PTC® Live Global

Embedded Platform for Simulation-Driven Design of Plastic Parts in PTC Creo

Srikar Vallury
Applications Engineer , Moldex3D Northern America Inc.

What Are Common Defects?

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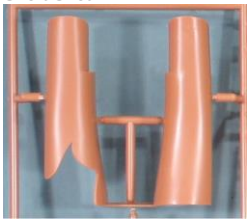
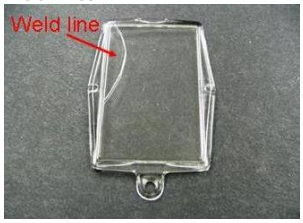
How Do You Deal With These Problems?

Short Shot



Weld Lines



Warp

Burn Mark

Sink Mark

About CoreTech System

Moldex3D
MOLDING INNOVATION

- Founded in 1995, a leading professional plastic injection molding simulation solution supplier for plastic injection molding industry
- World's largest professional team (230+ employees, 80% technical professionals) dedicated to plastics injection molding simulation
- Based on CAE as Core-Technology, provides advanced technologies and solutions for industrial demands with worldwide marketed "Moldex3D" series
- Provide leading software solution and attentive technical support to work with global customers for optimizing the process from design through manufacturing

Company History (1983-2014)

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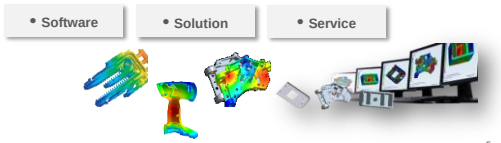
- Many years of development and experience in perfecting CAD-CAM-CAE workflow from design to simulation and manufacturing process
- Current customers have confidence in our leading technology
- Distinctive business image and value system



Contacts and Locations

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- Headquartered in Hsinchu, Taiwan
- Serves more than 65 sales locations with a global network of direct offices and collaborative channel partners
- Provides local, value-added service and support

www.moldex3d.com

Partnership

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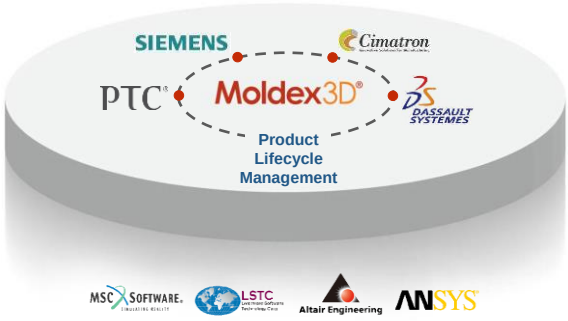
> **Strategic alliance with leading CAD/CAE software, working closely for product integration:**
  - **Material partners**
  - **Software partners**
  - **Solution partners**

> **Extended platform for enhanced simulation performance**



Meet Needs of Different Industries

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Our Featured Customers

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- Over 2,000 renowned companies and industries choose Moldex3D to get their business and products ahead of competitors

Automobile	High Tech/Electronics	Material/Equipment
Ford, Toyota, Donghee, Denso, Volvo, Yamaha, Nissan, Delphi, Bosch, Seat, Inteva, Mabuchi Motor, APM, Molex, TYC, Stanley, Visteon, Antolin, Festo, Witte, Koito, TYG	Texas Instruments, ASE, hynix, Panasonic, Foxconn, Flextronics, Logitech, Unilever, Pegatron, Olympus, LEGO, Konica Minolta, TomTom, Salcomp, Samsung, NXP, Danfoss, Wistron, Yazaki, Shimano, nunc, Liteon, HellermannTyton, LG	BASF, KOPLA Engineering, DSM, LATI, Sumitomo Chemical, Chimei, Lotte Chemical, Prime Polymer, Mitsui Chemicals, KEP, SPT, TPE, Nissei, Kraiburg, A. Schulman, Yudo, Samsung, Cheil Industries, Solvay, Teijin, LG Chem, Ticona

What Moldex3D Do?

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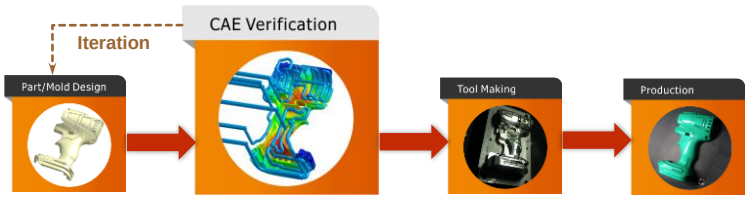
Employs the leading theories of polymer physics, fluid dynamics and material mechanics; brings accurate and efficient solutions for injection molding process simulations



Digitally validate and optimize the product and mold designs upfront for producing quality parts efficiently and effectively

Identifies the root causes of quality blemishes scientifically, replaces the time-consuming trial-and-error approach

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PTC Creo Mold Analysis

Fully Embedded Plastic Simulation

What is PTC Creo Mold Analysis?

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A Moldex3D injection molding process simulator, fully embedded in PTC Creo, empowers designers to obviate plastic defects problems in early design stage.

