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PITNEY BOWES BENEFIT FROM SHORT SERIES PRODUCTION USING SPACE PUZZLE MOLDING™ (SPM)

Getting the product right before the 'high-burn' of development cash

During the full cycle of a Rapid Product Development (RPD) project, the budgeted development cash is consumed at variable 'burn' rates for each stage.

During the concept and design stage, the costs are relatively predictable since they mainly comprise the regular wage bill for in-house staff, fixed fees from consultant design services, if required, and the operational costs of in-house CAD systems. For established multi-product companies this procedure is a well-travelled path as new products are sequentially introduced.

In the case of more advanced product development companies such as Pitney Bowes, the worldwide manufacturer and supplier of office paper-handling systems for mailing and other operations whose established new product, the "DI200 OfficeRight Mailer"™ paper handling product (Picture 1) is used to illustrate this article, have extensive facility and experience to move smoothly from the virtual fit and function stage in CAD, through to working prototypes.

Techniques such as vacuum casting, rapid machining from solid, and their own in-house SLS facility, place Pitney Bowes' designers and engineers in the forefront as users of RP technology. Again, this stage is relatively 'low-burn' and predictable, but it must be realised that, with all these various prototyping techniques, there is an inherent limitation to full, Alpha-build, assessment, due to the inability of these techniques to yield molded prototypes to production specification in production intent materials.

Typically, the intended production volume for products of this type can be between 2 to 5 thousand per annum depending on the application and the market success.

It is necessary therefore, at the appropriate stage, to commission full production tooling for injection-molded items such as the chassis illustrated (Picture 2). This is where the 'cash-burn' starts to ramp up for such tooling is both complex and expensive. In parallel with this it is normal for Marketing to release early specifications and to set up for the distribution and sales of the finished product. Nobody wants a warehouse full of finished product with nowhere to go.

It is more than just desirable, but increasingly regarded as essential, if the ultimate tooling is to be correct from square one, that the Alpha and Beta bench tests, be performed on items identical in design and material to the intended final specification. On previous exercises there has been no option but to wait for the 'first-off's from full tooling, an anxious time for designers in case expensive modifications become necessary due to unforeseeable problems in the molding.

At this stage in the game conventional RP has served its purpose as an *'enabling technology'* in the design process and it is now time to use the opportunity presented by the *'bridging technology'* of Space Puzzle Molding™ **(SPM)** to pre-test the production specification in real materials.

Space Puzzle Molding™ (SPM) provides a unique solution

Pitney Bowes were the first UK company to use Space Puzzle Molding™, a patented and exclusive process from protoform in Germany, on a major project although it has been used extensively elsewhere in Europe and the USA. This particular exercise took the process to new limits with spectacular results,

The Space Puzzle Molding™ process involves the rapid manufacture by CNC machining of a set of metal mold-forms and inserts capable of reproducing the design exactly, in every feature, but without ejectors or the full bulk of a fully automated production injection tool. Typically the finished volume of the tool can be no more than 20% larger than the envelope of the product itself as the exploded CAD picture of tooling and component illustrates (Pic 3).

Prior to injection, which can be in a wide choice of materials and with the opportunity of insert/outsert inclusions, co-injection and gas assisted techniques, the tool is assembled manually by skilled technicians at the side of the molding machine rather like the sophisticated 3D space puzzles which give the process its name.

The patented part of the SPM process is the device into which this assembly is loaded onto the face of the injection machine. These bolsters or carriers are universal to particular volumes of SPM tooling, and hold the secret to variable mould flow patterns, gating, and also providing the strength and stability required for the manufacture of series identical parts.

Every piece of the SPM tooling assembly is machined with great precision but remains easily modifiable to accept retrospective design changes after the Alpha build results are known. From ‘one off’s on demand for test purposes to several hundred for product launch is the main thrust of this popular technique which has been in operation by protoform in its home factory near Germany’s Nuremberg airport for over 25 years now, and claims in excess of 8000 successfully completed plastic product exercises.

