HEAT TREATMENT MAXIMIZATION SOFTWARE
AN INFORMATION TOOL FOR THE METALS INDUSTRY

1. THE BACKGROUND
Heat treatment of metal is the process by which thermal energy is added to a metal in order to alter its properties. Some of the most common heat treatments include aging, annealing, quenching, and tempering. Changes in the heating/cooling rates, the treatment temperature, and the duration of the treatment all result in changes in the properties (hardness, strength, durability, etc.) of the final product. Heat treatments are often batch processes and are a point of congestion in manufacturing.

A. Fink & Sons is the world’s leading supplier of forging die steels, plastic mold steels, the cast iron ball valves and custom-open die forgings, processing over 100,000 tons of metal each year. Fink & Sons also has capabilities in batch heat treatments in their manufacturing process.

2. THE ISSUE
As a result, batch size limitations, Fink experiences a production bottleneck at the heat treatment stage of their operation. Optimizing the heat treatment process requires loading the maximum amount of steel per batch. What parts can be loaded in the same batch and at what price are physically available in the heat treatment area. Some parts require non-routine and non-standard, the loading process is difficult for operators and batch size suffers. Years of experience and trial and error techniques are the only tools available to assist in load design and part placement.

3. THE CHALLENGE
To develop a software solution capable of optimizing the heat treatment process at A. Fink & Sons, the software must be capable of:
- Maximizing batch size
- Capturing the best loading pattern based on available parts (as heat treat area)
- Work order priority
- Integrating with Fink’s work order database
- Utilizing output by popular CAD packages with full integration in user display
- Accepting upgrades developed by future IPRO’s that could include:
  - Adherence to heat treating standards
  - Migration to a handheld device
  - Thermodynamic modeling functionality

4. THE PAST WORK
PRO 330 Spring 2006 and AutoStack Software Strengths:
- Integrates actual parts in 3D
- Adequate collision detection between multiple parts
- Load the foundation for our solution
- Weaknesses:
  - Non-solid, planer modeling (false representation with incomplete data above total part)
  - Difficult user interface
  - Incompatible with Fink work order database
  - Incompatible with CAD Packages

5. THE CURRENT GOALS
1. Reconstruct the AutosStack Software in order to eliminate the points of weakness, thus allowing development of a fully functional solution.
2. Construct a portfolio of the best existing Fink parts, modeled with Finkinfo. The parts should be compatible with the existing Fink work order database (an SQL database).

6. THE TOOLS
Various tools were employed in the reconstruction of the program and development of the program.

- Management of Software Development: TEMC, Project Management
- Submission (central source code repository)

7. THE SOLUTION
HeaTreat: The software solution created by IPRO 330-A represents the achievement of the first goal of the semester. The HeatTreat environment, seen or not, utilizes fully solid 3D modeling with a simple, yet effective user interface. HeatTreat is fully compatible with ProEngineer files and the Fink work order database. Since the HeatTreat environment utilizes fully solid modeling and part files compatible with ProEngineer, the thermodynamic modeling of the entire heat treatment furnace is only a step away. The growing trend of increased power of hand-held computers suggests a complete migration to a handheld device is nearly within reach.

8. THE ETHICS
The development of the HeatTreat program required several software packages. Each package is licensed for use as an educational tool for developmental purposes. The User Agreements of these licenses forbid commercial use or sale of their respective programs. As such, before delivery to a Fink, IPRO 330-A and any future IPRO teams must inform A. Fink & Sons of the steps they must take to secure official legal licenses for the components of the HeatTreat software, as well as pay any required royalties. Additionally, some tools utilized by IPRO 330-A are open source programs, and the original source code may be attached to the program and made freely available.

9. THE FUTURE
Using the solution developed by IPRO 330-A, students in upcoming IPROs can successfully address the remaining challenges:
- Complete a comprehensive shape database
- Maximizing batch size
- Use the Maximum Volume Principle currently utilized by cargo shippers to maximize load size
- Migration to a handheld device
- Thermodynamic modeling functionality

Thanks to the robust capabilities of solid modeling, the HOOPS Application Framework and the 3D AGIS Modeling Engine, the solid modeling functionality to the software will be much faster and easier than adding to the AutoStack Software previously developed.

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- The IT Staff
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- Central Corp. - Educational Licensing for 3D AGIS Modeler and HOOPS 3D Application Framework
- IPRO 330 (Spring 2006) - Taking the steps forwards is a fully functional solution.

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