HEAT TREAT
AN INFORMATION TOOL FOR THE METALS INDUSTRY

SPONSOR: A. Finkl & Sons Co.
ADVISORS: WILLIAM MAURER & SHELDON MOSTOVVOY

IPRO 304-A
FALL 2007
The Team

7 Members (in alphabetical order)

♦ Vlad Antal, Senior - Mechanical Engineering
♦ Steven Banaska, Senior - Electrical Engineering
♦ Hussain Biyawerwala, Junior - Electrical and Computer Engineering / Math
♦ John Groszko, Senior - Computer Science
♦ Ryan Jay, Senior - Mechanical Engineering
♦ Kyle Koning, Senior - Materials Science and Engineering / Mechanical Engineering
♦ Sangwook Lee, Senior - Electrical Engineering
The Background

What is heat treatment?

- Quenching, Tempering, Annealing, Aging

Batch processes

Effects of furnace shape

Part geometries
A. Finkl & Sons Company, Chicago, IL

- World’s leading supplier of forging die steels, plastic mold steels, die casting steels, custom open-die forgings
  - Some of highest standards/specifications in the industry
- Extensively uses heat treatments
- Irregularly shaped parts from 1/2 to 50 tons
The Problem

Heat treatment stage

- Irregular parts, irregular heat treatment
  - Finkl’s high standards = high scrap

- Furnace loading difficult
  - Current solution relies on Trial & Error and Experience
  - Process bottleneck = Slows production

Finkl needs a tool to maximize and document both batch quality and batch size thus decreasing scrap, rework, and the production delay
The Objective

To develop a software solution capable of optimizing the heat treatment process at A. Finkl & Sons.

The software must be capable of:

- Determining best part placement for best heat treatment
- Maximizing batch size
- Outputting the loading pattern in simple format
- Functioning with CAD Packages and Finkl
- Accepting upgrades developed by future IPROs

Replace current hand-drawn method
The Previous Work

IPRO 330 Spring 2006 and AutoStack Software

- 3D part representation in “furnace”

  ➡ Part Manipulation and collision detection

Disadvantages

- Non-solid modeling
- Incompatibility
- Difficult to upgrade
The Present Goals

- Reconstruct the AutoStack Software
  - Eliminate drawbacks and limitations
  - Build a highly capable and compatible platform

- Construct a template portfolio of Finkl parts
  - Modeled with ProEngineer
  - Compatible with Finkl work order database
The Method

- Review the past
- Examine development packages
  - Limitations, advantages
- Meet with Finkl
  - What they want, what they need
- Develop the software
- Progress meeting with Finkl
- Solution foundation delivery
The Tools

**Build Environment**
- Microsoft Visual Studio and Qt

**Development Packages**
- HOOPS 3D Application Framework (Graphics Engine)
- 3D ACIS Modeler (CAD/CAD 3D Modeling Engine)

**Management of Software Development**
- TRAC Project Management
- Subversion (Central Source Code Repository)

**Part Template Modeling**
- ProEngineer (Wildfire 2.0)
The Assignments

Based on technical skill sets, personal interests, and work load division

Software Development

- Steven Banaska **Software Developer**
- John Groszko **Lead Software Developer**
- Sangwook Lee **Software Usability Tester**

Template Database Development

- Vlad Antal **3D Modeler**
- Ryan Jay **3D Modeler**

Communications and Project Support

- Hussain Biyawerwala **Document Coordinator and Secretary**
- Kyle Koning **Visual Media and Communications Designer**
The Obstacles

**Computer Science**

- Re-introduction to programming
- What’s a build environment, Dr. Hu?
- Qt and Widgets

**Compatibility**

- Will it work with CAD?
- Will it work with/for Finkl?
The Ethics

Code of Ethics Summary for Software Development

✦ Pressures:
  ➡ Sell and use the software for commercial purposes without adequate permissions and licensing

✦ Risks:
  ➡ Delivering educational/trial/development software to Finkl
  ➡ Permitting sale of educational/trial/development software
  ➡ Using copyrighted code and programs
The Results

- HeaTreat Software
- Compatible
- Simple Interface
- 3D Modeling
- Robust Graphics
- Upgradeable
The Results

Completed:

✦ Template Portfolio

⇒ Represent actual Finkl parts available for purchase
The Future

Tasks for upcoming IPRO Teams

✦ Creating the loading function
  ➡ Thermodynamic modeling functionality for best placement
  ➡ Maximum Volume Principle / Shipping Software
✦ Complete a comprehensive shape database
✦ Migration to handheld device
The Reflections

Software development does not start from zero

- Based on developmental and public code

High Demand for Computer Science Skills

- REQUIRE more CS students in future IPROs
- Stress software development in description
The Acknowledgments

A. Finkl & Sons - Project Sponsor

♦ Sean McCann (Project Engineer) - Primary Liaison at Finkl
♦ Guy Brada (Chief Metallurgist) and the Metallurgy Staff
♦ The IT Staff

Dr. Zhiyong Hu (IIT MMAE Dept.) - Assistance and Guidance with setup of the software build environment

Spatial Corp. - Educational Licensing for ACIS and HOOPS

IPRO 330 (Spring 2006) - Taking the first steps towards a fully functional solution.
The Questions

Questions?
Concerns?
Clarifications?
Comments?
Suggestions?

The IPRO 304-A Team welcomes your input.

Thank you for your attention!

Please visit our exhibit in the northwest corner of the 1st Floor of the Herman Union Building.