The cost of SPM of tooling varies with complexity but can generally be regarded as 50 to 60% of the full production tool. The component cost, due obviously to the labour intensive assembly and mould stripping, can be expected to be between 8 and 10 times that of the mass produced item.

The investment paid off ‘in spades’ for Pitney Bowes

Principal Engineer, Barry Simkins, of Pitney Bowes picks up the story at this point:

“When we discovered Space Puzzle Molding™, via our US operation, we also learned of the satisfaction of clients such as Kodak and others. We recognised both the technical and commercial value of the process immediately.

Our new product at that time was the DI200 OfficeRight Mailer ™ illustrated and the most critical items were 2 of the 3 large and complex chassis components.

The SPM process was sufficiently rapid for the first off-tool molded items to be bench tested before committing the budget for the production tooling. This highlighted an early problem where more strength was needed to prevent a hinge area from cracking.

This and other minor design changes were simple to incorporate by modifying the SPM tooling. We also gained useful information about tool operation which we were able to pass on to the production toolmaker. Sufficient quantities of series-identical product were promptly made available for early-to-market samples to be made and also for operator training.

As we entered the ‘high-burn’ phase of the launch ramp, and for reasons beyond the scope of this article, it became clear to us that the main tooling was running late compared to the toolmaker’s promised schedule, and that fact was going to give us a major production problem since production ramp up had to commence to fulfill sales demand.

We discussed the matter with the Space Puzzle Molding™ engineers at protoform and the decision was taken, since the product supplied was now production perfect in every respect, to run the SPM tooling to the absolute limit in order to fill the shortfall until full production could start. There was a caveat that if it required a rebuild at some stage there would be a charge for the work but this proved not to be the case.

An amazing quantity in excess of 3000 items were produced to an acceptable schedule, and this from tooling that was only intended to provide up to a

maximum of 300 or so for initial assessment. This gave us the required smooth transition to volume manufacture.

Subsequently we were pleased to learn that the molding and associated tooling technology won the prestigious Golden Euromold Award.

Space Puzzle Molding™ certainly proved to be the solution to our problem and provided the opportunity for our launch and supply chain to proceed on time. Compared to this achievement the additional per item cost for early batches was considered acceptable for there was no other way we could have met our commitments.

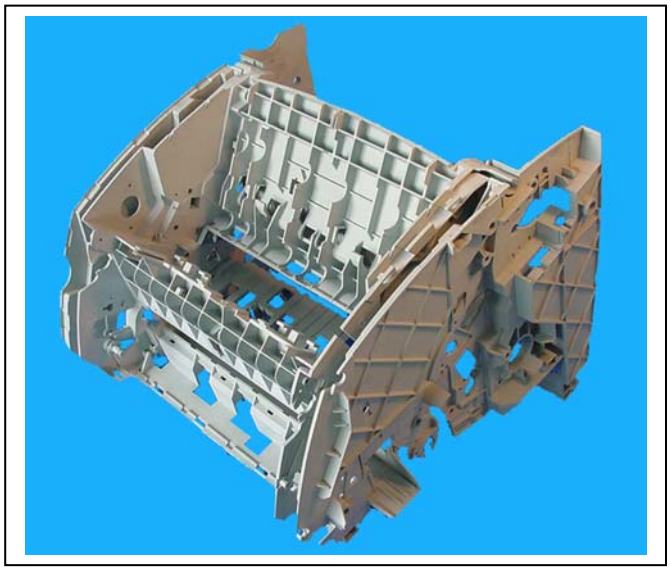
SPM engineers often refer to the process as ‘A soft landing for hard tooling’ and that certainly proved to be the case for Pitney Bowes in this development cycle.”

Picture 1

The Pitney Bowes “DI200 OfficeRight Mailer”™ paper handling product.

