Make the design and manufacturing of plastic injection moulds smarter

Powered by data and easy-to-use design software, connected solutions for plastic injection mould manufacturing help simplify a complex process.

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Injection moulding is a manufacturing technology for producing identical plastic parts with the required tolerances. In the injection moulding process, plastic pellets are first melted and then injected under pressure into a mould, where the plastic is then cooled and changed from a liquid to a solid. Thermoplastic polymer materials can be coloured or filled with other additives, such as glass fibres. Almost every plastic part around you was created using injection moulding: from automotive parts to consumer/medical electronics to kitchen appliances.

Typically, an injection moulding process is chosen due to the relatively low cost per unit when producing parts in high volumes. Injection moulding offers high repeatability and good design flexibility. The main restrictions on injection moulding usually come down to economics, as a substantial initial investment for the mould is required. Typical lead time for a low volume single cavity prototype mould is three to four weeks. A high volume, complex multiple cavity mould can take as long as six months.

Producing a mould is challenging regardless of the product it is designed to make. The increasing complexity of the parts we can produce reflects the growing sophistication of manufacturing machinery and software. Even with technology capable of producing tooling that was once difficult or impossible to make, the road to a successful mould can be burdened with difficulties from development and tuning through manufacturing and repair.

A lack of the readily available, experienced talent required to develop and produce moulds compounds challenges already heightened by shortening lead times and increased onshoring. Manufacturers are increasing domestic mould manufacturing in response to material costs and tariffs that reduce the affordability of outsourcing. However, they still struggle to build solutions that bring both optimal products and efficiency.

Fortunately, production software and machine tool providers are working hard to meet these challenges. They are bridging the skills gap by offering embedded expert knowledge and addressing problems specific to mould making. Software developed to level the playing field for less experienced mould engineers simplifies development by providing the tools to identify and resolve common issues quickly.

To ensure that data is used correctly at each stage, an end-to-end solution that connects planning, quotation, and plastic injection mould design with manufacturing, quality, and delivery is required. This “connected data” is enriched by each team member working with identical information across different departments. This fosters better collaboration, eliminates redundant data entry, and reduces errors.

VISI is Hexagon’s integrated CAD/CAM solution for plastic injection moulds. VISI is central to the end-to-end solution and ensures that even non-mould-experts can resolve common problems before they arise, making the entire manufacturing process more efficient.

**Data-powered quotation**

Typically, when a mould shop receives a Request for Quotation (RFQ), the project manager or qualified senior designer uses their experience and guesswork to quote based on a few rough dimensions. The estimate’s accuracy is solely based on their expertise and is typically referred to as a “guesstimate”. Due to time constraints, project managers revert to this intuitive estimation method. Applying this method requires years of personal experience and deep knowledge of specific design and manufacturing techniques. Typically, they revert to legacy information by recalling a previous job similar to the current query and buffering the cost by 5-10 percent. Winning the job is often a numbers game, as a moulder submits 30-40
identified by querying the CAD data require slides/lifters, bear associated costs realised by WORKPLAN.

VISI also simplifies designing and creating quotations for the electrodes required to burn sharp-edged features into moulds. VISI offers tools for mould development, including tools used to design and extract electrodes from solid models and to manage electrode materials machining with unique behaviours — such as graphite and copper. Knowing how many electrodes are needed for manufacturing and how long it will take to make them also factors into the job quote.

The availability of 3D CAD geometry that includes product manufacturing information (PMI) also influences the quotation. PMI helps determine factors necessary for part quality, such as how many machining operations are required and satisfying critical tolerances. WORKPLAN maintains a comprehensive database that doesn’t rely upon recall or guesswork and becomes more powerful with each quotation. Increasing accuracy with a scientific, repeatable, reliable method of generating accurate quotes is the best way to maximise profit for your jobs.

The challenge is designing the block’s mould-specific features, such as plates and cooling channels, and the placement of components like screws, pins, springs, and ejector points. VISI, which uses a direct modelling approach designed for mould development, offers associative functionality to ensure that assemblies are correct even when changes are made. For instance, these systems will automatically adjust screw dimensions to match the size of the selected plate or won’t allow a user to place a cooling channel where a screw is located. If a designer realises at the last minute that an assembly featuring thousands of components doesn’t have a thick enough plate, direct modelling with associativity ensures that the plate can be swapped out and all components automatically adjusted to the new dimension.

Similarly, defining mould core and cavity is a painstaking task that can be resolved with VISI. Regardless of the model's shape, it will feature an upper plate that contains the outer shape of the part and a lower plate that includes the inner form, as well as surfaces that extend across both plates. Direct modelling tools that enable easy splitting help even inexperienced designers correctly separate the core and cavity.

To further increase efficiency, VISI enables users to directly select models of supplier mould components for addition to in-progress designs can significantly simplify engineering and quotation. Once the system generates a bill of materials (BOM), users can easily order supplier components that will be assembled with the final product.
Compatibility between CAD and CAM systems can be vital for transmitting the comprehensive CAD data required for efficient, high-quality manufacturing. While data in a neutral file format can be shared between incompatible systems, it typically misses important PMI related to part tolerances and other essential attributes.

C.M.P. Bresso produces mould (Figure 4) for various industries, including automotive, medical, sports flooring, and electronics. At the turn of the century, it became one of the first companies in Italy’s Piedmont region to produce synthetic corks for wine bottles.

