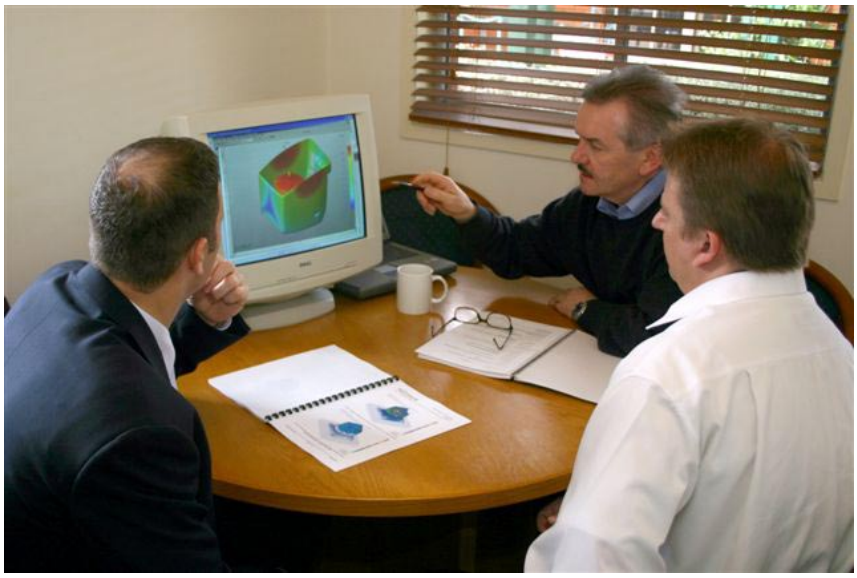
Manufacturing to a better environment: while saving time and money

Project report	Product	Methodologies	Benefits
July 2004	*Plastic housing for medical device*	*Thinking together (Concurrent or Collaborative Engineering)* *Computer simulation (Virtual Manufacturing)*	*reduced tooling cost* *reduced waste & pollution* *reduced lead time*



We believe simulation provides practical new information to Tool Designers that will help us reduce lead-time and costs in toolmaking.

Willi Spiller,
Hawill Tool Design

This project examined a recent tool build to determine if computer simulation could predict the problems that led to six costly rework operations.

An independent auditor was engaged to closely monitor and report on the before and after results.

The results show that greater use of computer simulation and more direct conversation between the product designer and the tool designer can result in reduced lead time, reduced tooling cost and reduced waste & pollution.

What we did

We helped product and tool designers, toolmakers and simulation experts talk and think together to redesign an existing tool using the results of computer simulation.

To validate the project's findings, we engaged an independent environmental auditor to calculate the exact energy and costs used in the original tool build when compared to the costs after simulation was used.

We chose to examine a plastic medical device case that experienced typical toolmaking problems. The casing had a deep cavity that was offset to accommodate a drive motor and electronics. This meant that one wall on the tool had to be very thin, giving rise to shrinking and tool distortion problems.

However discussions with the product designer revealed that moving the cavity closer to the centre to reduce the pressure problems on the die would not present any problems for the product. A simple change that came about after working as a team.

We used Moldflow™ to simulate the flow of molten polymer through the mould cavity.

The analysis showed that in the original design:

- the mould would not fill evenly; one side would fill faster than the other.
- there was considerable pressure variation throughout the mould while filling.
- the mould would likely flex during filling causing warping to occur.

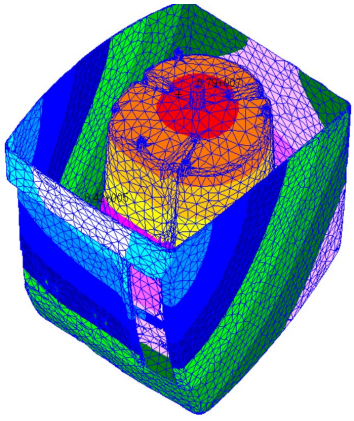
We used Finite Element Analysis to simulate internal tool stresses, deflection as well as tool fatigue.

