SHF: Medium: Collaborative Research:  
The Software Engineering of Generic Libraries

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1 PROJECT SUMMARY
The proposed research will develop a science of generic library design encompassing both the concept-based techniques and established metaprogramming methods that will be applicable in both traditional software engineering processes and agile development methods. To this end, the research will consist of two major efforts: providing a platform for experimentation with concepts (their syntax, semantics, and usage), and the development of models, techniques, and tools to assist in the software engineering of generic libraries.

In order to provide a platform for experimentation with concepts, a software library, written in native C++0x, that emulates the syntax and features of concepts will be developed. A preprocessor that translates the C++0x concept syntax into elements of this library is also planned. To satisfy the needs of design-driven engineering methods, a metamodel for generic libraries based on concepts and common metaprogramming techniques will be developed. This model will provide the capability for developers to effectively communicate the structure, intent, and extensibility of libraries, and it will provide the means for programmers to more readily consume and comprehend source code that is otherwise dense and difficult to read.

The development of a concepts-enabled programming platform, a metamodel for generic library description, and tools to support specific software engineering tasks will result in a science for the construction and evolution of generic libraries that transcends the host language’s paradigms (e.g., object oriented design).

2 INTELLECTUAL MERIT
The proposed work is critical to advancing the development of the generic programming paradigm and the software engineering of generic libraries. This research has the potential to change the way generic libraries are developed and maintained by providing a clear set of principles for realizing efficiency, consistency, and high quality in such libraries. Moreover, this research extends the software engineering and maintenance research domains in new directions as their principles are applied to a new programming paradigm, its elements and artifacts, and challenges.

3 BROADER IMPACT
The motivating factor for the research is to increase the ease with which programmers build and use generic libraries. This work will directly support the enhancement and quality of generic libraries through improved comprehension and software evolution methods and tools. This improvement will be reflected in the quality and reliability of the many critical and real-time systems that function as the backbone of our daily lives and our information-age society.

The results of the proposed research can help globally institutionalize generic programming and library construction by making these methods and technologies more accessible to programmers. Widespread use and experience encourages feedback, which will influence the future design of languages supporting generic programming, especially C++.

Keywords: software engineering; generic library design and programming; reverse engineering; C++0x; programming languages; concept inference