Design Validation

- **Easy to learn (Fully Automatic Mesh generation)**
- **Integration with CAD/PLM**
- **Fast/Accurate**

Molding Innovation

- **Decrease the cost of expensive mold tools**
- **Estimate produce cost and collocate with injection machine**

Common Solutions to Plastic Defects

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Design	• Change geometry
Tooling	• Change gate location • Change gate size • Change gate number
Manufacturing	• Change process condition

Obviate Molding Defects by Design Change

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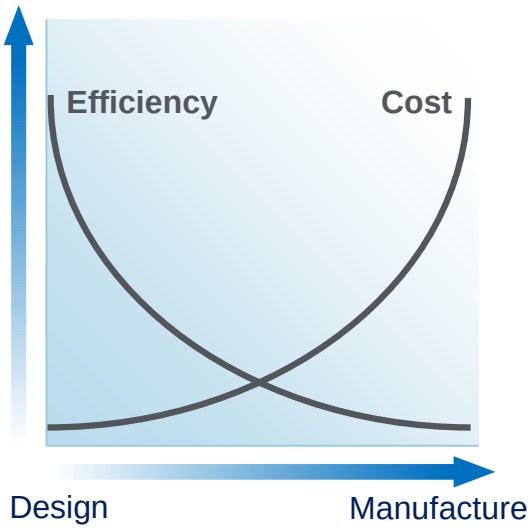
Cost and Effectiveness to Obviate Defects



Why PTC Creo Mold Analysis

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Functions and Benefits

- Simulate filling process of the part
- Predict possible defects
- Obviate defects by design changes with PTC Creo
- Validate the design changes with Mold Analysis

Design-to-Simulate Workflow

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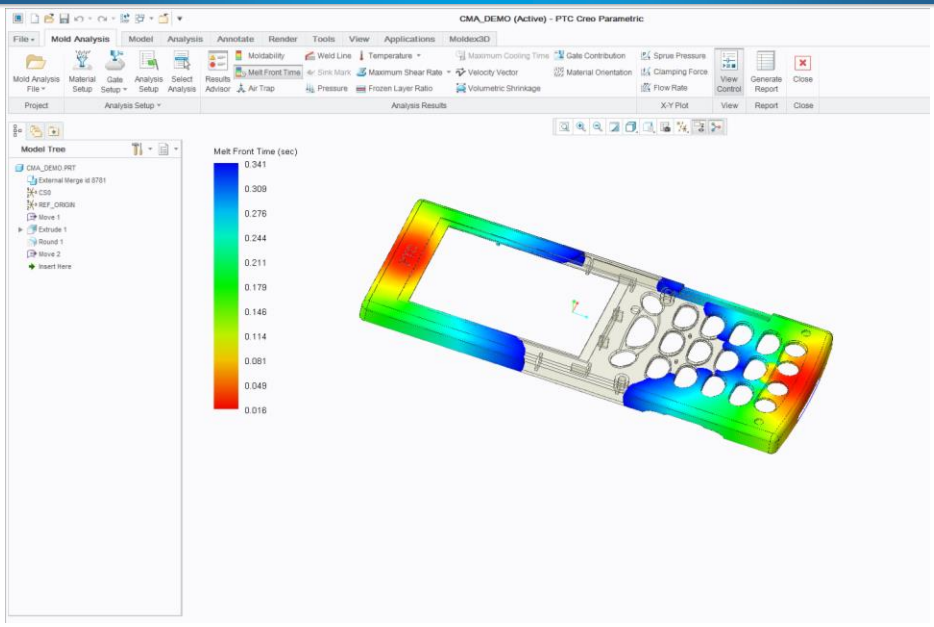

Simple Work Flow

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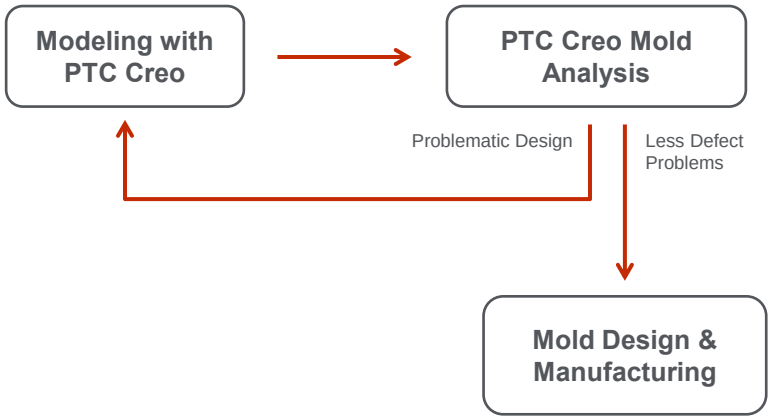

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Examples Cases

How PTC Creo Mold Analysis Can Advise Your Design

Connector

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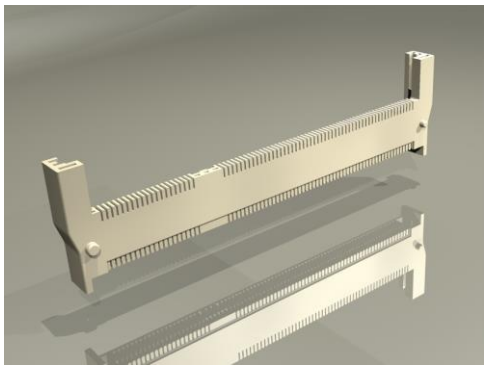
- Background information
  - Thickness of product: 0.7~1.0 mm
  - Length: 55 mm
  - Width: 5 mm
  - Height: 15 mm
  - Thickness of Frame: 0.35 mm

