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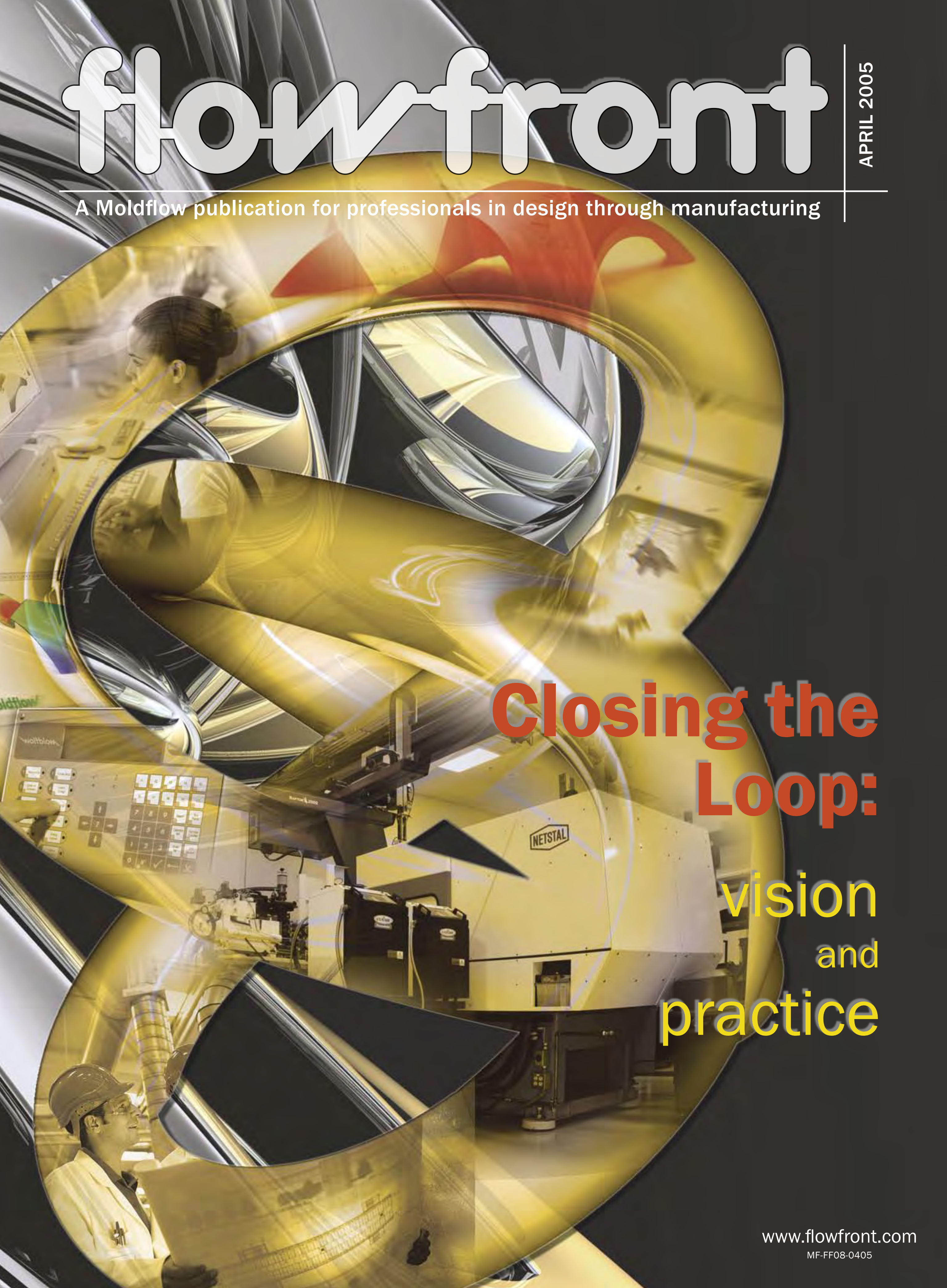

Closing the Loop:

vision and practice

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contents

focus

columns

what's new

design & molding

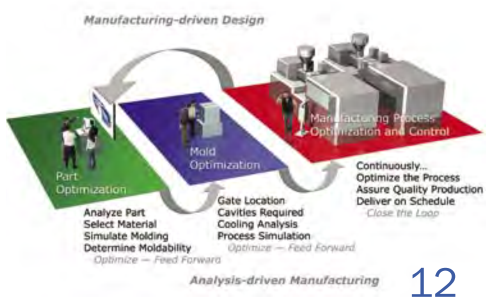
learning curves

polymer pages

real world success

user review

departments



12 A major challenge: How to continuously improve upon an efficient process that produces quality parts?

21 Matrix is the flagship operator interface for the Altanium hot runner process control systems.

24 Moldflow CAD Doctor delivers powerful tools for checking, correcting, healing and simplifying solid models.

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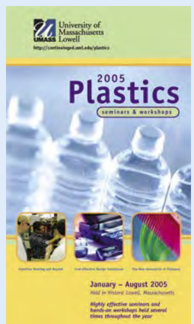

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Closing the Loop: Vision and Practice

In this issue of Flowfront, we look at the concept of "closing the loop" and how it inspires business strategy, technology research and development, and critical thinking that impacts every stage of product development through manufacturing.

Today, increasing numbers of manufacturers are realizing the benefits of investing in innovative software technologies that automate what used to be time-consuming design engineering and manufacturing processes.

Moldflow's president and CEO, Roland Thomas, outlines the company's strategic vision to optimize processes from design through manufacturing. Realizing this vision requires implementing processes at each stage which both feed information forward and receive information from subsequent stages to close the loop between manufacturing-driven design and analysis-driven manufacturing.

In practice, this vision translates to developing better ways to share information directly among the software technologies now in use. Here we review recent research on developing a two-way interface between Moldflow design analysis and manufacturing process set-up tools. We also see how the principle of lean thinking is applied to optimize product development processes.

Case history after case history documents the benefits companies have realized by investing in automation and optimization technologies to retain their competitive edge. As you will see in this issue, Moldflow customers Alcan Distribuzione, Diam France, Edel Tamp, Kanbishi Corporation and Radici Plastics are using Moldflow products to reduce product development times, enhance the quality of their products and services, cut time to market and maximize production efficiency.

Finally, we gain a perspective on how the current trend toward real-time performance management is driving manufacturers toward real-time-based solutions at the manufacturing and enterprise level.

Take note of the 2005 International Moldflow User Group Conference brochure that is included in this issue. Plan to join us in Orlando, Florida this October 25-27. In addition to presentations from peers, industry and Moldflow product experts, you will find a full complement of technical training opportunities offered before, during and after the conference, and you will be able to see firsthand the product innovations that Moldflow and our technology partners offer to truly close the loop and optimize processes from design through manufacture. Find iMUG05 details on the Web at www.moldflow.com/imug.

Marcia Swan

Marcia Swan
Editor

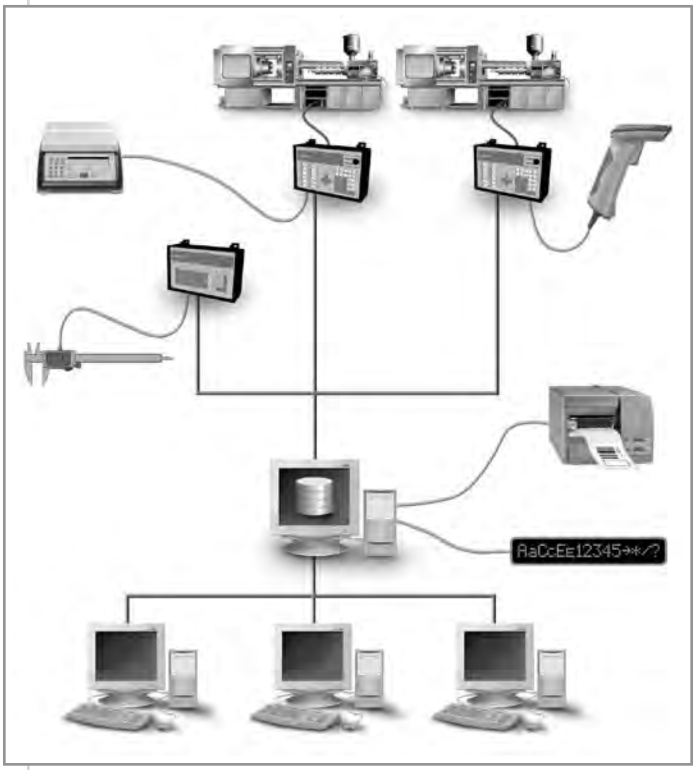
Celltrack™ Production Management — Moldflow's Latest Manufacturing Solution Delivers on Productivity, Profitability

By Nick Smith, Moldflow Corporation

Manufacturers today are not only expected to produce the lowest cost, highest quality products in the shortest time possible, but to improve constantly upon past performance. Many are now beginning to realize that a significant barrier to success lies in the disconnection between manufacturing and enterprise-wide resource planning (MRP or ERP) systems.

Managers who do not have access to production data in real time are at a disadvantage when it comes to making critical decisions for performance management. Basing operations purely on an enterprise-wide system — if one is implemented — and following production through the plant manually does not provide the most accurate or timely information.

Moldflow's Celltrack Production Management system delivers a solution that not only captures production data in real time, but also connects the shop floor to the enterprise. Using proven, state-of-the-art software architecture, the Celltrack system can be attached to virtually any type of cyclic, discrete manufacturing equipment so that valuable production data such as part counts, reject rates and machine status and efficiencies can be taken into account when making critical business decisions.

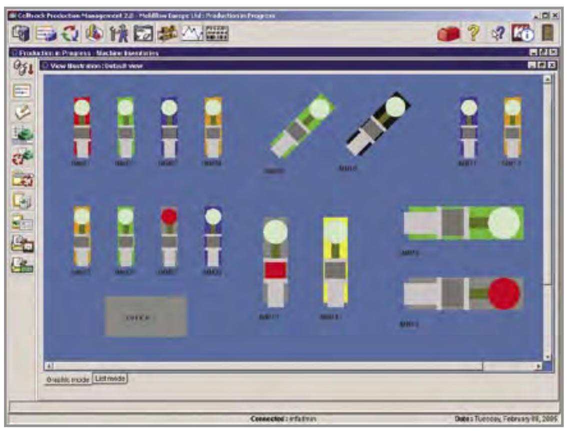


From factory floor to front office — The Celltrack Production Management system tracks and reports production and machine efficiencies in real time and can be interfaced to third-party devices and applications, such as label printers, overhead display units, ERP and reporting systems.

Regardless of the plant size, industry or process type, the Celltrack system provides a clear performance advantage in profitability, productivity and the ability to improve on key cost and customer service metrics.

Celltrack Capabilities

Implementing the Celltrack system allows manufacturing managers to measure constraints, identify production delays and assess machine capacity, providing critical, real-time information to maximize the efficiency of shop floor operations.



View real-time information regarding part counts, defect tracking, machine status and shop floor efficiencies.

Historically, Moldflow's core expertise has been in plastics injection molding, and the Celltrack system benefits from this history. Out of the box, the Celltrack system has predefined parameters for causes of rejects as well as machine status and mold configurations. Customers can modify these parameters or create new parameters to monitor virtually any manufacturing process associated with molding, such as printing, painting, assembly and packing. Customers also can turn to Moldflow's

Effortlessly schedule every machine using illustrative Gantt charts which are continuously updated with live production data.

Custom Applications Development Group for help with specific implementation needs, such as interfaces to enterprise-wide systems, custom production reports or unique data mining facilities.

Once the Celltrack system is implemented, it can automate data collection from a wide range of machinery, store critical production data in a single database, help achieve shorter and more controlled production times, track and reduce production waste and associated costs, and provide the critical link with MRP/ERP systems.

The system also provides capabilities for managing work orders, scheduling production jobs, tracking mold and machine maintenance, and producing reports on the production statistics and efficiency data of all machines. In addition, available add-on modules enable label printing and statistical process control and statistical quality control (SPC/SQC) capabilities.

Tangible Benefits

Customers have consistently reported improvements in information management as well as more efficient machine utilization and mold changeovers and reduced scrap and downtime as a result of implementing Celltrack technology. Productivity increases of two to 10 percent have been noted, and companies have achieved return on investment in as few as two years.

French injection molder CAPI first implemented the technology in 1996 and continues to see positive results. The company boosted its overall equipment efficiency by five percent between 2001 and 2002. “All of our plans of action flow from the performance indicators measured by [the Moldflow system],” notes Mr. Margand, industrial manager. “Not only does the software help us be more responsive thanks to a better flow of information, it also allows us to analyze results in fine detail.”

