Improving Product Launches with Development Tooling

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Agenda

• Terminology – Different Mold Types
• The impact of 3D Printing on New Plastic Part Development
• Challenges of New Product Launches
• Effectively using Development Tooling to
  • Shorten Overall Development Time
  • Improve cost effectiveness of New Product Launches
Terminology – Mold Types

- **Prototype**
- **Development**
- **Pilot**
- **Production**
Terminology – Mold Types

- **AKA – “Alpha” tool**
- **Purpose:**
  - Determine the critical part requirements for the market place
  - Show the part concept
  - Enable substantial and fast changes
- **Typical Design:**
  - 1 Cavity Mold
  - Soft material (Aluminum)
  - May not have cooling
  - May not have ejection (hand removal)
  - Typically cold sprue gate

GET A PART FAST .... CHANGE A PART EASILY
Terminology – Mold Types

- AKA – “Beta” tool
- Purpose:
  - Prove the final plastic part design
  - Determine the best production mold solution
- Typical Design:
  - 1 Cavity Mold
  - Steel (may be prehardened)
  - Cooled
  - In mold ejection
  - Hot runner gated

DEVELOPMENT

GET THE RIGHT PART…. DEFINE THE PRODUCTION MOLD DESIGN
Terminology – Mold Types

• AKA – “Pre-Production” or Bridge tool
• Purpose:
  • Prove the final production mold process
  • Define expected part quality and yield
• Typical Design:
  • 4,8,12 Cavity Mold (typically 10-25% cavitation of the prod’n mold)
  • Steel (hardened)
  • Identical insert design to the production mold
    • Same Cooling, gating, ejection
    • Inserts should be interchangeable

VALIDATE THE PRODUCT DESIGN AND THE PRODUCTION PROCESS
Terminology – Mold Types

• Purpose:
  • Make quality parts as profitably as possible

• Typical Design:
  • Cavitation established to meet anticipated demand + 3
  • Hardened steel, designed for MM of parts production
Selecting the right mold type...

NEW PRODUCT DEVELOPMENT PROCESS

- Ideation
- Concept Screening
- Design Development/Testing
- Business Analysis
- Design Validation
- Process Development
- Production Launch

Prototype
Development
Pilot
Production

Selecting the right mold at the right point in the process ensures the best decisions are made for the final part.

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Evolution of design communication

- 40k yrs. ago – Cave Art
- 1439 – Printing Press
- 1960s / 70s / 80s – 2D CAD
- 1990s / 2000s – 3D CAD
- 2000s / 2010s – 3D PRINTING

New product ideation has accelerated with improved visual communication tools
Key Benefits of 3D Printing

1. Clearly communicate design intent with a tangible model to a wide audience
2. The ability to generate part geometries – not previously possible through molding or machining
3. Customize each part as needed
4. Transmitting tangible designs electronically and print where needed
3D Printing provides unprecedented speed, cost and effectiveness in communicating a new part design.

Production molding millions of parts is still significantly more cost effective than 3D printing.
Cost Analysis on Random Group of PP Closure Parts

Typical costs at 50MM parts/yr.

An effective part and production mold design, optimizes resin and machine costs
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Accelerating Product Launch Success!

**THE CHALLENGE OF NEW PRODUCTS**

2011 Harvard Business Review Article by Joan Schneider and Julie Hall.....

Top 2 Reasons Product Launches Fail:

**Flaw 1: The company can’t support fast growth.**

*The Lesson:* Have a plan to ramp up quickly if the product takes off.

**Flaw 2: The product falls short of claims and gets bashed.**

*The Lesson:* Delay your launch until the product is really ready.

Development tooling provides the most significant gains in addressing these “Flaws”
Development Tooling Objectives...

1. Production Quality Plastic Parts
   • Optimized for high volume production

2. Proven Molding Results
   • Achieve improved part quality, predictable cycles
   • Develop a business case with validated molding results

3. Scalable Solutions
   • Shorten Product Launch times
   • Concurrent production mold design
   • Simultaneously optimize part and mold design
Transitioning Prototype to Development Mold

Tooling Decision Factors - Prototype or Development Tools?
- Product design stability
- Product complexity
- Success criteria clarity
- Production likelihood

Development Tooling ensures effective decision making at the business analysis stage-gate
## Transitioning Prototype to Development Mold?

<table>
<thead>
<tr>
<th>How parts are used</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prototype Parts</strong></td>
</tr>
<tr>
<td>• Limited internal use</td>
</tr>
<tr>
<td>• Very quick “yes/no” decisions (cosmetics)</td>
</tr>
<tr>
<td>• Preliminary elimination of part concepts</td>
</tr>
<tr>
<td><strong>Development Parts</strong></td>
</tr>
<tr>
<td>• Extensive Internal use</td>
</tr>
<tr>
<td>• Consumer Market Trials</td>
</tr>
<tr>
<td>• Functional part validation and quality testing</td>
</tr>
<tr>
<td>• Downstream production trials (assembly, painting, etc.) Production costing</td>
</tr>
</tbody>
</table>

| Appropriate Quantities | 1 to 50       | 100 to 10,000+ |
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Start-to-Finish (Mold Manufacturing Process)

**Step 1**
Part Optimization

**Step 2**
Mold Design

**Step 3**
Precision Manufacturing

**Step 4**
Part Qualification/Validation

**Step 5**
Mold Life Cycle Management
Start-to-Finish (Mold Manufacturing Process)

**Step 1**: Part Optimization

**Step 2**: Mold Development

**Step 3**: High Precision
High Production
Mold Solution

**Step 4**: Part Qualification

**Step 5**: Mold Life Assessment

**Concurrent Mold and Part Optimization**
- More agile
- Faster changes
- More cost effective

Development Tooling Program

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Define what you need to learn from the Development Mold....