VISI is central to the company’s enduring relationship with its customers. The company offers comprehensive mould services, including design, manufacturing, rapid prototyping, mock mould, mould assembly, and plastic injection moulding. C.M.P. Bresso uses the software to modify and correct complex 3D models, program CNC machine tools, control the positioning of the fourth and fifth axes when required, and generate highly efficient ISO toolpaths.

“We’re able and willing to solve significantly complex projects,” said Walter Bresso of C.M.P. Bresso, who adds that his company is unique because it’s adept at producing moulds for thermoplastic products initially made of metal. “A metal component cannot be reproduced as it is, in plastic, so we redesign it and then use the software to create the mould to ensure the part does what it’s supposed to.”

Flow analysis for validation

The first step in developing the mould design is performing a flow analysis to determine how the plastic material will behave when injected. Many solutions offer varying degrees of study and can integrate into an end-to-end solution to simulate material behaviour. What’s most often needed is a tool...
enabling mould designers, including those lacking extensive experience, to validate that their design will work.

In a worst-case scenario, a mould maker may only receive a part to reverse engineer at the beginning of the project. They may not have 3D CAD data to refer to for comparison. Regardless of whether reference data is available, a flow analysis is required to ensure that the result matches the job requirements requested by the customer. Robust interoperability between VISI Mould and VISI Flow ensures that accurate and identical data is used across both platforms.

Flow analysis helps inexperienced and seasoned designers determine how to set up injection machinery and the ideal size and location of the melt delivery system, including gates, vents, and cooling channels. The flow analysis accounts for cooling lines and predicts how plastic temperatures will be affected by the channels. It will also calculate how long it will take the plastic to reach various points within the mould.

Flow analysis software must be powerful enough to precisely predict warpage and shrinkage in the moulded part, and easy enough to use that less experienced mould makers can achieve project validation. Flow analysis helps mould designers know when to tweak the machine settings, such as pressure or temperature, and adjust cycle times to resolve issues. If the warpage or shrinkage is significant, it’s much less expensive to modify the mould design on the computer during development than after it is physically produced.

**Onni-Stamp**

Established in 1980, Onni-Stamp s.r.l. (based in northwest Italy) incorporates fully integrated project management into its core business of producing plastic injection moulds (Figure 6). At the start of each project, the company teams up with customers for co-creation and co-design activities to make products easier to manufacture, more cost-effective, and of higher quality.

Throughout this complex workflow, VISI software assists with identifying ideal technical and economical manufacturing solutions according to quality requirements, manufacturing volume, and economic investment. VISI is used to simplify the development of moulds with channels shaped to guarantee greater cost-effectiveness and energy efficiency in moulding with dynamic conditioning. The software also helps optimise models and the parameters used to simulate the manufacturing process, including the performance of pressure and temperature sensors within the mould.

Onni-Stamp streamlines engineering, simulation, and manufacturing processes using VISI, a single software solution for geometry analysis, 3D tool design, plastic flow simulation, and CNC manufacturing. The company uses the software’s flow analysis capabilities to predict part failure, achieve reliable mould designs, and save costs by determining optimal moulding conditions.
The symphony of manufacturing

Imagine that manufacturing in full swing is like the performance of a symphony orchestra during which various instruments sound at just the right moment to perform their parts. WORKPLAN is the conductor who understands how all those parts fit together, down to every single note. The symphony of manufacturing centres on harnessing the full potential of machinery, a goal that’s achievable only when you have the machinery, staff, and materials needed to complete each stage of the job in a continuous workflow.

Because WORKPLAN keeps running tabs on all manufacturing activity, it schedules jobs according to staff and machinery availability and views and manages the status of subcontracted work. The digital availability of all manufacturing information goes a long way to ensuring that staff know where to be and when. Large display screens placed on shop floors can help to distil information about jobs and associated machinery even more efficiently. Operators can log into WORKPLAN from the shop floor to access job lists and instructions, making it simple to understand all the details needed to perform the job without stopping to ask the shop lead for information.

As manufacturing gears up to make chips, WORKPLAN checks the inventory to ensure that the required materials are available and flags projects if supplies are low or out of stock. Materials, mould components, and other supplies can be ordered directly through the system interface ensuring that the correct amounts are requested and the ordering process is as efficient as possible. The system helps close the loop after manufacturing by managing assembly, delivery, and invoicing tasks.

Knowledge is power

As experienced mould makers retire, the industry is developing software that captures their knowledge. This built-in knowledge will empower the manufacturers of today and tomorrow.

While making moulds is not getting any easier, tools that expedite and simplify the quotation process ensure that manufacturers can provide figures for the jobs they’ll do while shortening the amount of time devoted to building quotes for jobs they won’t.

Developed to empower less experienced manufacturers, VISI helps to identify problems common to mould manufacturing during development — before errors become costly. Software capable of efficiently orchestrating multiple jobs for seamless manufacturing capitalises on the capabilities of machinery to help manufacturers make the most of their investments in technology while turning out top-notch moulds.

Connecting solutions in an end-to-end process decreases the need to juggle competing demands and reduces the stress of striving to keep all the balls in the air. Using a reliable system powered by data removes the guesswork from planning and manufacturing while ensuring that each stage in the process is a step in the right direction.