Knauf Pack, a French molder, serves many clients including those in the automotive and construction industries. These clients must meet ISO standards and are concerned that their suppliers have appropriate tracking capability. The decision was made to move from a paper-based, manual data-input system to the [Moldflow system], in which data is automatically captured for each machine, according to planning manager Jean-Marc Minne. The introduction of the system has helped the firm improve productivity and offer clients shorter delivery times, as it now monitors down times more accurately. The management team analyzes performance indicators, ratios and production statistics to help it reach strategic decisions, for example on a request for investment or machine maintenance. The [Moldflow system] paid for itself in less than two years, thanks to productivity increases of seven percent in the first year and two percent in the second year.

Sagaert-Plasturgie, a unit of the Textile Fauchille Group, offers its customers a one-stop shop solution, covering everything from design to manufacture of plastic components. “Our day-to-day organization and communication have become much easier since the installation of the [Moldflow system],” attests Emmanuel Vandamme, head of the plastics division. “Our overall equipment efficiency has risen by 10 percent, we are saving a lot of time, planning has become child’s play and our concerns over data archiving have now been resolved. We hope to continue moving forward with the Moldflow solution, and eventually to use it in labeling as well.”

Moldflow Manufacturing Solutions

Moldflow’s Manufacturing Solutions business unit focuses on the manufacturing floor and beyond, delivering a suite of products for process setup, optimization and monitoring, hot runner process control and production management. To ensure that Manufacturing Solutions customers realize maximum value from their investment, Moldflow’s Custom Applications Development Group addresses specific implementation needs, such as interfaces to enterprise-wide systems, custom production reports or unique data mining facilities.

Celltrack Production Management is the latest evolution of the CPI90 and CPI2000 systems originally developed by Cȏntrole Processus Industriels, a company acquired by Moldflow Corporation in 2003. The Celltrack system does not depend on and does not interface directly to other Moldflow Manufacturing Solutions software.

The release of Celltrack Production Management demonstrates Moldflow’s commitment to delivering manufacturing solutions not only for the plastic injection molding industry but for discrete manufacturers in general.

Celltrack — continued on page 8

Diam France Increases Productivity with Moldflow's Celltrack™ Production Management Solution

By Catherine Fayret, Moldflow Corporation

With operations in the United States and Europe, Diam International is a world-leading retail merchandising solutions provider focusing on cosmetics and perfumes. The company's customers in this market include L'Oreal, Chanel and Dior, but it also serves non-cosmetic clients such as Microsoft, Gillette and Mont Blanc.

The group has several subsidiaries in France: Diam France, Fieldflex, Adeco, Plasti Rapid and Decoretalage. Diam France (Les Mureaux [Paris], France) employs approximately 300 people. Didier Raymond, injection director at Diam France, manages 25 injection molding machines ranging in capacity from 50 to 1800 tons.

To meet client demands for quality and responsiveness, the company purchased Moldflow's Celltrack production management solution in 2003. Implementing the Moldflow system enabled network planning for each injection molding machine across the entire shop floor. "I can now visualize the injection process on each machine in real time and accurately track production performance data," states Mr. Raymond.

Diam France operates 25 injection molding machines ranging in capacity from 50 to 1800 tons.

The shop floor is organized into workgroups, so the Celltrack system is used to calculate the overall equipment efficiency (OEE) of each workgroup, accounting for both good parts produced and waste rates, among other parameters.

The Celltrack system is connected to Diam's enterprise resource planning (ERP) system to ensure information is transferred from the ERP system to Celltrack. Currently, tests are underway to enable data such as quantities of good and bad parts produced, machine operating time and setup time, to transfer from Celltrack back to the ERP system.

After taking the time needed to adjust the Celltrack system to Diam's particular requirements, Mr. Raymond is now satisfied that Celltrack provides a real benefit. "Since implementing the software, shop floor productivity has increased along with my knowledge of the process," notes Mr. Raymond. "Because I now get accurate figures from Celltrack, this helps me to plan tasks more efficiently and improve production deadlines."

Before purchasing Celltrack, Diam France used manufacturing planning software, but it was not connected to the injection molding machines nor to the ERP system. Implementing the Celltrack system enabled Diam France to increase its knowledge of costs and, consequently, to better manage production and address client demands for increased speed and responsiveness.

Mr. Raymond estimates that Celltrack improves global responsiveness and efficiency of the shop floor. He does not hesitate to show the Celltrack system to his potential clients when they visit the shop floor.

Looking to the future, Mr. Raymond wants to manage fabrication orders that are not linked to an injection molding machine by using Celltrack's manual data acquisition capabilities and even to extend the implementation of Celltrack to other shop floors in the Diam group. ▮

To learn more about Diam International, go to www.diam-int.com.

Celltrack — continued from page 7

With the Celltrack system, customers can automate data collection, store critical production data in a single database, achieve shorter and more controlled production times, track and reduce production waste and associated costs, and link critical production data with enterprise-wide systems to improve information flow and maximize efficiency of cyclic, discrete manufacturing operations. ▮

To learn more about the Celltrack Production Management system, visit www.moldflow.com or contact your Moldflow Manufacturing Solutions representative.

Lean Development

By David Kazmer, Department of Plastics Engineering, University of Massachusetts Lowell

Continued global competitiveness has increased standards for production consistency and flexibility while requiring reduced product development time and unit cost. Consider the following trends in the product development cycle:

- decreasing product development times by an average of 10 percent per year [1];
- increasing mass customization and proliferation of product variety [2];
- increasing reliance on electronic design and manufacturing environments [3]; and
- increasing global dispersion of the product development team [4].

For the design engineer, these trends increase the pressure to quickly deliver functional designs which can be easily manufactured. In theory, improved design and communication tools enable the designer to more accurately define the product specifications, more quickly synthesize robust designs and more accurately evaluate the design performance and manufacturability. In reality, increased product variety and reduced product development time reduce the allowable engineering design time, while the topology of the globally distributed product development team obscures the design interfaces and inhibits communication with manufacturing. For the process engineer, these trends place enormous pressure to manufacture functional components at the lowest possible cost.

All of these trends were recognized more than ten years ago and show no sign of ceasing. In this competitive manufacturing paradigm, the efficient development of robust products and agile processes differentiates the market leader from the follower. Management consultants abound with advice on strategic initiatives [5] such as Six Sigma, Lean Thinking and Theory of Constraints. Of these, lean thinking may provide the most strategic advantage for product design and process development. The American Society for Quality defines "lean" as an "initiative focused on eliminating all waste in manufacturing processes."

Consider the five essential steps for being and staying lean, as applied to product design and process development:

1. Develop the Value Proposition

Value is expressed in terms of how the specific product design or molding process will meet the customer's needs at a specific price and at a specific time. Development of a value proposition may be competitive or cooperative. Tensions may exist about who is responsible, authorized, and rewarded for various contributions. This value proposition should be made and verified from both the internal and external customer standpoints.

Understanding the possible value contributions that you or your organization is capable of providing is vital to commercial success.

For example, a common request made during development is to verify that a product design won't lead to excessive injection pressures. A timely and accurate analysis may fulfill this request, but may not realize the maximum value that could have been attained if the analysis had also considered feed system details, material selection and other product/process optimization issues of which the customer may not be aware.

Understanding the possible value contributions that you or your organization is capable of providing is vital to commercial success. However, you shouldn't necessarily contribute when the customer does not recognize (or is not willing to pay for) your added value. For this reason, you need to define and provide your value proposition to your end customer(s). Once the value proposition is realized, you can identify the value stream within your development processes.

2. Identify the Value Stream

The value stream is the set of activities and decisions through which the value proposition is fulfilled. In an ideal development process, the value stream would consist of all the development activities. In reality, however, only a small set of all the development work truly adds significant value. As such, it is necessary to determine what development tasks add value, and what other development tasks are prerequisites to value-added activities. Other activities should be eliminated, outsourced or automated.

For example, a common issue in analysis is the establishment of process conditions such as barrel temperature, injection time and others. The time spent on establishing these conditions may or may not create significant value, depending upon the application and the value proposition. Is the analysis for a new application or material that has never been molded? Or is the analysis for an existing application for which current processing conditions have been well-documented elsewhere? Does the customer desire sensitivity analysis and optimization of the processing window? Depending on the answers to these questions, you need to utilize different value streams that keep the activities flowing.

3. Make the Activities Flow

Once the identification of the value stream has led to a rational development process, it is important to make the development tasks flow as much as possible. Why? Such tight linkage between activities will ensure that development decisions are made based on timely information. If development decisions are adverse or additional information is necessary, a rapid response from downstream activities should yield immediate resolution from upstream resources since the project is still fresh. Most importantly, the smooth flow of activities without delay will minimize the total development time.

Common roadblocks to flow are work in queue, batch processing of tasks and delays due to the unavailability of required information or materials. There are several strategies that are often used to improve flow. Work in queue and batch processing times are often reduced by adequate resourcing or managed according to project priority. However, they may best be eliminated through cross-training. In the context of product design, could the designer do the simulation rather than wait for results from the analyst, or could the analyst lookup the process conditions in a company database rather than wait for documents from the process engineer?

One commonly used strategy to improve flow with respect to unavailability of information or materials is the use of a kanban-type system, where the arrival of the information or materials triggers the initiation of subsequent action. This strategy not only eliminates delays, but also frees the people in the organization from having to plan, since activities are completed on a first-come, first-served basis. For example, an information technology or form-based system can be established whereby an analysis is tasked only after the product design and process conditions are provided in electronic format.

4. Leverage Customer Pull

Once an efficient development process has been established that fulfills the value stream, lean principles may be advanced by getting the customer to pull the product or service through the process. Customer pull is motivated by the desire to eliminate pushing undesired quantities of products with undesired quality out to the customer. By leveraging customer pull, it is possible to get the customer to specify and even bear the responsibility for the timing, pricing and quality of your output.

Customer pull is often achieved in tightly linked manufacturing processes, but its achievement in product design or process development is more difficult. The key is to integrate the customer into the development process, for instance to provide critical information, or to verify acceptance of critical decisions, or to authorize and initiate new stages of activity. With respect to plastics manufacturing, component end-users are often provided sample parts at the pilot stage of manufacturing. Manufacturing costs and manufactured part quality could often be improved if customers understood the potential benefits of various molding technologies (such as process instrumentation, two-shot molding, etc.) and authorized their use at an early stage so as to optimize both the product and process design.

5. Work toward Perfection

Entropy never stops. Technological progress, customer needs, and competitive threats all dictate the need for continuous improvement. In 1990, the design and analysis of a plastic product was measured in weeks. Today, higher quality work can be completed in hours. Gains in productivity and capability must be continuously delivered, or technology platforms become obsolete, development methodologies become antiquated and cost structures become non-competitive.

The lean development process will lead to higher quality and lower cost. And on a cultural level, lean thinking makes people define their roles and actively contribute to development.

While the described lean principles focus on improving flow and removing non-value adding activities, continuous application will provide benefits on the strategic scale. By improving flow and reducing development time, common development pitfalls (such as lack of cash flow, feature creep, misinformation, and propagation of errors) are reduced. The lean development process will lead to higher quality and lower cost. And on a cultural level, lean thinking makes people define their roles and actively contribute to development. ∎

David Kazmer is a faculty member in the Department of Plastics Engineering at the University of Massachusetts Lowell, where he focuses on modeling, simulation, development and optimization of manufacturing processes.

References

[1] E.A. Muccio, *Plastic Part Technology*. Material Park, Ohio: ASM International, 1992.

[2] M.V. Martin, "Design for Variety: A methodology for understanding the costs of product proliferation," presented at Proceedings of the 1996 ASME Design Engineering Technical Conference and Computers in Engineering Conference, Irvine, CA, 1996.

[3] P.M. Noaker, "CAM's solid modeling connection," *Manufacturing Engineering*, vol. 117, pp. 361-368, 1996.

[4] R. Blaich, "From Experience - Global Design," *Journal of Product Innovation Management*, vol. 5, pp. 296, 1988.

[5] D. Nave, "How To Compare Six Sigma, Lean, and the Theory of Constraints," *Quality Progress*, pp. 73-79, 2002.

