ISSN 2052-9376

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November/December 2013

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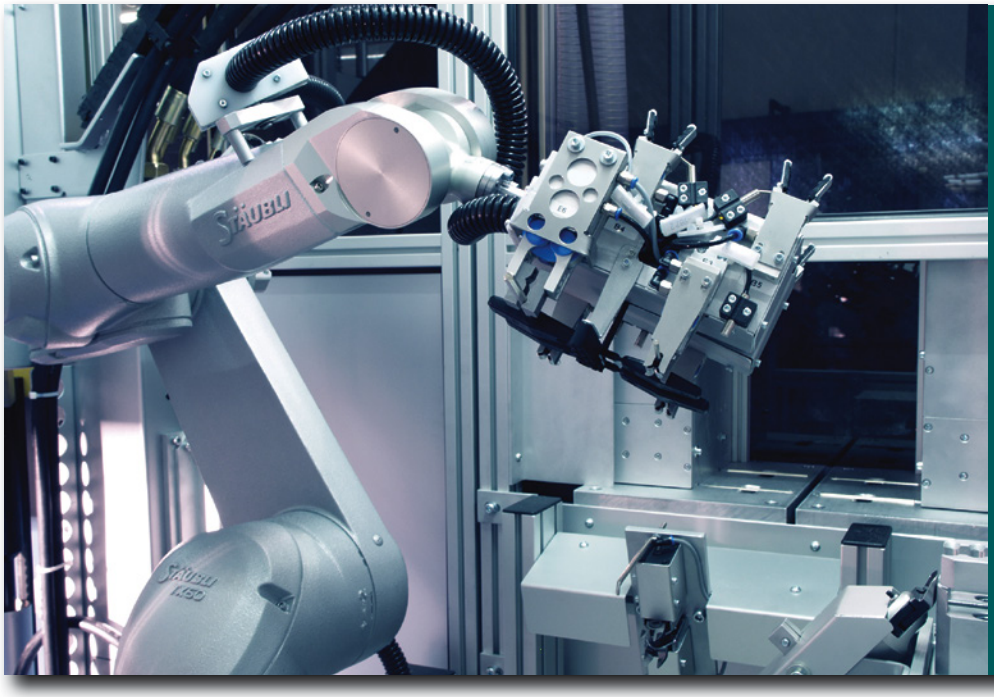

There's more to a successful DFM project than just 'can the part be moulded?' **André Eichhorn** looks at how good design can simplify downstream production

Design for peak production

Previous articles in this series have explored many of the key considerations that need to be taken into account during the DFM phase of a product development project, with the key focus on how to design a part in such a way that it can be injection moulded without significant problems. Following those guidelines makes it possible to increase part quality and reduce production costs.

However, there is another aspect of part design that it is also important to consider during the DFM process that goes beyond the question of 'Can a component can be injection moulded?' Anyone that has spent any time involved in active project support work will have seen many occasions where the part has been developed to be within specification and to meet all visual quality and given tolerances, but simply cannot be handled through post-moulding operations such as cutting, plating, painting. It sometimes cannot even be reliably picked out of the mould tool by a robot.

Oversights such as this this can end up in expensive production equipment modifications or additional manual work requirements to manufacture a product. In most cases, a specific supplier of post processing equipment will be involved at a certain point in the design process and asked if the proposed design can be removed, handled, painted, and assembled in a cost-effective way. However, it is often the case, unfortunately, that this involvement happens when the overall product design is very mature and firm. This article will discuss some specific examples where robots, plating, painting and assembly can have an impact on DFM considerations.

Above: Good part design is the key to fast and efficient automated production

Thinking about automation

There are a number of specific reasons for using a robot for part removal from the mould tool:

- Avoiding damage to the part caused by dropping from the mould;
- Reducing the risk of damage to the mould by trapped components;
- Simplifying separation of component and coldrunner;
- Maintaining correlation between each part and its mould cavity;
- Delivering oriented parts into assembly lines or post processing.