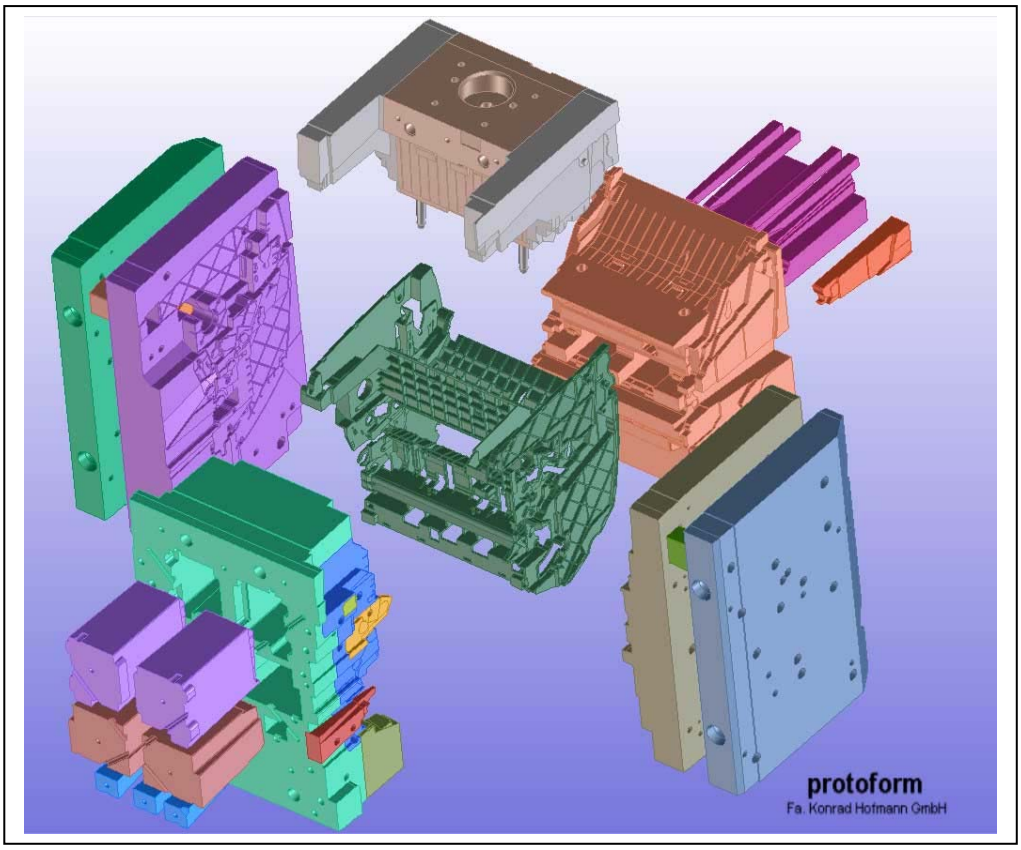
Picture 2

The complex and highly functional main chassis molding.



Picture 3

Exploded CAD view of the Space Puzzle Molding™ tooling with component shown central.



Procedure in Brief for information or reproduction supplementary to articles:

The SPM method, Space Puzzle Molding™, is a hybrid technique of joint Rapid Tooling and Rapid Prototyping technologies, and provides low-cost, simplified moulding tools made of aluminium, using state-of-the- art CAD software and high speed CNC machining methods, working from client's CAD data. With these moulds, one can call off both prototypes and batches of plastic parts in production intent materials.

Moldings so produced are Class A, quality perfect and series identical. They are manufactured to exacting standards using semi-automated methods on standard injection molding machines.

Space Puzzle Molds comprise individual pieces like parts of a puzzle precisely interfaced and secured to the injection machine in a unique patented device which is product-envelope categorised common to many sets of molds.

The SPM process is Ideal for complex parts. New iterations / Design variants can be readily introduced by changing the individual inserts and elements that make up the tooling.

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