A Strategic Vision: Optimize Processes and Close the Loop from Design through Manufacture

By A. Roland Thomas, President and CEO, Moldflow Corporation

Competitive pressures and rising labor and material costs continuously force manufacturers to reduce time to market, decrease part cost, and maximize capacity utilization and production efficiencies without compromising product quality. These are just the facts of life in today's economy, and the plastics industry faces the same constraints that impact all manufacturers. What differentiates companies now is how they respond to these constraints.

In recent years, injection molders have made sizable capital investments to improve quality and efficiency: new injection molding machines, advanced automation and inspection devices, automated assembly machinery and sophisticated materials handling equipment have enabled molding plants to significantly increase output with a lower operating cost basis.

Despite these advances in manufacturing technology — or perhaps, even because of them — the injection molding industry still faces a major challenge: how to continuously improve upon an efficient process that produces quality parts?

Value is created — and lost — at many stages of the process from design through manufacturing, which are not always controlled by the same organization. However, regardless of who is controlling each stage, in order to further optimize efficiency, there is a need for an integrated approach that closes the loop from the conceptual stage of part design, to its high volume production, to its ultimate delivery to the customer, to the feedback of critical information gained at each step in the process so the process as a whole can be improved.

Without an optimization strategy and technologies to execute it, manufacturers are at a competitive disadvantage from the first step in the process.

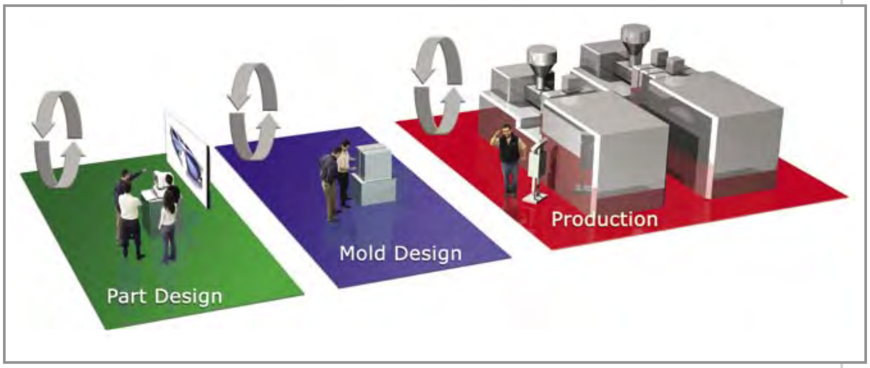
If technology is implemented to predict and solve injection molding manufacturing problems at the earliest stage of product development, manufacturing constraints become design criteria that can be considered at the same time as form, fit and function. If information can be fed forward at each step of the process not only to optimize the part and the mold designs, but to establish molding parameters that produce quality parts at the fastest possible cycle, identify potential production delays, assess machine capacities, predict waste and maintenance requirements, then monitor and control it all in real time, an optimized operation can be achieved. When knowledge acquired from one step can be fed back to previous steps, this closes the loop as the source for future predictive modeling, which makes it possible to further optimize each iteration. And when this manufacturing data becomes available to the enterprise as a whole in real time, informed decisions can be made efficiently.

With an effective optimization strategy, it is possible to achieve the highest possible return on investment in advanced technologies. Recent history has demonstrated that the use of these technologies is no longer the sole domain of large companies tackling the most complex problems. Rather, it has become an everyday tool used to drive manufacturing effectiveness.

Moldflow's vision is to provide solutions not only to optimize each step in the design through manufacture process, but to integrate those solutions to optimize the process as a whole, as well as integrate plastics processing with the overall organization. This optimization strategy closes the loop between manufacturing-driven design and analysis-driven manufacturing.

Islands of Automation — Optimize Each Step

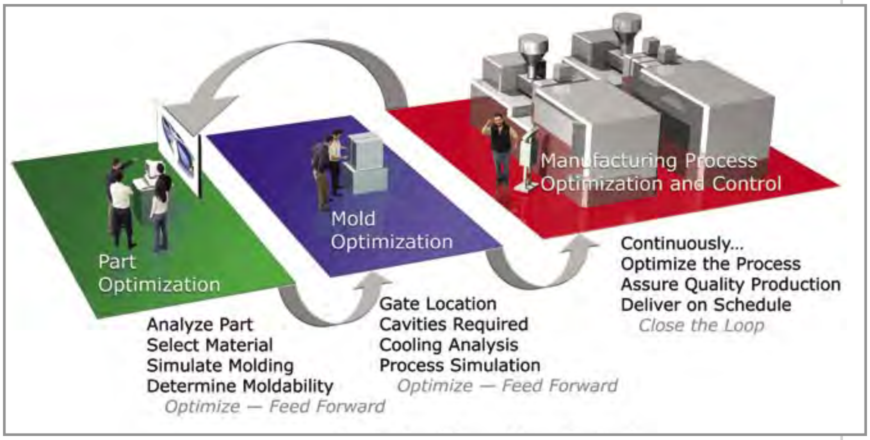
Due to the structure of the industry today, the three key stages of the value chain — part design, mold design and production — actually may be controlled by up to three different organizations. While these



"Islands of automation" operate independently.

organizations may be independent, it is vital that the controlling OEM should drive the optimization imperative into the supply chain.

In this scenario, part design, mold design and manufacturing each may be optimized independently, but the solutions are not integrated. Significant benefits may be realized at each step, but without feeding information forward and back between each step, the opportunity to optimize the process as a whole is lost.



Moldflow's optimization strategy closes the loop between manufacturing-driven design and analysis-driven manufacturing

Integrated Optimization Solutions for Design through Manufacture

Moldflow's optimization strategy closes the loop between manufacturing-driven design and analysis-driven manufacturing using proven technologies that are available today.

Moldflow solutions comprise a scalable set of products with capabilities that include entry level to in-depth part, mold and process simulation that can be fed forward to the manufacturing floor, where potential production delays, machine capacities and waste allowances can be identified, maintenance can be scheduled, and the production process can be monitored and controlled in real time.

"In order to maximize value to the customer and to our company, we must have accurate part design, supported by accurate tool design and construction, supported by an accurate process that's in control time after time," states Steve Rorie of B&B Molders (Mishawaka, IN). B&B Molders have implemented a range of Moldflow design analysis and manufacturing solutions in their effort to close the loop in terms of designing for the manufacturing environment, and they are using the data to communicate internally within the organization as well as with customers and suppliers. Rorie notes, "In today's supply chain, there are multiple tiers of vendors that are part of the communications loop, so without the ability to electronically transfer all the updated project-related data, you are fighting an uphill battle. Thanks to the Moldflow products, we are able to seamlessly and electronically transfer data out of the design engineer's hands and deliver it directly to the shop floor technician's hands."

Manufacturing-Driven Design

Computer-aided engineering (CAE) products, although available for more than 25 years, are only now reaching prominence with the general plastics engineering public. As they relate to the injection molding process, CAE tools can be used to simulate a wide variety of phenomena that occur during the development and manufacture of a plastic part. A recent Daratech, Inc. report concluded, "investment in CAE software and services will top $2.1 billion in 2004… at 25 percent of the PLM market, CAE can no longer be ignored."

Specifically, CAE for plastics is required to determine the optimum wall thickness of a given part design, or to determine the manufacturability of a given part feature such as a thin rib or a thick boss. A change in thickness from 2.0 millimeters to 1.9 millimeters not only means a five percent reduction in material cost, but also an estimated 10 percent reduction in cycle time. During mold design, CAE for plastics can also be used to determine the optimum cooling line layout of an injection mold or to determine an ideal set of processing conditions for a given mold-material-machine combination, all of which drive the creation of significant economic benefit. Moldflow's design analysis solutions have become the world's most widely used CAE solutions in the injection molding industry.

Concept to Part Design

The first step toward optimizing manufacturing operation begins with conceptual part design: use a CAE simulation that allows plastics part and injection mold designers to determine primary geometry factors, such as thickness, aspects of shape and the placement of features. This is achieved by testing these decisions against how easily a part can be manufactured; whether a particular design and material combination will create quality issues; and the positive or negative cost impact.

CAE technologies address a broad range of design geometry types and manufacturing issues. By analyzing each design concept iteration before committing to a particular part design, it is possible to reduce costs and avoid potential downstream problems that can lead to delays, rework and sometimes even to the loss of a customer.

A Strategic Vision — continued on page 14

A Strategic Vision — continued from page 13

To fully optimize the concept-to-part step in the process, both strategy and technology must be structured to feed critical part data forward to the next step.

Part to Mold Design

Feeding the generated part analysis forward to the mold design phase integrates these two steps. The part analysis is based on the assumption that the mold is designed to perform up to its potential. The next step is to turn that assumption into a fact.

Employing the technology to simulate the molding process allows the mold designer to vary gate types, gate sizes and gate locations as well as runner layouts, sizes and cross-sectional shapes. Further, it permits decisions on the placement of the cooling circuits based on molded part performance and the characteristics of the material chosen in the part design phase.

Seeing the potential result of decisions about critical parameters of a mold design before the mold is produced is invaluable, because once the mold is being constructed, the cost to back up and change the design is expensive. Often, the changes are never made due to short-term production demands. From that point forward, that mold will produce more costly parts than would be produced with an optimized mold. Another simulation is very inexpensive by contrast.

Avenue Mould (Sligo, Ireland), is committed to using state-of-the-art products and techniques to develop its molds. "As a result of investing in Moldflow technology," says Felim McNeela, the company's managing director, "we have retained top manufacturers and our return business is at a rate of 98 percent. Our work demands precision and quality and using Moldflow technology assures us and our customers of both."

The key to a successful optimization strategy is to consider and account for manufacturing constraints during the part and mold design steps. This is manufacturing-driven design optimization.

Analysis-Driven Manufacturing

The use of design analysis makes it possible to create a mold that has the potential to perform efficiently. Used intelligently, design analysis results can provide appropriate initial conditions from which to begin the manufacturing process setup and downstream optimization and control tasks.

Moldflow's manufacturing solutions products comprise a complete suite of tools that can be used for the setup, optimization, and control of the injection molding process, as well as related production monitoring and management. The primary objective of manufacturing optimization is to realize the potential of the mold and achieve and maintain the best processing conditions, resulting in higher part quality and more efficient use of machine time.

Mold Design to Molding

From the design analysis steps, information is available regarding key quality criteria for the part, including control of short shots, flash, warpage, dimensional tolerances, flow front velocity, constant flow front temperature, and frozen layer thicknesses.

From this data, it is possible to automatically determine the optimum processing conditions, including the injection stroke, injection velocity profile, velocity-to-pressure switch-over, and pressure profiles required to produce a quality part given the specific mold-machine-material combination.

Further, the data fed forward from the mold design step provides information such as number of cavities, cycle time, clamp tonnage and shot size to assist with manufacturing decisions, such as determining which injection molding machines are capable of producing the part and pre-determining production capacities.

Molding to Quality Parts

At this point, with technologies in place to integrate part design with mold design and mold design with molding, it is now possible to feed forward setup conditions directly to the injection molding machine.

Automating the setup process enables production to start more quickly and shortens the time required to determine and achieve the ideal process parameters and cycle time, all of which facilitates reducing time to market. This is analysis-driven manufacturing.

"Manufacturers recognize that each and every process provides a vital link to real-time data for the enterprise as a whole…" — Craig Resnick, ARC Advisory Group

Once the machine is running and producing quality parts, the next phase of optimization begins: the manufacturing process is continuously monitored in real time and, where necessary, it is automatically corrected to assure that only quality parts, produced at the lowest possible cost, are fed forward into the production stream.

Quality Parts to the Customer

The next step in the process is to deliver those high-quality, lowest-cost parts to the customer in the right quantities and at the right time.

Many manufacturers are now beginning to realize that a significant barrier to success lies in the

A Strategic Vision — continued on page 28

Engineering Polyamides for Automotive Under-the-Hood Applications

By Giovanni Pioltini, Marketing & Technical Service Director, Radici Plastics

Until some years ago, polyamides were used in automotive applications mainly where mechanical behavior was the dominant characteristic, for example, parts such as radiator end tanks, fan shrouds and electrical connectors.

Polyamides were also used for some parts which required good surface finish characteristics, such as external mirror housings, door handles and steering column switches, but in all of these examples, the exposed surface is limited in area and, in some cases, painted. In polyamide wheel covers, surface finish became critical because of the relatively large surface area of the items and because every surface problem is amplified by the paint.

The introduction of plastics for under-the-hood applications such as engine covers (Figure 1) forced producers of polyamides to develop materials that fulfilled the new specifications received from original equipment manufacturers (OEMs) for these applications: thermal aging behavior, dimensional stability, flow characteristics, paintability and surface finish. Polyamides were chosen as base materials for these applications because of the working temperature of the engine compartment and because of polyamides' natural resistance to the liquids encountered in automotive applications: oils, fuels and coolants.