The die stress simulation showed uneven pressure in the tool that would cause distortion of the mould during the injection process. The tool designer used this knowledge to add two injection points to correct the pressure variation problem. This reduced the maximum displacement of the fixed core component by 80%. This modified design would also fill more evenly and shrinkage across the product would be more uniform.

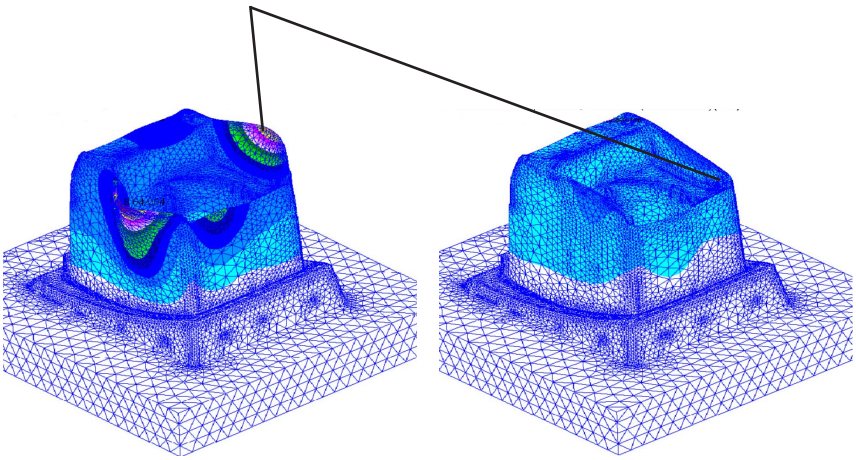
Fatigue analysis simulates the stress of repeatedly loading and unloading the die during production - these load fluctuations can lead to fatigue and failure. We found high stress concentrations around sharp corners of the die would result in reduced tool life.

This is an important insight for both product and tool designers – sharp inner radii may lead to premature tool failure.

Flow analysis shows the tool designer the pressure variation through the mould at a point in time



Excessive distortion in the original design is eliminated in the redesigned mould



What we learnt

Simple communication between the key players can significantly reduce rework and save money – at near zero cost!

Rework is very costly, time consuming and a terrible waste of resources, both for the toolmaker and the moulder.

Many problems can be eliminated when the product designer, tool designer, tool maker & manufacturer talk together. A team approach combines the expertise of all the players to better design the product and its tooling so that it meets the objectives of the client while being made in a cost effective and timely way.

Computer simulations can often predict problems and allow solutions to be tested

In this case, computer simulation:

- identified a sudden rise in temperature in one area of the part, suggesting the need to rearrange the cooling circuits to more evenly distribute the temperature throughout the tool
- demonstrated that modifying the design to include additional injection points would result in a more even pressure distribution and more consistent volumetric shrinkage
- calculated that maximum deflection in the tool could be reduced by 80% by providing additional injection points
- identified critical locations for stress and potential fatigue in the tool
- calculated the likely cycle life of the tool.

Significant amounts of waste can be eliminated

Working together and using simulation computer models means:

- less machining time, fewer crane movements, and lower workshop lighting/heating needs; so less electricity consumption. In this case, 16,464 kWh of electricity could have been saved (enough to run 4 family homes for 1 year)
- less transport is required, so less fuel consumption and emissions
- less material use, so less waste to landfill and lower demands on metal production. In this case, preventing rework through discussion and simulation would have saved 1,100 kg of steel.