> **Result data**
  - **Melt front distribution**

- Materials
  - PA \ CAE \ CSL-2

- Process Conditions
  - Filling time: 0.21 Sec
  - Melt temperature: 295°C
  - Mold temperature: 70°C



Problem Diagnosis – Flow Imbalance

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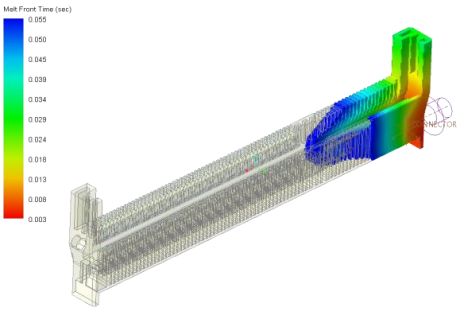
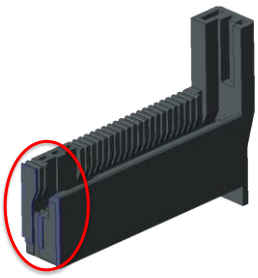
- Problems and challenges the product encountered
  - Flow imbalance and short shot





Race-tracking is due to uneven thickness of part and thus leads to imbalance flow.

Original Design
In-depth diagnosis(1) Fill: 25%

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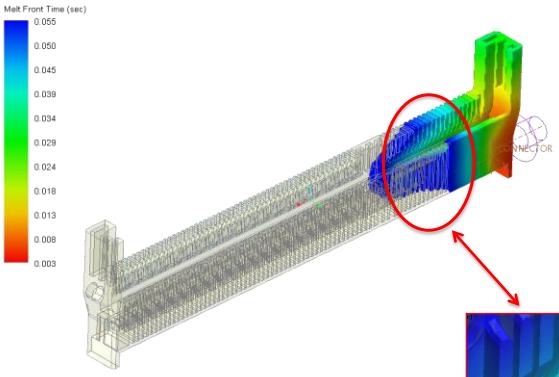
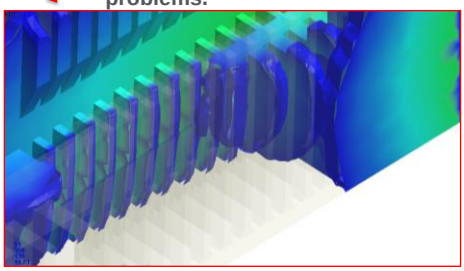


Hesitation occurs in thin areas in the middle of the part, leading to short shot, air trap and other problems.



Original Design
In-depth diagnosis(2) Fill: 34%

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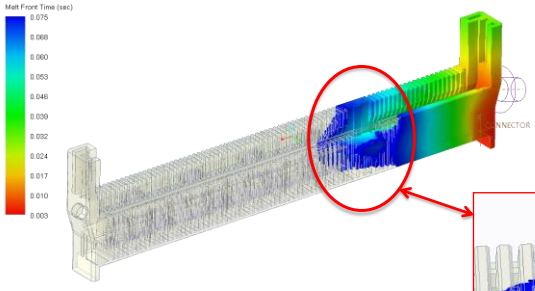
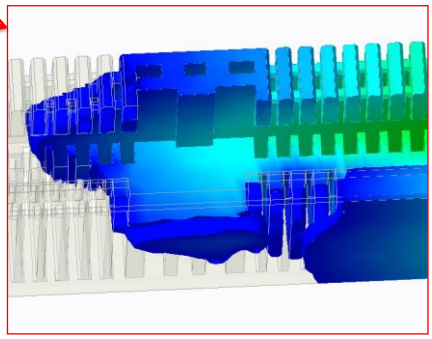


The areas where air traps and weld lines frequently occur



Original Design
In-depth diagnosis(3) Fill: 85%

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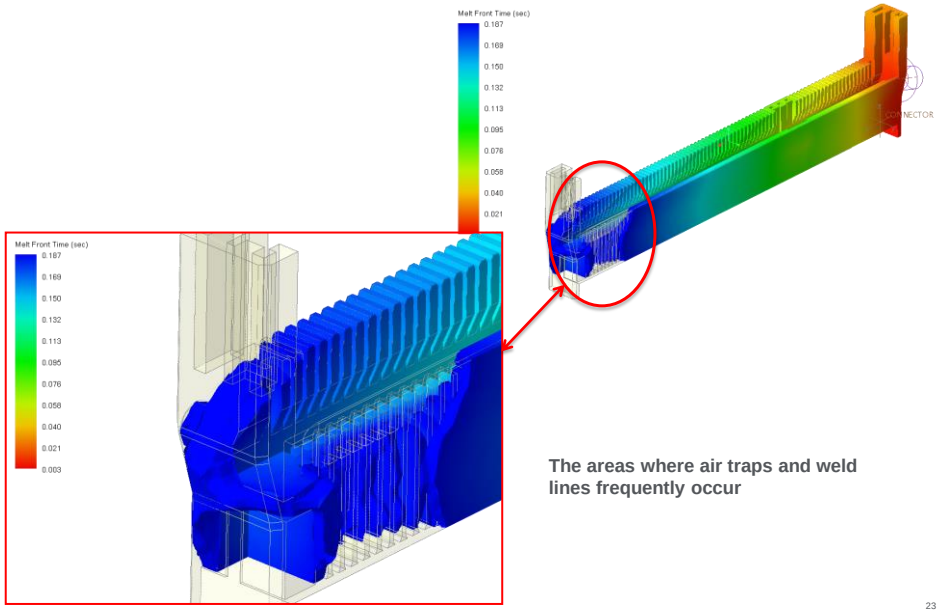