For thermal aging behavior, the requirements are usually 1000 hours at 130°C with a maximum of 50 percent change. Flexural strength heat aging tests have been performed according to DIN 53452 on several compounds using different thermal stabilizers; Figure 2 shows the results at 0, 1000, 2000 and 3000 hours for material used in the engine cover application referenced in Figure 1.

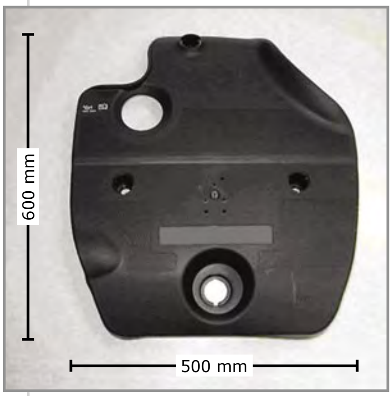


Figure 1. Engine cover molded of Radilon S RCP3010LK black.

Dimensional stability has been attained by blending in a 1:2 ratio glass fiber, to get high stiffness and impact resistance, and a special mineral filler, to reduce differential shrinkage due to glass fiber content.

Finally, due to the relatively large dimensions (600 mm x 500 mm for the engine cover shown in Figure 1) and the thickness (2 mm to 3 mm) of typical under-the-hood applications, the material must flow very well in order to reduce the injection pressure required on the molding machine. Moreover, it is necessary to minimize the injection time, because polyamide materials show a high crystallization speed, which could stop cavity filling in cases where a long flow path occurred in the mold cavity combined with reduced part thickness and material flow.

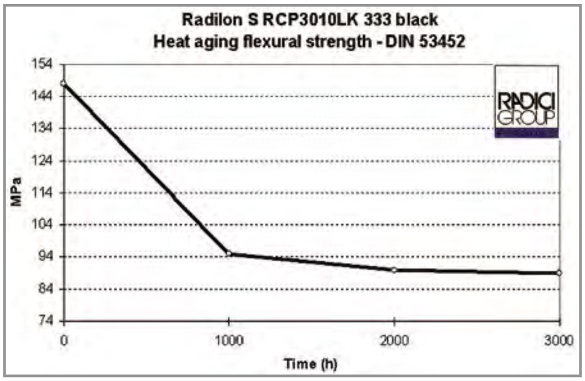


Figure 2. Flexural heat aging results for Radilon S RCP3010LK black.

Generally speaking, in order to improve flow characteristics, it is necessary to reduce the viscosity of the base polymer, but this means reducing impact resistance as well. This material behavior is described in Table 1, where mechanical properties of a standard viscosity material (Radilon S 27) are compared with those of a low viscosity product (Radilon S 24).

Table 1. Mechanical properties comparison of low viscosity and standard viscosity materials.

	Radilon S 24 (low viscosity)	Radilon S 27 (standard viscosity)
Charpy notched impact strength, + 23°C, J/m	5	7
Tensile modulus, MPa	2700	2900
Yield stress, MPa	70	75
Strain at break, %	40	45

The impact strength for the low viscosity material is nearly 30 percent lower than that of the standard viscosity material. This means that simply reducing the viscosity of the base material will significantly reduce the impact resistance of the resulting compound. In order to modify material flow characteristics, therefore, we cannot manipulate just the material viscosity, but it is necessary to account

Engineering Polyamides — continued on page 16

Engineering Polyamides — continued from page 15

for impact strength to the level the application needs by adding substances able to reduce the melt strength of the material.

The deal is finally to find the right compromise among viscosity, additives (lubricants and other processing aids), filler (mineral), glass fiber and pigments, which creates the suitable compound formulation for the application in hand.

Figure 3 shows the rheological behavior of the Radilon S RCP3010LK black material (used for production of the engine cover shown in Figure 1) due to viscosity and additives at three temperatures.

The desirable flow characteristics of the material are shown by shear rates higher than 10E+3 1/s, because those are the shear rate values occurring in the injection molding process (shear rate values lower than 10E+3 1/s correspond to an extrusion process). Moreover, reducing the melt viscosity means lower pressure on the injection molding machine for filling the cavity; as a result, a lower clamp force is required for the process, and consequently, a smaller injection molding machine could be used for the production of the engine cover.

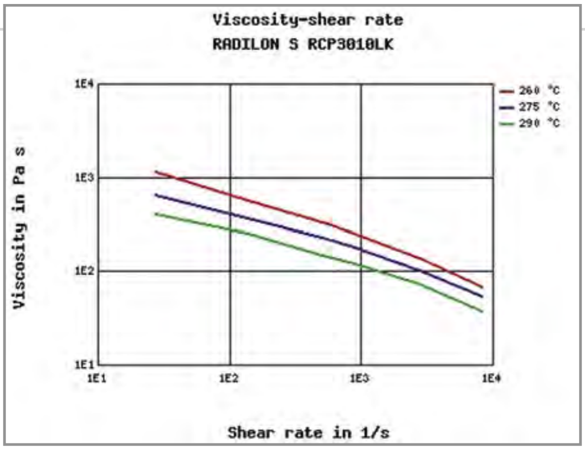


Figure 3. Rheological behavior of Radilon S RCP3010LK black.

As mentioned above, mechanical properties must be controlled when materials are modified to improve flow characteristics: the right choice of fillers and a very good knowledge of compounding technology are the keys for achieving the target mechanical properties targets specified by the original equipment manufacturers (see Table 2).

Tailoring the material for the engine cover application is really the first step for beginning tool design. At that step, it becomes necessary to cooperate closely with the tool makers in order to take best advantage of the material behavior. That is why the Radilon S RCP3010LK material has been fully characterized for flow and warpage behavior by Moldflow Plastics Labs, and this is one of several Radici Plastics products included in the Moldflow database.

Table 2. Material properties of Radilon S RCP3010LK black

Mechanical properties	dry / cond	Unit	Test Standard
Tensile Modulus	8200 / 6250	MPa	ISO 527-1/-2
Stress at break	95 / 65	MPa	ISO 527-1/-2
Strain at break	2.9 / 2.9	%	ISO 527-1/-2
Charpy impact strength (+23°C)	45 / 52	kJ/m²	ISO 179/1eU
Charpy impact strength (-30°C)	44 / 49	kJ/m²	ISO 179/1eU
Charpy notched impact strength (+23°C)	6 / 8.5	kJ/m²	ISO 179/1eA
Charpy notched impact strength (-30°C)	5.1 / 5.5	kJ/m²	ISO 179/1eA
Thermal properties	**dry / cond**	**Unit**	**Test Standard**
Melting temperature (10°C/min)	220 / *	°C	ISO 11357-1/-3
Temp. of deflection under load (1.80 MPa)	195 / *	°C	ISO 75-1/-2
Temp. of deflection under load (0.45 MPa)	210 / *	°C	ISO 75-1/-2
Vicat softening temperature (50°C/h 50N)	210 / *	°C	ISO 306
Burning Behav. at 1.6 mm nom. thickn.	HB / *	class	IEC 60695-11-10
Thickness tested	1.6 / *	mm	IEC 60695-11-10
Burning Behav. at thickness h	HB / *	class	IEC 60695-11-10
Thickness tested	0.8 / *	mm	IEC 60695-11-10
Electrical properties	**dry / cond**	**Unit**	**Test Standard**
Volume resistivity	1E13 / 1E11	Ohm*m	IEC 60093
Surface resistivity	* / 1E12	Ohm	IEC 60093
Comparative tracking index	* / 550	-	IEC 60112
Other properties	**dry / cond**	**Unit**	**Test Standard**
Water absorption	7.5 / *	%	Sim. to ISO 62
Humidity absorption	2 / *	%	Sim. to ISO 62
Density	1330 / *	kg/m³	ISO 1183

Filling and warpage analyses are necessary in order to minimize the typical problems encountered in molding engine covers: burns, flash, white stripes, weld lines and item deflection. Engine covers today are wider than some years ago and have more complex shapes. Therefore, choosing the right number, type and dimensions of the gate(s) with the help of upfront analysis is a key factor for reducing the time necessary for tool building and trials. Using Moldflow analysis together with precise material properties helps tool makers to find different injection system solutions — for example, multiple hot runner sequential injection — for producing finished parts that meet the specified functional and aesthetic properties. ▮

To learn more about Radici Plastics, visit www.radiciplastics.com.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* Conference registration fees include admission to all conference sessions, refreshments and meals during the conference and welcome reception, transportation to the Night Out festivities, and the conference proceedings CD.

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Closing the Loop in Practice: Exchanging Process Set-up Data between Design Analysis and Manufacturing Solutions Tools

By Marcia Swan, Moldflow Corporation

Moldflow's overall design-through-manufacturing optimization strategy relies on closing the loop between manufacturing-driven design and analysis-driven manufacturing. One of the company's research and development projects has focused on interfacing mechanisms between injection molding process analysis tools and tools for automating machine setup.

Recent work has shown that the interface is an effective way to communicate between these tools. The results can benefit both design and process analysts and manufacturers by achieving process conditions that are consistent and based on scientific principles. Analysis results yield more accurate predictions of molding outcomes when input process conditions match shop floor process parameters, and more accurate predictions of process conditions in turn yield machine setup parameters that are more accurate, thus cutting the time required to set up a successful process when manufacturing begins.

Evolution of Design Analysis and Manufacturing Solutions

Since the early 1980s, computer-aided-engineering tools have been commercially available for injection molding process simulation. These software tools focus on plastic part and mold designs as well as processing conditions to analyze the plastic material flow and solidification behavior during the molding process. While countless examples have been published over the years to illustrate the benefits of Moldflow Plastics Insight® (MPI®) and Moldflow Plastics Advisers® (MPA®) design analysis tools, a continuing source of concern in using these tools remains: if the input processing conditions used for analyses do not match the actual processing conditions used in manufacturing, the results of the simulated process will differ from the actual molding outcomes.

In the 1990s, Moldflow developers began looking for a way to apply process knowledge and feedback at the machine itself, to minimize molding defects and achieve consistent quality of molded parts in production. This newer type of tool monitors important process parameters, such as pressure and ram position, which are used to automatically set up, optimize and control the molding process during manufacturing. The Moldflow Plastics Xpert® (MPX®) system was released commercially in 1998. While the method applies scientific principles to achieve and maintain a robust process window that produces consistent quality parts, if the initial conditions set are far from the optimal conditions, it may take a long while to arrive at the optimal conditions through iterations of the method.

Reaching Across Time

Both the design analysis tools and manufacturing control tools described above cover the details of the injection molding process, but these two types of tools work in different time scales. Generally, minutes to hours are required to complete a molding simulation (depending on the design complexity), while the typical cycle time required to mold one part is seconds, and process control tools must send feedback in this short timeframe.

Developing an interface for exchanging data between the two types of tools is the easiest way to realize the benefits of both and close the loop across the time gap.

The obvious application of such an interface should be to detect possible molding problems during the mold trial, because the actual processing conditions may not be known during the earlier part and mold design stages. Before molding trials begin, the emphasis is on using design analysis tools to investigate alternatives and troubleshoot potential problems related to runner systems, gate locations and types, dimensional stability, cooling efficiency, cycle time and operation cost reduction, and so on, in order to begin the molding trial with a design that is close to optimized based on theoretically reasonable process parameters.

Identifying Data Requirements

Input of correct processing conditions into a process simulation is one of the key elements required to achieve accurate analysis results. Table 1 lists important processing conditions required for analysis.

The process parameters recorded by injection molding machine control tools represent the actual interaction among particular part and mold designs, plastic material and process conditions. The recorded data can be classified as either machine information or time series data. Table 2 lists the data produced from machine control tools.

The machine data and major process data, such as injection pressure and ram position time series, can be used directly or indirectly to establish the process conditions required for analysis, as described in Table 1.

Table 1: Process conditions used for flow analysis.

Feature	Description
Velocity control	Various options such as fill time, flow rate or ram speed control
Pressure control	Various options to set up a profile; extends into packing phase of molding process
Velocity/Pressure switch-over control	Typically set as a percent of cavity volume filled; other options may be used
Melt temperature	Temperature of the molten plastic when it enters the mold cavity
Cooling time	Time required for plastic to cool and solidify before the part is ejected; typically the greatest contributor to total cycle time

Table 2: Process data from control tools.