Part
• Functional requirements – strength, durability, etc.
• Aesthetics – shape, polish, feature definition

Process
• Cycle time
• Part consistency
• Key process variables
• Confirm filling analysis (knit lines, gas entrapment, etc.)

Tooling
• Design optimization options
• Key factors influencing cycle and part quality
Best practices for development molds

Typically Single cavity mold including:

1) Like cooling to the production mold
   • Same materials and cooling patterns

2) Consistent gating
   • Gate location and nozzle style

3) Like ejection
   • Same mold actions and means of actuation

4) Consider other critical factors
   • In Mold Closing
   • In-mold labeling or assembly
   • Two material overmolding (material bonding)
   • Robot part removal
   • Etc.
Typical findings from a Development Mold

Part
- Part design complexity review for production molding
  - Part material “RIGHT SIZING” for functional performance and cost
- Plastic shrinkage and dimensional capability
- Finalizing split lines
- Surface finishes
- Gate cosmetics
- Defined undercut / transfer features
- Ejection witness lines
- Final resin and colorant selection

Process
- DFM molding review for draft, warp, and flow line issues
- Cycle time optimization / cost optimization /verify business assumptions
- Production molding process capability verification

Tooling
- Mold steel condition review “eliminate poor steel conditions”
- Material selections
- Gating style / nozzle selection
- Style and position of pressure transducers

Decoupled process established with pressure transducers
Development Mold Example

Customer Goals
- Significantly reduce the cost and part weight of an existing specialty beverage closure

Foundations Development Molds included:
- Two optimization options
  - Option 1 – No external design change and 23% weight savings
  - Option 2 – Minor external design changes and 28% weight savings
- 30,000 parts for testing (fill lines and consumer evaluation)
- Initial parts in 4 wks., full runs in 8 wks.

Results
- Customer gained clear market acceptance for the part
- Better information delivered a decisive selection of the final part option
- Filling line tests were fully demonstrated
- Resin savings projected to exceed 530,000 lbs. in the first year
- Cycle time projections for the final mold were improved 10%

Conclusions
- Key decisions on production tooling requirements (# cavities required) and design were made in less than 6 months, rather than 1-2 years.
- Consumer test confidence in the production part

Not actual closures referenced
### Time requirement

<table>
<thead>
<tr>
<th>#</th>
<th>Step</th>
<th>Timing</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Part Review &amp; Quote</td>
<td>1 Day</td>
<td>Pricing for Parts, Optional Mold and final Timing</td>
</tr>
<tr>
<td>1</td>
<td>Optimize Parts</td>
<td>5 Days</td>
<td>Part Analysis completed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Report - Part Filling, Design For Moldability (DFM)</td>
</tr>
<tr>
<td>2</td>
<td>Develop Inserts</td>
<td>10 Days</td>
<td>Mold inserts designed to fit one of 30 configurable frames</td>
</tr>
<tr>
<td>3</td>
<td>Mold Parts</td>
<td>2 Days</td>
<td>Parts molded</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Decoupled process established</td>
</tr>
<tr>
<td>4</td>
<td>Validate Parts</td>
<td>2 Days</td>
<td>3D ProScan Report generated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Part Inspection completed</td>
</tr>
<tr>
<td>5</td>
<td>Scale Up</td>
<td>1 Day</td>
<td>Production Recommendations Provided</td>
</tr>
</tbody>
</table>

Total: 20 Days/ 4 Wks. (Typical)

*Conclusion:* A proper single cavity Foundations Development Mold takes approx. 4 wks (approx. 2-3x longer than a prototype), but the benefits include:
- Significantly better production parts
- Faster overall time to production launch by several months
Innovate & Add Value

Understanding and achieving the desired Product Quality has to be the core of optimal system development.

System Reliability

Performance & Output

Total Cost Optimization

Ease and Frequency of Maintenance

System Longevity

Build the right mold to deliver the BEST SOLUTION

Optimized Mold Solutions

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Thank you!
FAQ’s

• Can I use a Development mold as a bridge/pilot mold for initial production?
• How do I ensure key information is effectively communicated from each previous type of mold?
• If R&D and tooling budgets are constrained are there cost effective ways to complete a development mold and maintain the quality of learnings?
• How do you handle development molds for multi-material systems or in-mold closing?
• When is it necessary to integrate robot part removal in the development mold?