The areas where air traps and weld lines frequently occur

Revised Design

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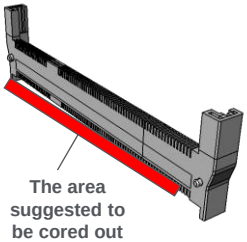
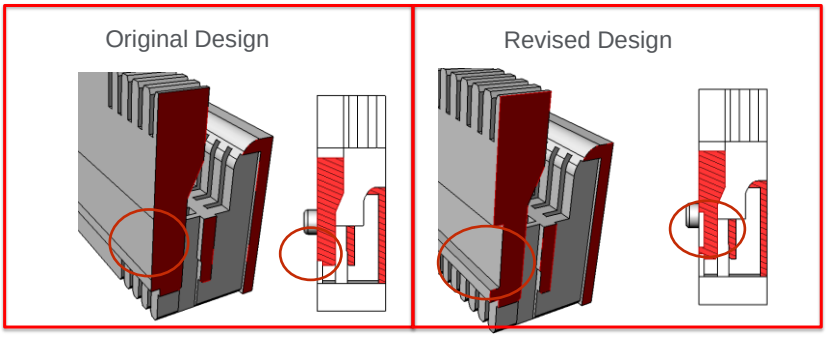
> Product design change
  - **Flow imbalance and hesitation in some areas**
  - **Weld lines and air traps**



The area suggested to be cored out



Flow Behavior Comparison

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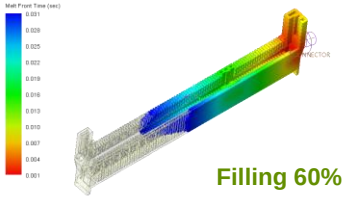
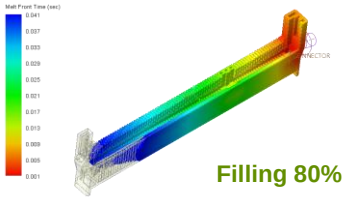
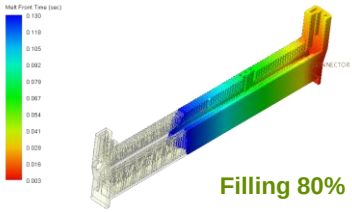
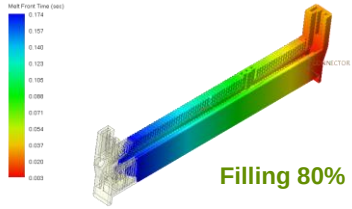
Original Design





Revised Design





The Comparison of Weld Line Result

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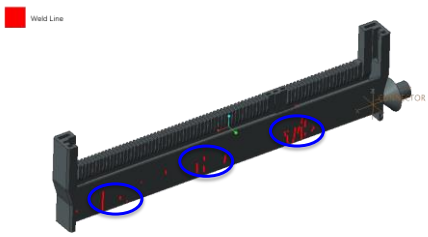
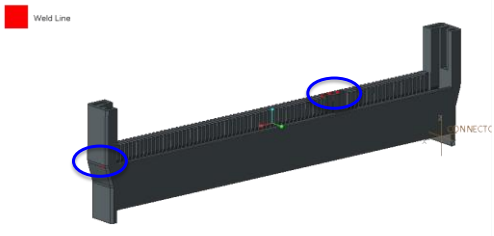
Original Design



In the original design, there has many weld line problem due to the flow imbalance.

Revised Design



In the revised design, the defect of weld line has been decreased due to the improvement of flow balance.

Cell Phone Case

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- Dimension
  - Length: 127 mm
  - Width: 50 mm
  - Height: 5 mm
  - Average Thickness: 0.7 mm
- Materials
  - PP \ Advanced Composites \ ATX-880N-1
- Processing Conditions
  - Filling time: 0.54 Sec
  - Melt temperature: 210°C
  - Mold temperature: 50°C

Cell Phone Shell

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Original Design

Two gates are located on the two ends of the product.