Data	Feature	Type/availability
Machine Data	Maximum injection stroke	Single value
	Maximum injection rate	Single value
	Machine screw diameter	Single value
	Intensification factor	Single value
	Maximum injection pressure	Single value
Process Data	Ram position	Time series
	Ram velocity	Time series
	Injection pressure	Time series
	Velocity/Pressure switch-over	Indirect
	Mold surface temperature	Time series (if available)
	Melt temperature	Time series (if available)
	Open time	Indirect
	Cycle time	Indirect

Developing the Two-Way Interface

From Machine Control Tool to Analysis Tool

The time series data from the machine control tool comprise hundreds of values and often include some "noise." Also, some parameters need to be derived indirectly from the recorded process data, such as the switch-over point and the end of filling point. The interface from the control tool to the analysis tool includes these capabilities:

- Filters out noise and non-physical values
- Builds a characteristic curve with fewer data points
- Derives important parameters from curves
- Allows human intervention to modify the resulting process conditions, if desired

From Analysis Tool to Machine Control Tool

The second component of the interface is to pass results from analysis tools to the machine control tool. This feature is to help set up the machine with optimized process conditions determined through design analysis.

Example

Figure 1 shows the pressure time series data recorded for an example case. In order to follow the pressure curve closely in the filling and packing stages, one option is to set the switch-over point in the flow analysis earlier than it was set in the machine. For demonstration purposes, a switch-over value of 0.67 second is used in this example, and the pressure trace curve is then converted from this time on — the resulting fitted curve is shown in Figure 2.

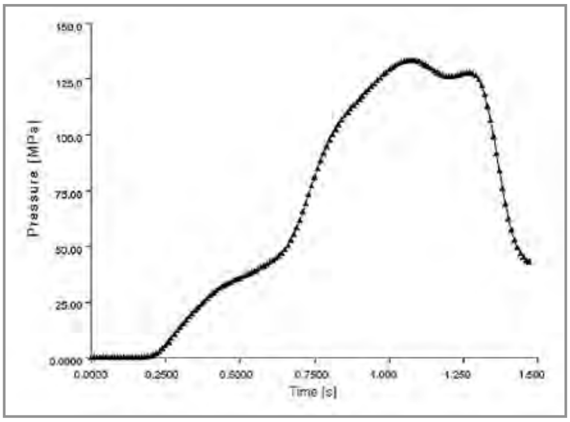


Figure 1. Injection pressure time series data recorded by the machine control tool.

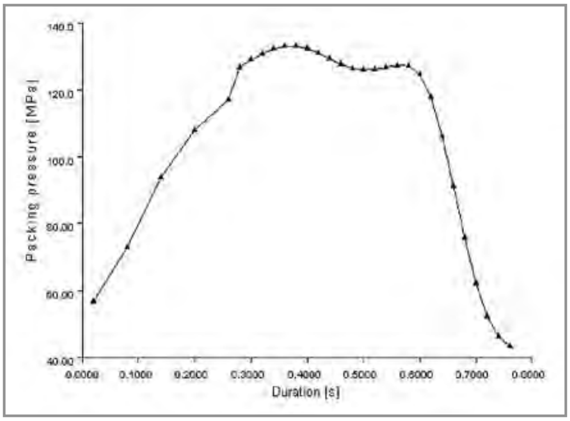


Figure 2. Pressure profile fitted from time series data when switch-over is set to 0.67 sec.

Figure 3 shows the resulting injection pressure profile from the flow analysis for this case. There is good agreement between the fitted data and the traced data, and between the pressure profile setting and the resulting predicted injection pressure.

Exchanging Process Set-up Data — continued on page 28

Design-through-Manufacture Provider Relies on Moldflow Plastics Insight Solutions in Manufacturing Risk Assessment

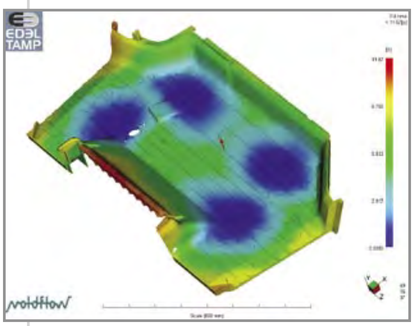
By Catherine Baghdiguian, Moldflow Corporation

Edel Tamp (Annecy, France) was established in 1989 by its present CEO, Yannick Edel. The company designs and manufactures thermoplastic injection-molded components, producing capital goods such as garden machinery (lawnmower casings), street lighting, fans, electrical components and similar items. Edel Tamp controls the whole development process for its products from design through manufacture and relies on skilled employees using high-quality, computer-aided design and injection molding simulation tools to quickly set up molds and manufacture products.

The company operates two manufacturing plants in the Ain region and employs a workforce of about one hundred people. The manufacturing plants are equipped with molding machines ranging in size from 40 to 1,800 tons. The company has remained successful during the recent global economic downturn while much larger organizations, which traditionally attracted more customers because of their supposed financial stability, have experienced problems. Edel Tamp's customers are loyal, and the company's products are long-lasting.

Yannick Edel has a reputation for clear thinking. He has been using Moldflow design analysis software for many years, and now has the full suite of Moldflow Plastics Insight® (MPI®) modules. He commented, "Most of the products we develop require us to use the full gamut of process and structural calculation modules. And the fact that we have all the MPI modules means that we can simulate any injection technique (filling and packing, gas, sequential, injection-compression), which is handy and reassuring for our customers."

Mr. Edel has drawn up a working Failure Mode, Effects and Criticality Analysis protocol for studies to assess manufacturing risks, which relies on MPI software. "We wanted to add something to the FMECA procedure carried out on each product, defining the manufacturing risks before setting up molds. This approach also allows us to change the design of the part if this proves necessary," he explained. Simulation accuracy depends on the quality of the input data and is sometimes viewed as suspect. To counteract this, Yannick Edel is committed to being extremely accurate. If he is making the injection mold and producing the part in-house, he will not accept a simulation study from a third party. This insistence on maintaining control of the entire design-through-manufacture process provides an added security bonus for his customers.



Filling pattern result for a floor mat product using a TPE material.

During the risk assessment procedure, the results of MPI simulations using midplane, Fusion (Dual Domain™) or 3D models may be compared with a view to achieving the best conclusion. MPI/3D analyses, in particular, can be used to highlight areas of difficulty in great detail. For every application, after basic filling (MPI/Flow) and cooling (MPI/Cool) analyses are completed, a structural calculation is carried out using MPI/Warp and MPI/Shrink analyses to predict to what degree the molded components will shrink and warp. If a fiber-filled material is selected for an application, MPI/Fiber analysis is used to predict the fiber orientation and mechanical strength of filled parts. MPI/Stress analysis is used to define how much load a molded component can bear and how much it will deform when subject to this load.

In addition to traditional injection molding processes, Edel Tamp uses gas injection techniques. Parts to be manufactured using gas injection molding need to be carefully designed to position the gas channels effectively. MPI/Gas analysis is used to show how the material will behave at specific points and define the filling pattern of plastic and gas; midplane and 3D models help to highlight certain features of the gas-assist parts.

The company follows the same risk assessment protocol incorporating MPI solutions for all types of injection molding processes. The benefits of this software are enormous in terms of prestige, risk evaluation and mold development. All this is possible thanks to Yannick Edel's in-depth knowledge of the MPI software. Edel Tamp has gained a real competitive edge over its rivals and is truly able to offer a total solution for thermoplastic injection-molded components, from design right through to production.

The company's next step will be to introduce Moldflow Manufacturing Solutions products to assist the manufacturing process itself, with features including molding machine self-correction parameters, process management and shop floor monitoring.

Moldflow’s Matrix™ 2.0 Software Release Improves Operator Interface to Altanium® Hot Runner Process Control Systems

By David Rotondo, Moldflow Corporation

Matrix is the flagship operator interface for the Altanium product line. Matrix provides an intuitive, graphical user interface through a high-resolution touchscreen display. The Matrix software delivers the most comprehensive set of standard features and supports the maximum number of control zones among all of the available Altanium operator interfaces. With point-and-push simplicity, icons and pull-out menus give instant access to numerous temperature control, data recording, alarm and diagnostics functions.

The Matrix operator interface sets a benchmark in intelligent temperature control capabilities, with 12- to 18-inch touchscreen operator interfaces featuring high contrast, full color graphics.

The new Matrix 2.0 software release provides new networking capabilities, enhanced diagnostic and troubleshooting options, additional error handling functions, improved mold setup options and support of PDF documents. All of the new features, enhancements and fixes are detailed in the on-screen release notes.

Highlights include:

- Network capability now allows users to connect the system to the company network for remote viewing, control and other tasks.
- Users now have the ability to select among three types of Diagnostics tests. Users can now choose to run a Heater, Sensor or Wiring test individually, or they can run all the tests. A new Troubleshooting screen helps users perform a test automatically — users select their problem description from a list, and the Matrix then performs the proper tests on the user-identified zones.
- Error Log enhancements allow users to view Setup Errors, Mold Errors or All Errors by pressing the appropriate button. Users can also clear the setup and mold errors.

The Matrix 2.0 software provides a new Process History screen which allows users to view historical data that is being logged.

- System III Orion and Altanium Orion2 mold setups can now be imported into the Matrix.
- The new Remote Setup Load option allows you to load any mold setup from a remote location, for example the injection molding machine.
- It is now possible to sort the dynamically changing information throughout the system. This can be very helpful for troubleshooting a process.
- A new Process History (Data Recording) screen allows users to view historical data that is being logged. Users can select between a graph or text view, set the logging frequency and enable or disable data logging. An Export Data function now allows users to export the historical data to a USB disk in a CSV format. This can then be loaded in an application such as Microsoft Excel for data manipulation.
- It is now possible to import and view PDF documents.
- An INFO key has been added to the main screen. Pressing this key will launch the PDF viewer and display the Matrix Operational Guide.

The Matrix 2.0 release is available now for English-language implementations. Support for other languages is planned and will be made available in future releases. ▮

To learn more about Moldflow’s Altanium hot runner process control systems and the Matrix operator interface, go to www.moldflow.com. Contact the Moldflow customer support team to request the Matrix 2.0 update.

Developing Precision Automotive Parts: a Case Study

By Kazuto Matsumoto, Development Sec., Engineering Dept., Kanbishi Corporation

Plastics have become essential materials for use in automotive applications. Plastic components are now found throughout the vehicle in parts of the engine, fuel system, safety system and chassis, as well as exterior and interior décor. Demand for plastics in automotive applications, especially for engine components, is predicted to increase in the future. Plastics are valued because they are lighter in weight, offer better performance and decrease the cost of the vehicle compared to other materials. The recent trend emphasizing global environmental protection, resource conservation and lower fuel consumption can be supported by promoting lightweight automotive parts.

Computer-aided engineering (CAE) analysis has become an indispensable tool in the development of automotive parts, because using CAE analysis has been proven to decrease development time and reduce development costs. After introducing Moldflow's CAE analysis products at Kanbishi Corporation, even inexperienced engineers now gain understanding of plastic material properties and analysis content early in the design phase. They can analyze and extract the most appropriate geometry before manufacturing the pre-production mold. They can also analyze processes during the pre-production mold trials. As a result the number of mold trials and associated costs have been greatly reduced.

Optimization of a Fuel Delivery Pipe

Moldflow analysis was used in the development of a fuel delivery pipe, an automotive engine component. The material chosen for this application is a 66 nylon (PA66) containing 35 percent glass fibers, which has the appropriate heat resistance, strength, stiffness and other necessary properties.

The key factors in this product are the flow pattern and minimization of warpage. Thus, optimizing the mold design — the runner system, including gate locations, and the cooling system — is important. However, there are other factors related to part production which must be considered. It is important to know in the initial stages of product development how factors such as the flow pattern of the polymer influence weld lines, warpage and strength.

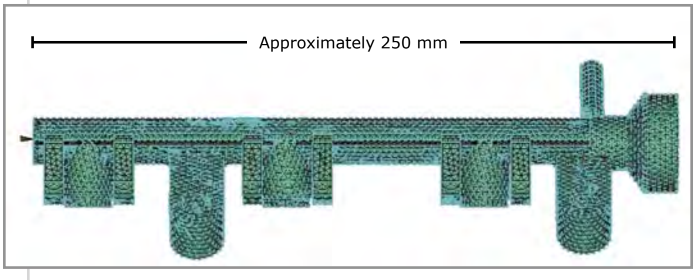


Figure 1. Analysis model of the fuel delivery pipe.

