Casting Design Research

- Process design
- Process modeling
- Process simulation
- Opportunities
Casting System Components
Casting System Components

[Diagram of casting system components with labels: Open riser, Vent, Pouring basin (cup), Cope, Drag, Core (sand), Blind riser, Sprue, Flask, Sand, Parting line, Mold cavity, Runner, Gate, Choke]
Metalcasting Lead Time & Cost Reduction Project

- **Objectives:**
  - Define an integrated casting design environment
  - Determine the capabilities of existing software
  - Consider both expendable mold & permanent mold processes

- **Tasks:**
  - Complete surveys of software suppliers & users
  - Determine current industrial practice with casting software
  - Evaluate costs & benefits of casting design software
  - Define scenarios for foundry use of software
  - Develop functional design of an integrated casting design environment
Casting Process Design

- Part orientation
- Parting line location
- Gate(s) and riser(s) design
- Pattern/mold design
- Process simulation
Casting Design Environment

- Laser Scanning
- CAD System
- Shared Database
  - Part & mold geometry
  - Casting material properties
  - Mold material properties
  - Process types & characteristics
- CAE Applications
  - Dynamics
  - Heat transfer
  - FEM
  - Design optimization
- Activity Manager
- Pattern/mold Design
  - Parting line location
  - Allowances & draft
  - Rigging system
  - Tolerance specification
  - Shape constraints
- Performance Capability
  - Resource availability
  - Time estimation
  - Cost estimation
- CAM Applications
  - CNC machining
  - Rapid prototyping
- Process Simulation
  - Fluid flow
  - Heat transfer
  - Solidification
  - Stress growth
  - Defects/Quality Criteria Functions
Integrated Casting Design Software Environment
Casting Design Software Functions

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<th>Part Requirements</th>
<th>Part Design</th>
<th>Process Selection</th>
<th>Pattern/Mold Design</th>
<th>Casting Process Simulation</th>
<th>Pour Casting</th>
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</table>

+ Good Coverage
0 Some Coverage
- No Coverage
Casting Model

**Input Parameters**
- Part Geometry
- Part Material
- Tolerance & Finish
- Production Requirements

**Process Design**
- Casting Process
- Parting Line Location
- Gating & Risering

**Model Output**
- Casting Geometry
- Production Cost
- Solidification Time
- Stresses & Defects
Casting Process Simulation

Casting Simulation Using MAGMAsoft – XM35 Rotor
• Part design
• Simulation model
• Simulation results
• Redesign iterations
Continuous Casting Research

- Continuous casting process
- Workflow – production planning
- IPSCO Caster model – process planning
Continuous Casting Process
Continuous Casting Model

Thickness
Width
Carbon%
Superheat
Casting Speed
Cooling Rate

Neural Network

Mean
Standard Deviation

Mean
Standard Deviation
Optimization Scheme
Questions & Answers