Melt Front History

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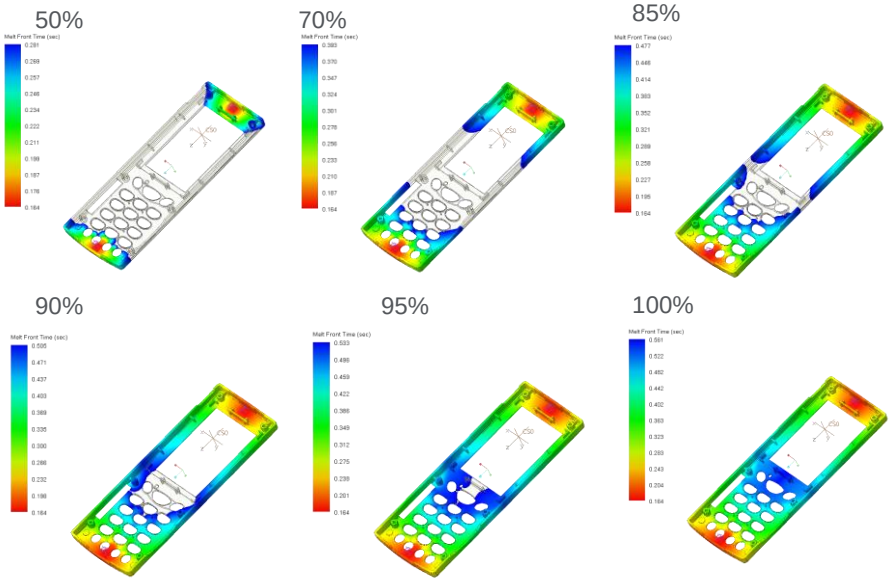

A Potential Problem: Welding Line

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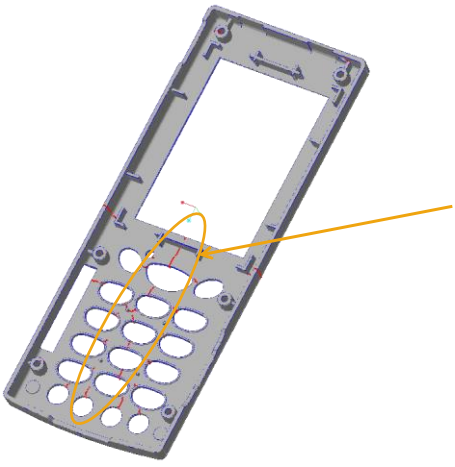

The welding lines are aligned, forming a long weak line on the center.

Gate Contribution and Sprue Pressure

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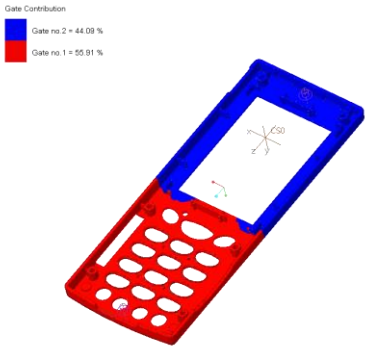
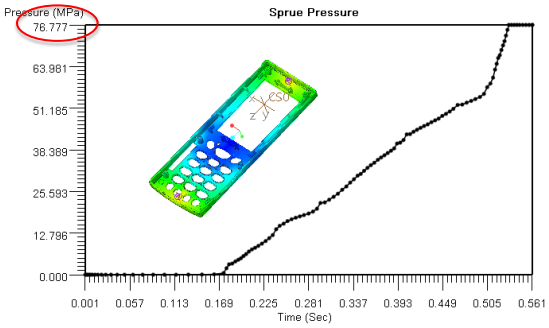
Gate distribution



Sprue pressure



There is a 10% difference between the contributions of each gate.
The maximum sprue pressure reaches to 76.78 MPa

Solution: Changing Deployment of Gates

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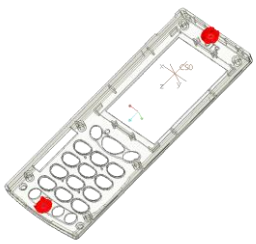
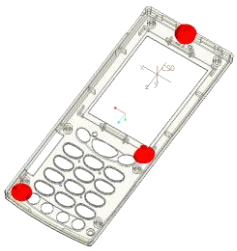


Original design

Change the gate locations

Increase the number of gates



Revised design

Length to Thickness Ratio Comparison

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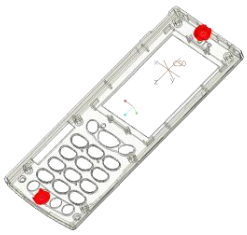
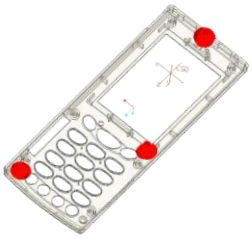
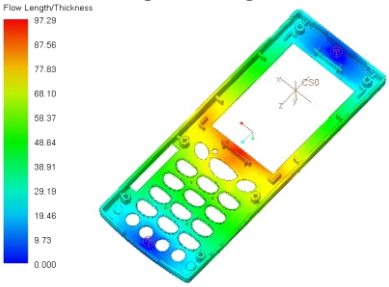
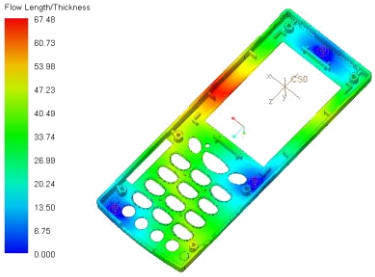