Polymer Flow Analysis

Using Moldflow analysis it is possible to consider how gate location and processing conditions such as material temperature, mold temperature, injection time and packing can influence the flow pattern and warpage of the product. In the initial stage of development, it is also possible to design the geometry with attention to the parting line of the mold. In this case, both confirmation of the gate location and strength are important.

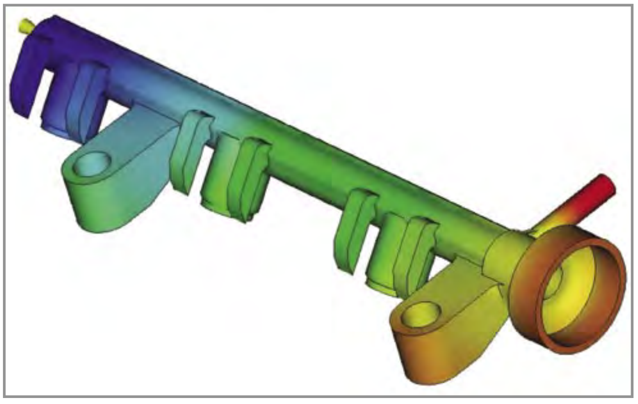


Figure 2. Flow pattern (overall).

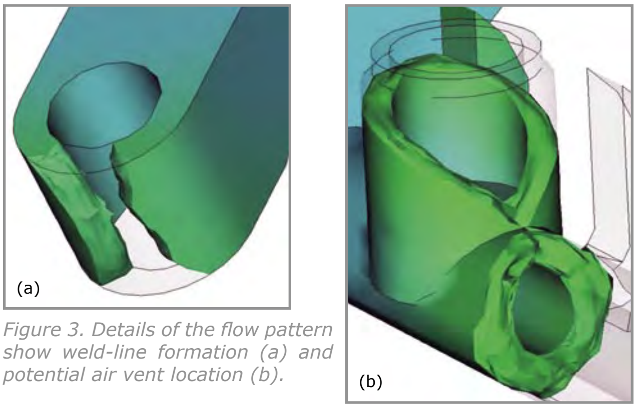


Figure 3. Details of the flow pattern show weld-line formation (a) and potential air vent location (b).

The flow pattern of the fuel delivery pipe is shown in Figure 2; details of the flow pattern, shown in Figure 3, highlight formation of weld lines in critical locations and gas traps where air vents may be needed.

By confirming the flow pattern in this way, the following factors can be predicted and identified:

- Location of weld lines — confirm areas where part strength may be insufficient.
- Location of gas traps — confirm regions where air vents are necessary.
- Balance of fill — Confirm that the flow is balanced.

These factors can be considered in the design stage before determining the final mold geometry. By analyzing the product geometry, modifications can also be made to influence the part thickness and flow pattern, decrease pressure requirements and lower temperature. Using this information, it is possible to build a mass-production mold that is free of problems when product manufacturing begins.

Warpage

For this fuel delivery pipe, warpage will affect product performance. If a warped fuel pipe is installed on the engine, it is necessary to correct the warpage with the fastening bolts.

Moldflow analysis was used to confirm the difference in warpage that occurred depending on different gate locations and to decide the most appropriate gate location to minimize warpage. Warpage results of two potential gate locations are shown in Figure 4.

When glass-fiber-reinforced materials are used, the orientation of the glass fibers can influence part warpage. Placing the single point gate at the left end improved the part warpage by more than 30 percent compared to the warpage that occurred with the single point gate located at the mount position. It is possible to further reduce the warpage by improving the molding conditions.

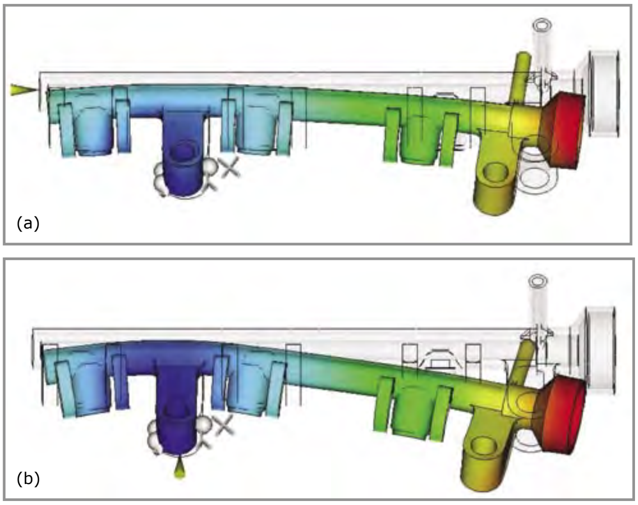


Figure 4. Warpage results (magnified five times) for a single-point gate at the left end (a) and at the mount position (b).

Strength

The orientation of glass fibers in the material not only greatly influences warpage, but also the strength of the product itself. The overall strength depends on the product geometry, but the part is often weakest in the regions where weld lines form. In the fuel pipe, weld lines form around the holes where fastening bolts are inserted. Figure 5 shows the orientation of glass fibers (a) and the material's modulus of elongation (b) at the weld line location identified in Figure 3(a) for the part design using the single-point gate on the left end.

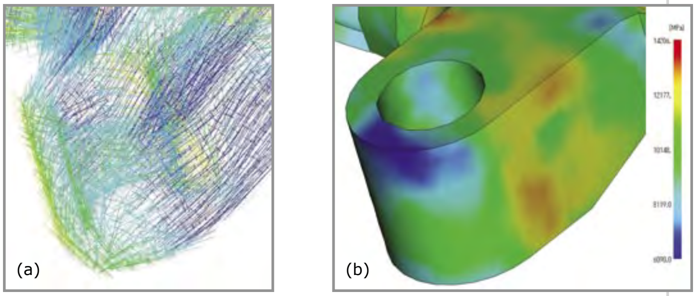


Figure 5. Orientation of glass fibers (a) and modulus of elongation (b) at weld line locations.

Because of the parting line location and part geometry, it is difficult to change locations of weld lines by changing the gate location or increasing the number of gates. This is why it is important to know where weld lines occur and confirm the impact on part strength from the initial phases of development. Using Moldflow analysis, it is possible to predict the strength of the product by examining the fiber orientation and modulus of elongation at weld lines that occur in critical areas.

Traditionally, it was the practice to confirm part strength by using a structural analysis and comparing those results with the physical properties of the selected material. Now, using Moldflow analysis to predict the variation of the modulus of elongation in the part makes it possible to use this data in the structural analysis. Based on this, further decreases in development time and costs can be realized by comparing the results obtained from molded parts with the results of Moldflow analysis and extracting the options possible to correct part strength earlier in the development process. Being able to accumulate this know-how early in the process is the most important reason to increase the frequency of CAE analysis during product development.

Kanbishi Corporation was established in 1951 as a manufacturer of automotive parts and now has expanded its business to include functional components for architectural uses and gas appliances. To learn more, go to www.kanbishi.co.jp.

Working with Moldflow CAD Doctor

By Murali Annareddy, Moldflow Corporation

Plastics part models created using CAD software and imported into Moldflow Plastics Insight® (MPI®) and Moldflow Plastics Advisers® (MPA®) products can be broadly classified into two categories: solid surfaces-based and facets-based models. Solid surfaces-based models include IGES, Parasolid, Pro/ENGINEER, CATIA V5, SolidWorks and STEP formats, while STL models fall into the facets-based category.

This article focuses on problems that may be encountered when importing solid surfaces-based models to the Moldflow design analysis environment and introduces the Moldflow CAD Doctor™ product specifically to address these problems.

Problems with solid surfaces-based models are inherited by the analysis mesh creation process, which results in an assortment of mesh quality issues. There are two groups of problems:

- Geometry Errors. These problems are a byproduct of the 3D CAD data translation process. These can be caused by human error or by mathematical inconsistencies that occur when data is converted from one system to another. Uncorrected geometry errors result in gaps, unmeshed surfaces, overlaps and intersections in the mesh (Figure 1).

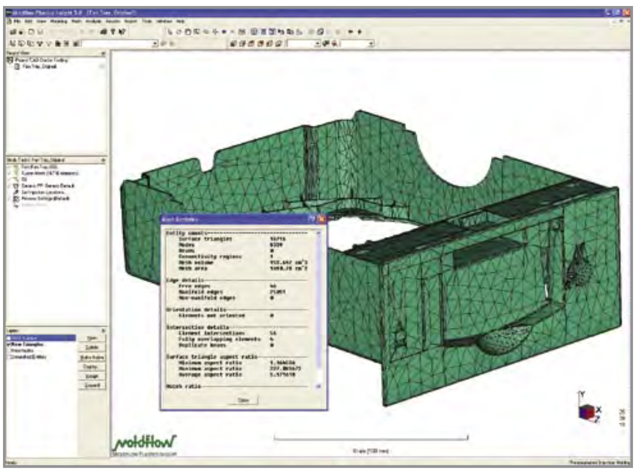


Figure 1. Mesh quality issues due to geometry errors.

- Geometry Complexity. These problems arise from the use of intricate design elements such as lofts, blends, sweeps, fillets, chamfers and the like. Geometry complexity affects mesh by increasing the number of required elements and resulting in elements with poor aspect ratios.

An example model is used here to highlight the salient features of Moldflow CAD Doctor.

A typical workflow in Moldflow CAD Doctor involves four steps: geometry checking; free edge stitching; geometry healing; and geometry simplification.

Step 1 — Geometry Checking

Use Moldflow CAD Doctor to check the model for more than a dozen model quality issues (Figure 2). These issues include free edges, intersecting edges, intersecting surfaces, overlapping edges, duplicate edges and sliver edges, among others.

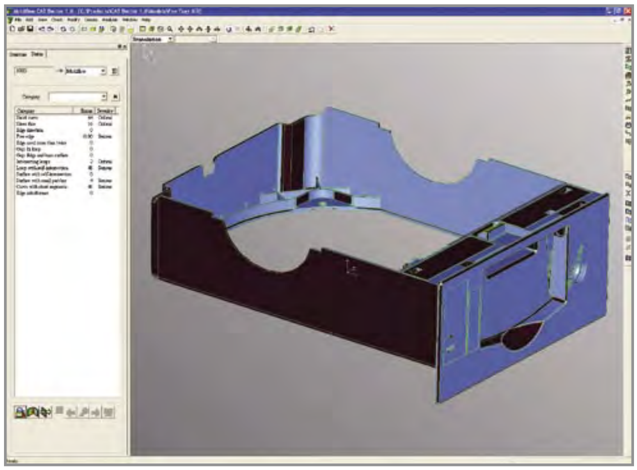


Figure 2. Model quality issues identified in the checking step.

Advanced options provided allow you to perform other model quality checks (from a suite of thirty), customize the types of checks performed and adjust the tolerance and threshold values used in identifying these problems. Moldflow CAD Doctor supplies intelligent default tolerance and threshold values suitable for Moldflow design analysis solutions.

Step 2 — Free Edge Stitching

Once the various model quality problems have been identified, you can automatically stitch free edges. The stitching process uses a tolerance value, which is automatically calculated by the Moldflow CAD Doctor program. A useful feature is the preview of the stitching process for a given tolerance value. The preview allows you to gauge the effectiveness of the tolerance value used and adjust it if necessary.

Stitching of free edges typically corrects the majority of the model quality problems (Figure 3). Model quality issues that remain are targeted for correction in the next step, model healing.

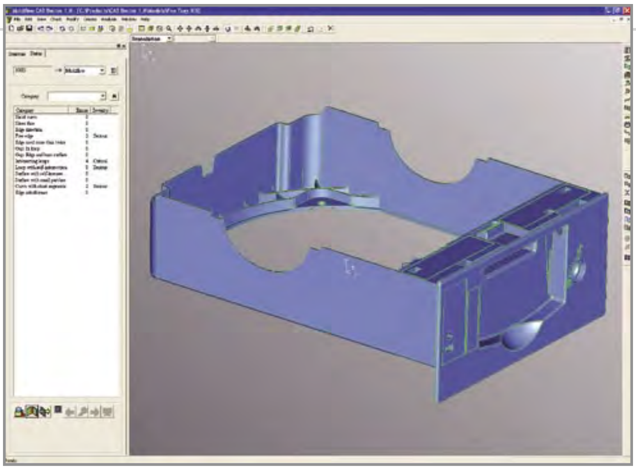


Figure 3. Model at the end of the free edge stitching step.