The robot end-of-arm-tooling can include features such as grippers, vacuum cups or unscrewing units. These need to be reviewed during the DFM process to determine which specific system should be applied to remove the part from the mould tool most reliably. The externally-threaded component shown in Figure 1 presented a problem in that it was not acceptable to have a slider split line for the outer thread on the component surface. As a consequence, some design features on the inside of the component geometry had to be modified to enable the required unscrewing unit to

Figure 1: Mould modifications were required to successfully implement the unscrewing mechanism for this externally-threaded component

dive in and unscrew the part from the cavity without causing any damage to it.

When considering post processes such as plating, painting, printing and the like it is very important to consider requirements for secure retention in the necessary jigs or handling equipment. Figure 2 shows a typical feature that allows a part to be clamped onto a painting jig without causing any damage to the visual surfaces and so that the whole of the surface that has to be painted can be covered in one pass. In this example it is also a gating feature, which will be cut off after painting. Considering this during early DFM allowed it to be included in the final tooling / gating solution and enabled the manufacturer to run the final painting process without any problems and at a high yield.

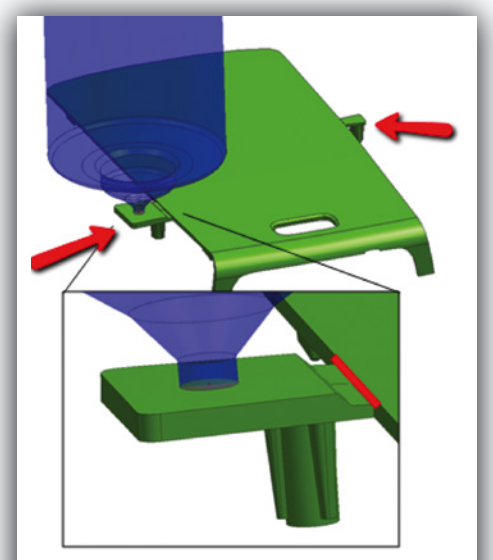

Figure 2: This gating feature is also used to handle the part during painting

Similarly, it is important to think about assembly line requirements. Both automatic and manual assembly lines will have their own specific requirements when it comes to control and positioning of the components that are assembled in the final product. Automatic lines are most often used where production volumes are high, so it is important that they provide:

- Full automatic operation;
- High operational speeds;
- High volume capability.

Achieving these performance criteria may require the addition of features on the component geometry that facilitates orientation of the parts and maintains them in the correct position for assembly or specific in-line testing procedures.

Where moulded components have been stored in bulk boxes or bags, bowl feeders will typically be used to automatically orientate parts and to present them correctly to the assembly line. Vibratory action is used to move the components through the device and specific design features on the part are employed to spin or rotate it at a number of stations to align it correctly before it enters the assembly line. These design features may not have any purpose in the functionality of the product but need to be reviewed with automation and handling specialists at an early stage to ensure they will not negatively impact assembly, quality or function.

Opting for a manual assembly method does not relieve the DFM team of the need to consider part features. In fact, it can be even more critical that features are incorporated that prevent parts being assembled incorrectly. The human factor is most often the most critical influence when it comes down to consistency and variances on the yield of an assembly line. Any feature in the component design that helps to make it 'idiot-proof' can pay off in revenue terms.

A recent project undertaken by AST involved the redesign of a part that was causing a production reject rate of 42% because an inner sub-assembly could be put together the wrong way around and could subsequently jam in service. It was established that this assembly mistake most often happened during the night shift. Adding just a simple, decentered guiding feature to the sub-assembly eliminated the problem immediately.

About the author:

André Eichhorn is general manager of Germany-based AST Technology. This is the latest instalment in a series of articles in which he discusses how product manufacturing problems can be overcome at the start of a project by the application of Design for Manufacturing techniques. You can read the most recent articles in this series **here**, **here** and **here**.