Original design

Revised design





Melt Front History (Revised Design)

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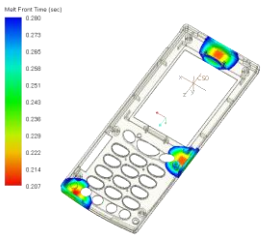
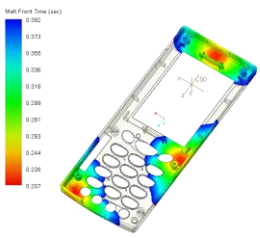
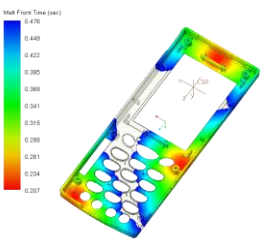
50%



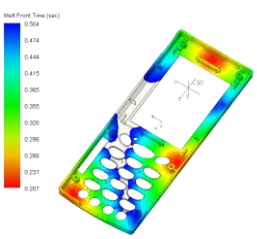
70%



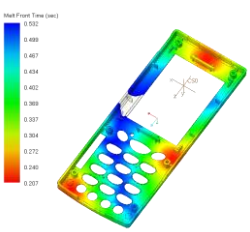
85%



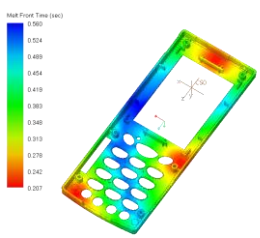
90%



95%



100%



Comparison of Welding Line

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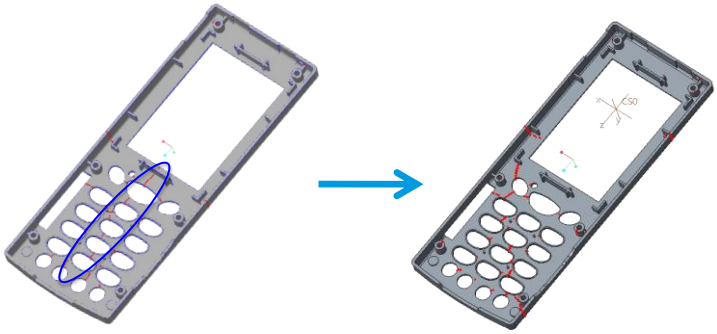
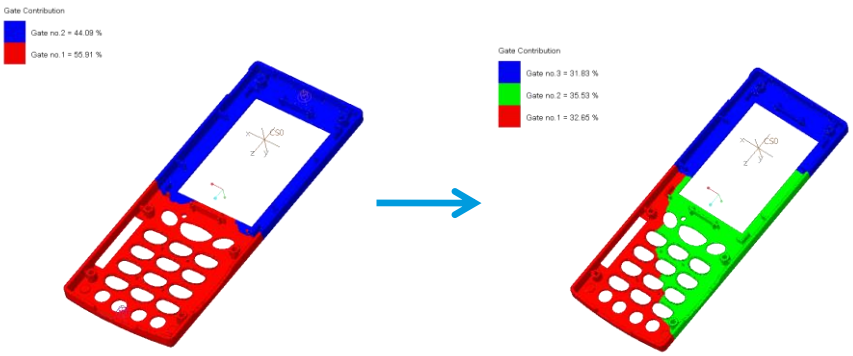


Original design Revised design

The problems of welding line are improved in revised design:
1. The number and length of welding line decrease.
2. The weld line aren't aligned.

Comparison of Gate contribution

PTC Live Global



Original design Revised design

In the revised design, the gate contributions are even.
Only 3-4% difference between each gate.

Comparison of Sprue Pressure

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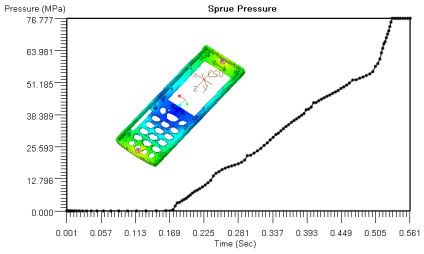
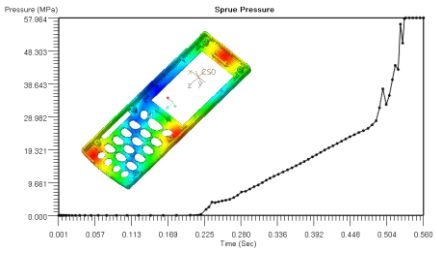
The maximum sprue is 20 MPa smaller in revised design



Original design (77.78 MPa)



Revised design (57.96MPa)

Conclusion

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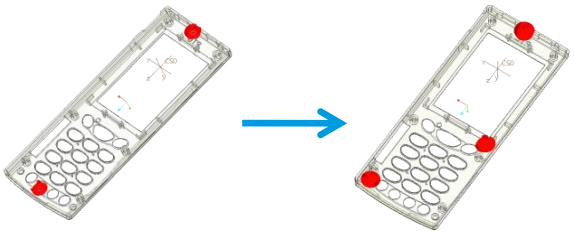
- Two benefits can be obtained by the revised design:

1. Welding line

Decreasing the number and length of welding line
Breaking the alignment of weld line

2. Sprue pressure

Gate contribution became more even
Sprue pressure decreased by 20 MPa



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Moldex3D Capabilities

Moldex3D Total Solution

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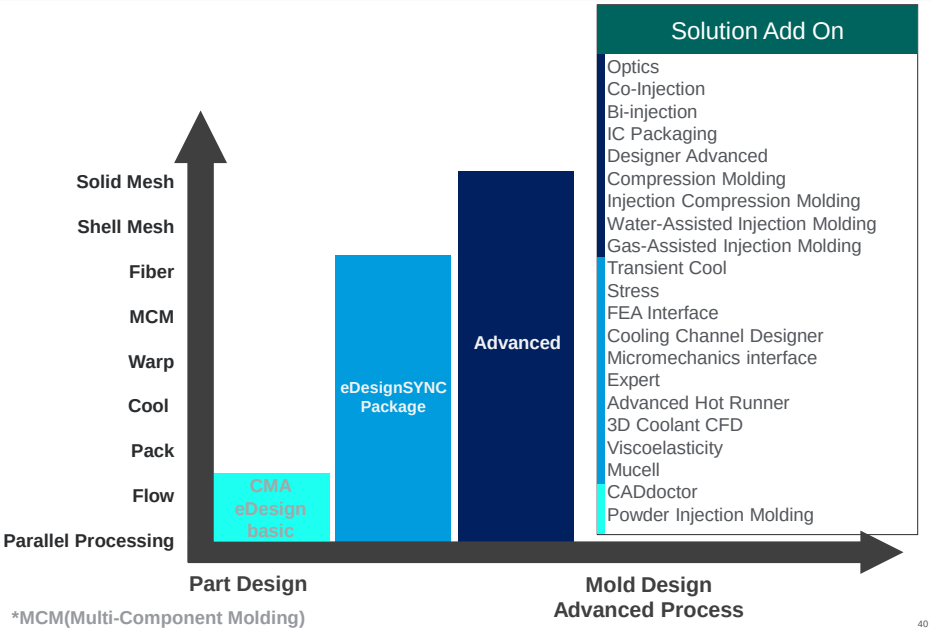

*MCM(Multi-Component Molding)

How to Sale?

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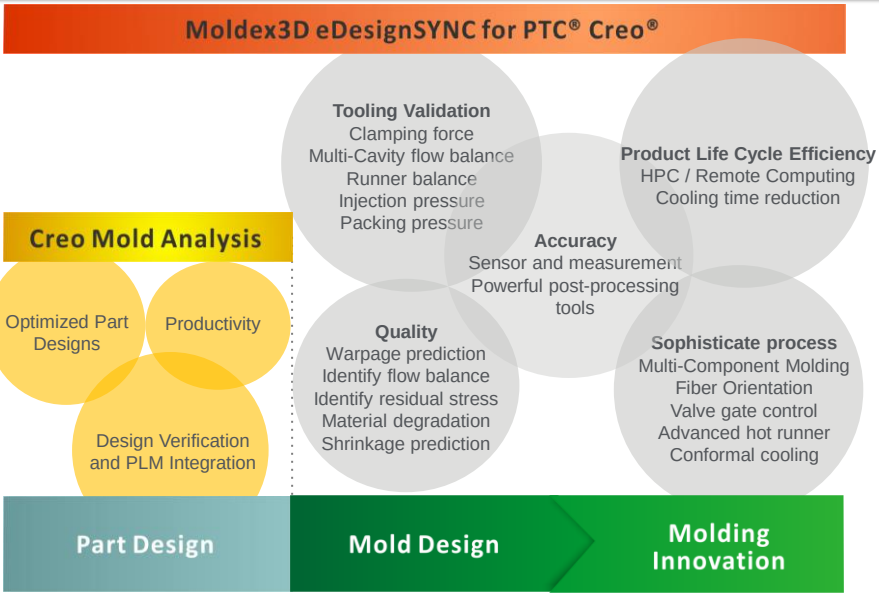

Moldex3D Flow Simulation

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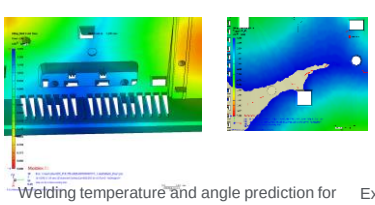
Flow **Everything starts from filling analysis**

> Simulates the filling process of melted plastic inside the cavity

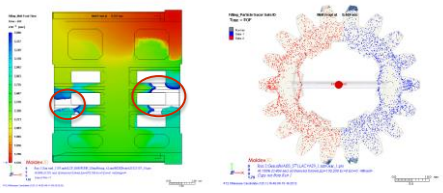
> Indicates the locations of weld lines, air traps, burn marks, and short shot problems