Step 3 — Geometry Healing

Healing is a crucial step to ensure the integrity of the model. Healing targets the following problems: self intersecting surfaces and curves, gaps between trim curves and base surfaces, sliver faces, short curves and other issues.

At the end of the healing step, occasionally a few model quality problems may remain (Figure 4). These require manual intervention. Moldflow CAD Doctor has interactive diagnostic tools that allow you to zoom into a problem area (Figure 5) and isolate the problem surface(s) from the rest of model. Additionally, repair tools are provided based on the type of problem being solved. Use these repair tools to manually correct any remaining problems in the model.

When all of the identified model quality problems have been corrected, you may choose to export the model for use in MPI and MPA analyses. Optionally, you may choose to perform geometry simplification before exporting the model.

Step 4 — Geometry Simplification

Geometry simplification is an optional step in preparing a model for Moldflow analysis. It is important to note that performing geometry simplification will modify the geometry intent, although the changes will be minimal. The objective of the simplification step is to identify and remove or suppress features that add complexity to the geometry. These features include small fillets, chamfers, radii, slivers, shallow ribs, tiny holes, tool symbols, embossing, logos, lettering and similar small details.

Moldflow CAD Doctor — continued on page 27

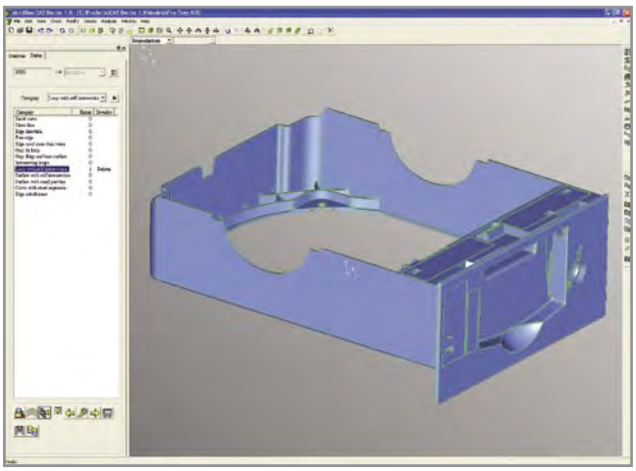


Figure 4. Model at the end of healing step.

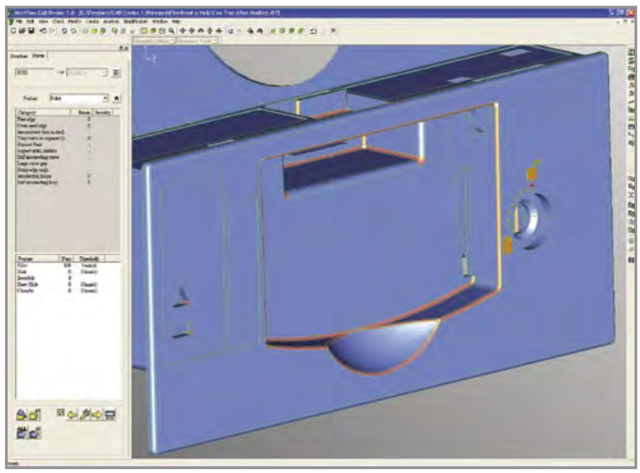


Figure 6. Highlighted features are targeted for geometry simplification.

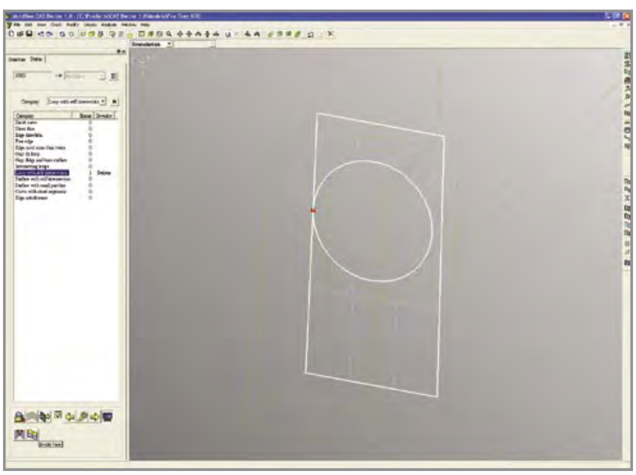


Figure 5. Example of model correction using manual repair tools.

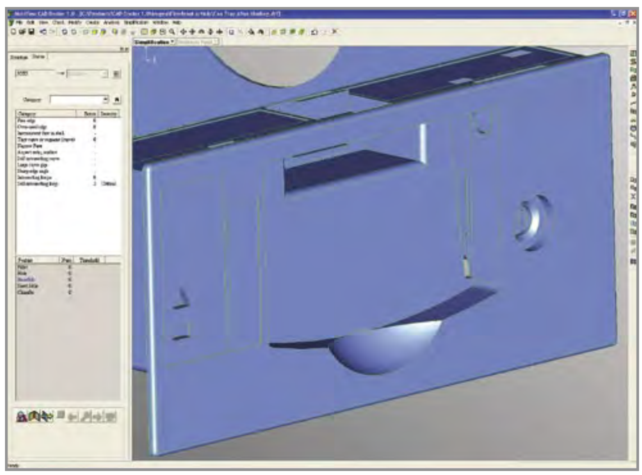


Figure 7. Model after the simplification step.

Competitive Advantages of Aluminum Molds for Injection Molding Applications: Process Simulation Used to Evaluate Cycle Times

By Claudia Zironi, Alcan Distribuzione, in collaboration with Università degli Studi di Modena and Reggio Emilia

Converting plastic materials to finished products is a process which benefits from detailed analysis as early on as the initial concept of the part. The design as a whole includes a number of parallel studies in addition to the part geometry: the creation of the finished product begins with the mold cavity, which must incorporate both aesthetic and functional characteristics which are passed on to the part; and the manufacturing process parameters, which must be considered with the aim of improving the level of quality delivered at the lowest cost and in the least amount of time. In particular, the mold design and construction phases, functionality of the mold, shortest possible cycle time and the lifespan of the mold all have to be guaranteed so as to ensure the required production run. The choice of the mold material has a considerable affect on each and every one of these specifications.

Aluminum can be machined at high speeds and it has high heat conductivity. These characteristics confer clear advantages when considering a material for construction injection molds: a reduction in the amount of time (and therefore the cost) spent on machining the mold, faster cycle times, more flexibility to simplify the cooling channels. Together, this translates to a reduction in the time to market. However, a number of shady areas regarding the competitive advantages of aluminum molds still have to be studied in detail. To this end, a recent study carried out by Alcan Distribuzione together with the Università degli Studi in Modena and Reggio Emilia — Department of Material Engineering and the Environment, investigated how heat conductivity can reduce the cycle time and affect the quality of the finished part. The research is now the subject of a degree thesis, financed by Alcan Distribuzione, and a number of seminars.

Aluminum Under Observation

The idea for the study project came from the observation that, in terms of assessing cycle times, the information available is often not that accurate; there is no coherent analysis and the mold-maker often finds it difficult to benefit from reducing cycle time alone, because the mold-maker may not be involved in the manufacturing process itself. There being little concrete data available, the decision was made to simulate the injection molding process and evaluate the results achieved.

To begin with, steel molds were compared with aluminum molds to see what the differences were in terms of the mold-cooling time (and, as a result, the cycle time) and the level of quality of the parts that resulted from each type of mold material. Analyses were carried out on a number of different parts of different sizes, made out of various plastic materials and used in different market sectors.

To gauge the level of quality of the finished product, a tolerance level was set regarding a critical dimension for the part in question. To allow for the functionality of the geometries being examined, it was, in fact, necessary that certain specified dimensions respected rather low tolerance levels. With the specified tolerances as a guide, for parts with very tight tolerances, the mold-cooling times required to achieve the same level of precision in the part were compared between steel and aluminum molds. For parts deemed to have less critical tolerances, only the mold-cooling times were evaluated without regard to specific dimensional criteria.

While the process simulations did not make it possible to deduce a general rule in terms of the number of advantages obtained using aluminum molds — because the parts studied differed a great deal in morphology, size and polymer used in manufacture — the heterogeneity of the sample was valuable to give an extensive and complete report of trends across various applications. Moldflow Plastics Advisers (MPA) simulations were used in these investigations.

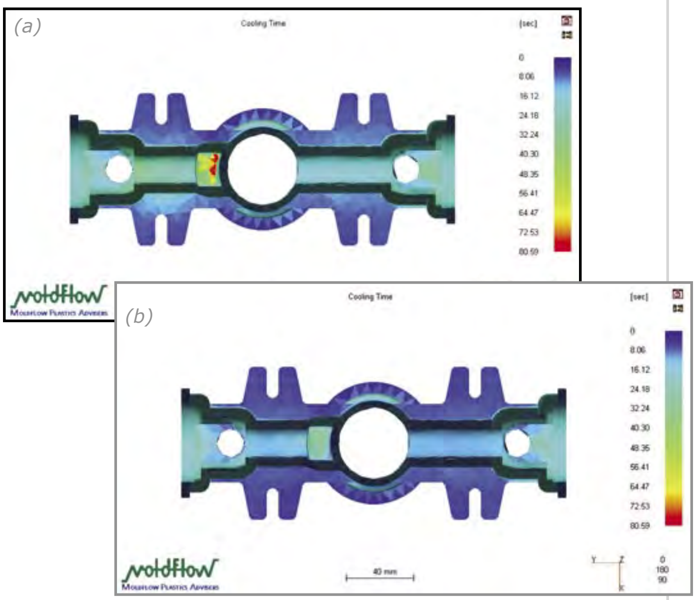


Figure 1. Comparison of the mold cooling times for a connector (cross-section view) when using a steel mold (a) and an aluminum mold (b).

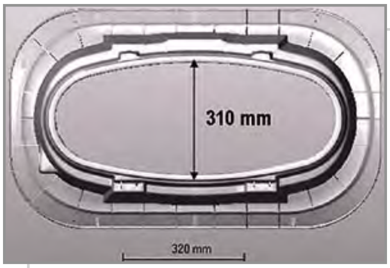


Figure 2. Critical dimension studied in the gas tower case.

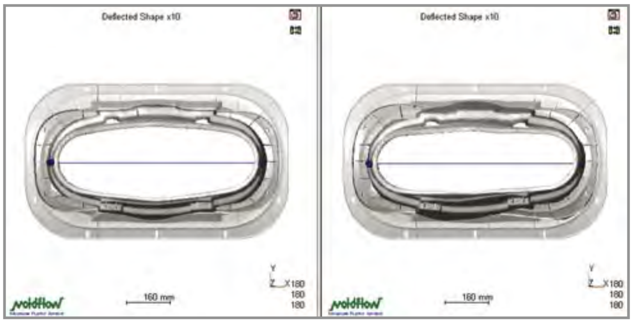


Figure 3. Deflection of part molded using the aluminum mold (left) and the steel mold (right) when cycle time is the same (deflection amplified 10 times to facilitate visualization of results).

From Simulations to Conclusions

The use of MPA simulations was fundamental for improving the geometries of the mold cavities and the corresponding process parameters. Further, access to an extensive database of materials meant that it was possible to simulate the molding process using different types of thermoplastic resin. Finally, using efficient automatic reporting tools, it was possible to quickly compare the results of the analyses regarding the molds made out of normal tool steel (P20), with those achieved using either of two of Alcan's top alloys: Alcast and Certal SPC.

Among the various cases studied, two are detailed here. In the first, no heat distortion occurred. In the second, deformation affected the critical dimensional tolerance level.

In the first case, the effect of using Certal SPC aluminum alloy compared to P20 steel as the mold material was evaluated for a connector molded of PA66. The use of this aluminum alloy was suggested by the need to have a big production run. Compared to the Certal SPC mold, with the steel mold it was necessary to extend the mold-cooling time by 10 seconds before the component could be extracted from the mold, and the total cycle time increased from 42 to 52 seconds — an increase of 24 percent using the steel mold.

In the second case, the effect of using Alcast aluminum alloy compared to P20 steel as the mold material was evaluated for a part molded HDPE. The part is a tower for containing aerosol gases, and in this case, a critical dimension in the area where the tower would be joined to the lid was affected by heat distortion. When the same total cycle time was imposed for both mold materials, the part made using the steel mold proved to be much more deformed.

To maintain the dimensional tolerance level specified for the part, it was necessary to increase the mold-cooling time of the steel mold by 60 seconds, with a corresponding 72 percent increase in the cycle time compared to the aluminum mold.

