry EXCM offers system engineers a genuine alternative.

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