Project Title: Enabling Metalcasting as a Process Option at the Conceptual Design Phase
Research Thrust Area: Materials and manufacturing processes
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Need and Industrial Relevance:
Metalcasting is a preferred manufacturing process option for many components because of its ability to directly produce complex geometries with little or no need for post processing. Metalcastings, however, do have some requirements to make the design feasible. If these requirements are not considered early enough in the design process, the option to produce the component as a metalcasting is lost. While it is theoretically feasible to redesign the component in the later design stages to accommodate metalcasting, this is often not plausible because of the time-to-market pressures.

Project Goals:
The ultimate goal is to have every component be designed so that it enables the best manufacturing methods for its production. This project will provide designers with the information they need to allow for components to be optimally designed as metalcastings. This will reduce the overall design and procurement costs.

Three examples of components that were originally designed as fabrication, when it was not the best manufacturing option. After redesigns, they were then produced more economically as a metalcastings, and with better performance characteristics.
Objectives:
The research will identify the key design characteristics that eliminate or enable the ability to produce a component as a metalcasting. The characteristics will be prioritized, so we can provide the designer with the most relevant information. Finally, e-design tools will be developed that will automatically identify these characteristics and alert the design engineer.

Approach and Methods:
Examples of good and poor casting designs will be analyzed for the key characteristics. In particular, designs of components that have been redesigned as a metalcasting will likely provide very useful information. Key characteristics may include directional solidification, feeding lengths, soundness, surface and dimensional requirements and tooling needs.

With this information, interviews will be conducted with design engineers to determine the importance of these characteristics in their decision making. This study will likely be done with those designers with and without much experience with castings.

Outcome/Deliverables:
The first key deliverable will be a prioritized catalog of the design characteristics and their importance for consideration in the conceptual design stages. This information will then be incorporated into software tools that will provide the designer with concise and relevant information on castability during the early design phase.

Impact:
For components in which the metalcasting process option has been eliminated via design decisions, there are two possibilities. The first is that the component continues to be made via the less than optimal process. The second is that the component is redesigned and requalified as a casting, and then converted. This project will eliminate the need for both of these options, by enabling metalcasting as the original process option.

Project Duration (plan and timeline):
Task 1: Catalog design characteristics that make castings feasible/infeasible (6 months)
Task 2: Prioritize characteristics based on need at conceptual design stages (7 months)
Task 3: e-design tools and testing (11 months)

Proposed Budget:
$216,000: 2 graduate students plus travel to industrial partners