Table 1. Summary of increase in cycle time when changing from aluminum to steel mold for the two example cases.

Part	Cooling Time, Aluminum Mold	Cooling Time, Steel Mold	Increase in Total Cycle Time
Connector	12 sec	22 sec	+24%
Gas Tower	40 sec	100 sec	+72%

After having carried out simulations on 12 parts, which had very different characteristics in terms of shape, size and plastic material, it was concluded that significant savings in total cycle time could be realized by using aluminum instead of steel molds. Cycle time savings of 10-25 percent were seen in cases where there were no critical tolerances linked to the deformation of the part due to effect of the heat. However, even greater savings of 60-200 percent were seen in cases where heat deformation affected critical design tolerances levels. ▮

Alcan is a multinational, market-driven company and a global leader in aluminum and packaging, as well as aluminum recycling. To learn more about Alcan Distribuzione, visit www.alcandistribuzione.it.

Moldflow CAD Doctor — continued from page 25

Including these complex features increases the number of elements that result when the analysis mesh is generated and usually results in longer analysis times. However, these features are small enough that they rarely affect the flow of plastic through the part and may safely be removed from the analysis part geometry.

For the example model, several of these complex features are highlighted (Figure 6) and through the simplification process either removed or suppressed (Figure 7).

Supported Input and Output Geometry

Moldflow CAD Doctor 1.0 supports the import of IGES and CATIA V4 (requires optional add-on license) models. Moldflow CAD Doctor 1.0 outputs models in Moldflow's proprietary UDM format, which can then be imported into MPI 4.1 or higher and MPA 7.1.

Moldflow CAD Doctor delivers powerful tools for checking, correcting, healing and simplifying solid models imported from popular 3D CAD systems in preparation for Moldflow analysis. ▮

To learn more about Moldflow CAD Doctor and all of Moldflow's CAD Connectivity Tools, go to www.moldflow.com.

A Strategic Vision — continued from page 14

disconnection between manufacturing optimization and enterprise-wide resource planning (ERP or MRP) systems. "Manufacturers recognize that each and every process provides a vital link to real-time data for the enterprise as a whole, which is especially critical with the move towards Real-time Performance Management," notes Craig Resnick of the ARC Advisory Group.

Managers who do not have access to production data in real time are at a disadvantage when it comes to making critical decisions for performance management. Only when a manager can measure constraints, identify production delays, assess machine capacities, track waste and maintain equipment will the manufacturer be able to consistently deliver what is expected at the right time.

Plastivaloire (Langeais, France), an injection molder specializing in complex components for the automotive, electronics and consumer goods market sectors, has implemented Moldflow's production management technology (Celltrack™). "The Moldflow system has enabled us to improve our machine capacity utilization by 10 percent and to cut our scrap rates, resulting in lower raw material consumption," states Mr. Audiger, head of the company's IT organization. "We are making lasting gains by improving the information which we receive in real time thanks to the Moldflow system: on each production run we see improvements in down-times, recycling times, mold changes, production start and finish times."

Closing the Loop

The last step involves integrating statistical process control (SPC) methods and measuring and archiving data for all the critical parameters per shot during production. Once this information is retrieved, it can be fed forward once again to provide more detailed manufacturing constraints as input to refine the predictive design analysis in the next iteration of the design-through-manufacture cycle.

Moldflow delivers technology solutions that can be used to optimize and integrate processes at every step from conceptual part design through manufacture, effectively closing the loop between manufacturing-driven design and analysis-driven manufacturing. ▮

To learn more about Moldflow solutions for optimizing design through manufacturing, contact your Moldflow representative or visit www.moldflow.com.

Exchanging Process Set-up Data — continued from page 19

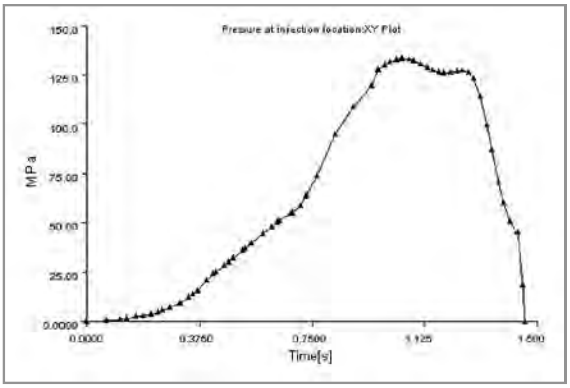


Figure 3. Injection pressure profile predicted by the analysis tool.

With data passing from both analysis tools to control tools and control tools to analysis tools, the interface provides a two-way communication mechanism which is a powerful tool for users to diagnose technical problems in the real world of plastic injection molding. ▮

Based on research reported in "Interfacing Process Setting Data between Analysis and Machine Control," by Xiaoshi Jin, Paul Brincat, Baojiu Lin and Zhongshuang Yuan, submitted for presentation at the Society of Plastics Engineers Annual Technical Conference, Boston (2005).

References:

- Hieber, C.A. and Shen, S.F., "A finite element/finite difference simulation of injection molding filling process," J. Non-Newtonian Fluid Mech. 7, 1-32 (1980).
- Tucker, C.I., (Ed.), "Computer Modeling for Polymer Processing," Hanser (1989).
- Chiang, H.H., Hieber, C.A. and Wang, K.K., "A unified simulation of filling and postfilling stages in injection molding: Part I and Part II," Polymer Eng. Sci. 31 (1991).
- Kennedy, P., "Flow Analysis Reference," Moldflow Pty. Ltd. (1993).
- Speight, R.G., "Injection Molding Process Control," Society of Plastics Engineers, Technical Papers Vol. 46 (2000).
- Sherbelis, G. and Speight, R.G., "On-Line Viscosity Control for the Injection Molding Process," Society of Plastics Engineers Annual Technical Conference, Dallas (2001).
- Speight, R.G., Reisinger, L., Lee, L. and Spence, M., "Automated Injection Molding Machine Optimization," Society of Plastics Engineers Annual Technical Conference, Dallas (2001)
- Bakharev, A.S., Speight, R.G. and Thomas, A.R., "Automated Plastication Setup for Injection Molding Machines," Society of Plastics Engineers Annual Technical Conference, San Francisco (2002).
- Bakharev, A. S., Speight, R.G., and Brincat, P.A., "Closed Loop Viscosity Control for Injection Molding," Society of Plastics Engineers Annual Technical Conference, San Francisco (2002)
- Astbury, D.R., Bakharev, A.S. and Speight, R.G., "Automatic Injection Velocity Initialization for Computer-Assisted Injection Molding Setup," Society of Plastics Engineers Annual Technical Conference, Nashville (2003).
- Bakharev, A.S. and Speight, R.G. "Closed-Loop Process Control Strategies for Thermoplastic Injection Molding," Society of Plastics Engineers Annual Technical Conference, Nashville (2003).

Manufacturing Performance Services Software Leverages Production Information

By Craig Resnick and Greg Gorbach, ARC Advisory Group

Manufacturers operate in an environment that requires an exchange of information across all domains of the manufacturing enterprise. Manufacturers recognize that each and every process provides a vital link to real-time data for the enterprise as a whole, which is especially critical with the move towards Real-time Performance Management (RPM) that uses dynamic performance targets to drive an enterprise to its optimum potential and competitive advantage. This is driving manufacturers toward real-time-based solutions at the manufacturing and enterprise level, a space served by Manufacturing Performance Services (MPS) software.

Analysis

Manufacturing Performance Services software is an indispensable component of Collaborative Production Management (CPM) systems. It provides a common basis for using manufacturing information from the plant floor to enterprise systems and business partners. Supporting the enterprise's information and visualization requirements places new demands on manufacturing and typically requires the coordination of disparate sources and platforms. Manufacturers also recognize that connectivity of each and every process is essential for an enterprise to achieve operational excellence.

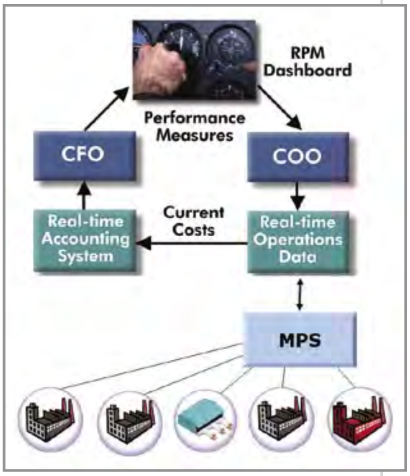
Fact-based analysis drives consensus and improvement, which is impossible without the real-time connectivity of both enterprise systems and the plant floor.

MPS Software Is Part of an RPM Strategy

Manufacturing Performance Services software provides manufacturing information to people, processes and applications, and delivers new performance capability to users at the plant-level and throughout the distributed manufacturing enterprise and supply network. MPS software provides real-time data collection and connectivity at the plant floor, establishes operational context and exposes manufacturing information to the rest of the enterprise.

Real-time Performance Management

MPS software provides the foundation for manufacturers to run their business using an RPM strategy from the bottom up. A plant-centered enterprise component, MPS software can tap all operational areas, including production, planning, quality, engineering, inventory/materials management and maintenance and asset management applications. These solutions typically scale to work across multiple plants and locations. Benefits can include higher levels of production, better asset utilization, reduced production cost, improved local decision-making and improved service to customers.



MPS software provides the foundation for RPM at the plant level.

A role-based, personalized view of this information can be available to distributed users, who may include plant managers, operators, manufacturing executives, process engineers, IT professionals, maintenance personnel and business partners, so each can see the plant and production information they need to make the best decisions in real-time with current data.

Functionality

Key MPS software functionality includes: service-based connectivity to a wide variety of plant equipment and legacy systems; manufacturing context information, often based on a plant model or historian; aggregation, transformation and conditional processing of data; distributed visibility via dashboards or portals; data interfaces for Web service applications and other applications; and the ability to create new performance applications to leverage the data and systems that currently exist.

MPS software suppliers may also provide an execution engine and additional modules such as SPC, analytics or decision support. These suppliers may also provide integration with ERP systems, enterprise platforms and other business systems using OPC, ISA 95, OAGIS, or the like, as well as other applications such as analytics and performance measurement.

Scalability, management and deployment, and common context of data across multiple facilities are proving to be very important for large manufacturers. Some manufacturers look for a standardized data model to support this kind of functionality. Another approach is to integrate elements of synchronized

Analyst — continued on page 30

Analyst — continued from page 29

business processes, manufacturing-initiated supply chain alerts or events and new business processes to support operations based on existing sources of data.

Many Suppliers Are Active in the MPS Software Space

Until a few years ago, the only place where plant floor information from a multitude of sources could be found in a single location was in the production management system. Many CPM suppliers even positioned themselves as a solution to the 'spaghetti integration' problems manufacturers faced when trying to pull together information from many sources. Often this was based more on the idea that CPM products provided a centralizing application, rather than any specific integration or information management functionality. Today, however, CPM products are quite likely to have these functionalities.

More recently, a small number of suppliers took a narrowly focused approach, initially concentrating on the data and its manufacturing context, and serving it up to people and applications. These pioneers have established a new approach to dealing with manufacturing information, based on the use of new technologies. They are now adding even more value for their customers by supplying additional modules to allow users throughout the plant or extended enterprise to enhance manufacturing performance using decision support, analysis, quality or other packaged functionality that leverages the newly available information.

Another group of suppliers has also targeted this niche, and they are sure to have an impact. Human Machine Interface (HMI) companies have awakened to the realization that they are well-positioned to create and offer MPS software solutions. ARC feels that these companies will heavily leverage their large HMI installed bases to become formidable players in this market.

Recommendations

Manufacturers should utilize the ARC MPS software model as a template for providing real-time data collection and connectivity at the plant floor, establishing operational context, and exposing manufacturing information to the rest of the enterprise.

MPS software suppliers should leverage technologies and standards such as XML, OPC and ISA 95 to develop products that gather, organize, and expose manufacturing information and deliver the required performance capabilities that manufacturers need to support their distributed enterprises and supply networks. ▮

Founded in 1986, ARC is the leading industry analyst and research firm in manufacturing automation and supply chain. Greg Gorbach is Vice President of Collaborative Manufacturing and Craig Resnick is Research Director for Manufacturing.

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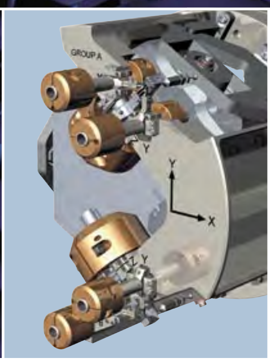

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