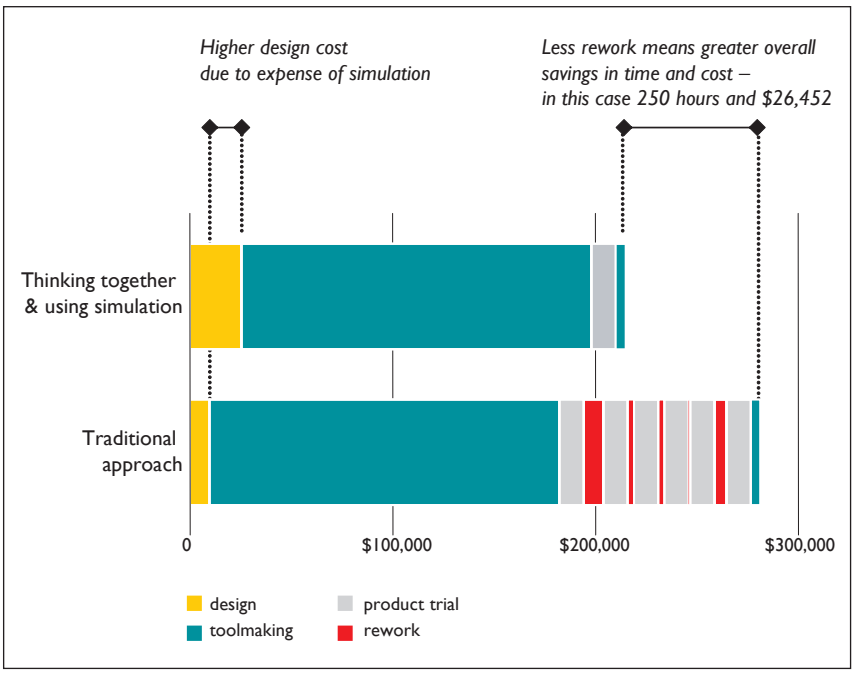
The cumulative benefit over many tooling projects is significant. Working this way will create a lighter environmental impact.

Tooling development time can be reduced (by 250 hours in this case)

Working together and using computer simulations can reduce the number of tool trials and rework required. This shortens lead time and also reduces uncertainty. It lessens the chances of a late product launch and loss of market share.

Tooling development costs can be reduced (by $26,452 in this case)

Reduced cost is another consequence of less rework. There are costs associated with computer simulation, but these are far outweighed by the savings in rework.



Applying this learning

Collaboration linked to simulation will improve new product development

Manage projects in a way that will allow the client, product designer, tool designer, toolmaker and moulder to meet together and work through the whole process as a team. Each individual will contribute their expertise so that, together, they find the best possible solution – quickly and at minimum cost.

Build a network of professionals you trust and can work with. Involve these people at every opportunity. (Austool members are listed on our website.)

Make computer simulation a normal part of design

Simulation helps you make it right first time. It doesn't replace your intelligence and insight, but gives you information so you can make better design decisions.

Good computing power is as important as your tooling machines. Small operators could share the cost with another firm, or buy in the expertise when you need it.

The benefits of collaboration can be achieved for almost zero additional investment.

Project contributors

This project has been funded by Austool and the NSW Department of Environment & Conservation through the NSW Governments, Industry Partnership Program.

Other contributors include:

- MSC Software Australia www. mscsoftware.com.au
- URS Australia www.urscorp.com
- Moldflow www.moldflow.com
- Hawill Tool Design.

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The Austool Digital Factory – the roll-out strategy

The Digital Factory mission is to increase the competitiveness of the Australian Toolmaking Industry by helping to change the traditional approach to product development.

The Digital Factory aims to:

- Reduce lead time and costs in toolmaking
- Introduce "right first time" design into new product development
- Increase the number of new products able to be produced
- Increase the links between designers and manufacturers as product development partners
- Improve the ability to develop turnkey operations for international export access.

The Digital Factory does this by:

- Conducting frequent awareness raising workshops about the benefits of computer simulation technologies and concurrent engineering methods
- Conducting short training courses in 3D modelling, simulation, CAM, collaborative design methods and other advanced topics
- Providing access to the latest technology for training, demonstration and practical project use
- Proactively working with manufacturers to assist their move to product development teams.

Three ways you can be involved:

- Register your interest with Austool
- Participate in a design audit
- Attend Austool Awareness seminars and technology Workshops.

The Digital Factory is an Austool Project funded by Department of Transport and Regional Services under the Sustainable Regions Program

More information

Further information about this project or the Digital Factory is available at www.austool.com.au.