> Enhanced particle tracking simulation

> Enhanced flow solver computation efficiency



Welding temperature and angle prediction for defects identification



Extended trapped air temperature and pressure indicate burn mark possibility

Moldex3D Pack Simulation

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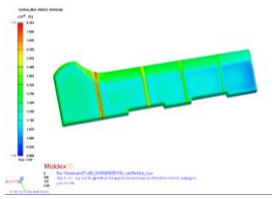
Pack **Shrinkage compensation, minimize warpage effect**

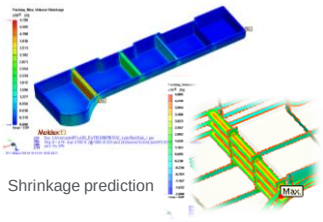
> Imposes the melt into the cavity continuously after filling

> Predicts gate freeze time and estimate effective packing time for average pressure effect

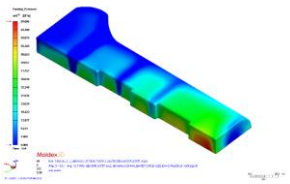
> Minimizes sink marks and shrinkage for warpage control



Sink mark validation



Shrinkage prediction



Enhanced pressure transmission and more uniform packing effect

Moldex3D Cooling Simulation

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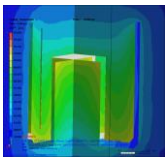
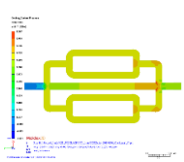
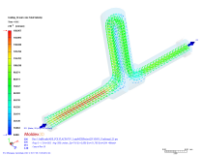
Cool **Efficient mold temperature management**

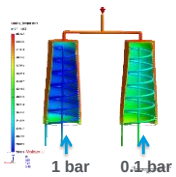
- Supports 3D cooling simulation with advanced analysis capabilities for mold and cooling circuit designs:
  - transient cool
  - variotherm
  - conformal cooling inserts
- Controls mold temperature variations to optimize cooling efficiency and minimize part warpage

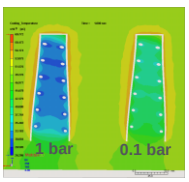






Turbulence cooling simulation





Moldex3D Warp Simulation

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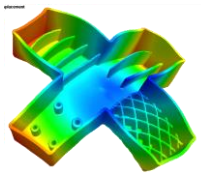
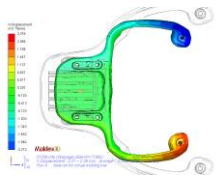
Warp

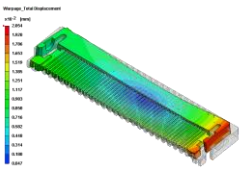
Minimize part deformation for perfect design accuracy

> Validates part deformed ratio of shrinkage effect such as sink marks, volumetric shrinkage and warpage for quality excellence

> Supports to consider fiber orientation, residual stress and material viscoelasticity for accurate warpage prediction







Moldex3D Multi-Components Molding

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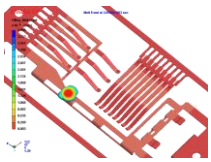
MCM

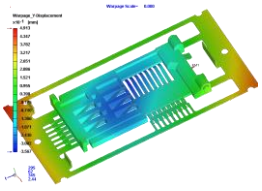
Precise multi-component molding analysis

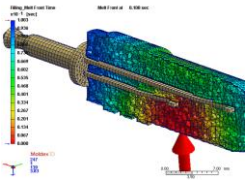
> Simulates insert molding, overmolding and multi-shot sequential molding processes

> Evaluates the interactions of different materials, and considers the material properties to minimize warpage and delamination

> Evaluate core deflection by unbalanced flow



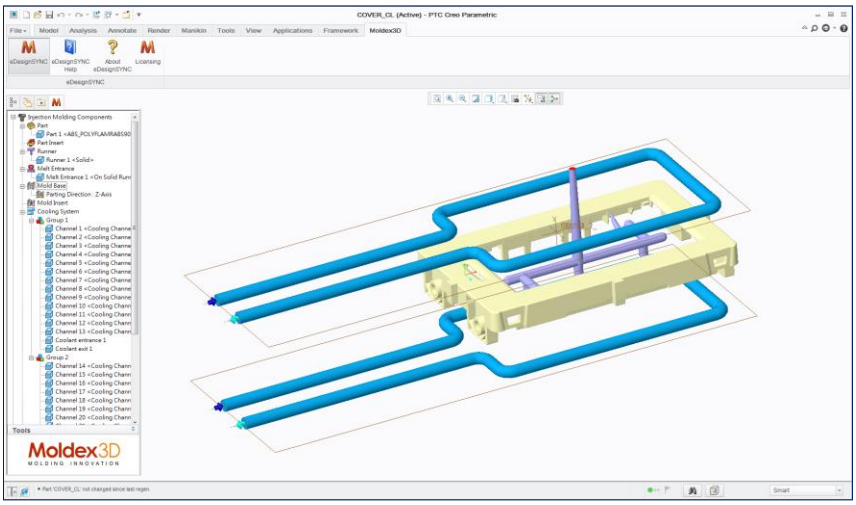




Note:
One-way FSI is supported. Two-way FSI analysis needs an additional **Stress** license

eDesignSYNC for PTC® Creo ®

Bridging between Creo and Moldex3D



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