Project Summary

This research proposal presents a new, evidence-based approach to the generation and adoption of best practices. Instead of looking outward into the community for best practices, and attempting to adapt them to one's own environment, our research will investigate how best practices can emerge organically from within one's current organizational and project context. Instead of relying on politics or persuasiveness for adoption, our research approach involves instrumentation that generates empirical data that can be used to either argue for the benefits of adoption, or else provide evidence that the practice is not actually effective in the current context. Finally, our research will involve analytic approaches designed to generate candidate best practices from analysis of process and product data. To accomplish this, we will synthesize and extend four streams of research: (a) software project telemetry, which provides a mechanism for in-process monitoring of software engineering data streams; (b) software development stream analysis (SDSA), a mechanism for recognition of certain best practices (such as test-driven design) from low-level developer behaviors, (c) pattern discovery, a collection of data mining techniques for discovery of patterns in event data, and (d) evidence-based software engineering, an approach to better empirically-based research. Our project has seven objectives:

(1) Enhancement of the Software Development Stream Analysis mechanism to support a variety of current best practices, and determination of the kinds of abstractions, automation, and best practices that are amenable to recognition using SDSA.

(2) Development of integration mechanisms between SDSA and Software Project Telemetry in order to allow users to determine how practices recognized by SDSA relate to telemetry data at any particular point in time.

(3) Development of a pattern discovery subsystem in Hackystat to support automated recognition of behavioral patterns by developers as they use tools, abstractions, and automation, and the use of Software Project Telemetry to determine whether these behavioral patterns are potential candidates for best practices.

(4) Classroom-based, case study evaluation of the proposed techniques. We will apply these techniques to gain evidence regarding programmer productivity and variability with respect to the Test Driven Design best practice. This activity will also refine the technology, develop curriculum materials, and ready the approach for industrial evaluation.

(5) Industry-based evaluation of the proposed techniques. Following classroom evaluation, we will carry out two industry-based case studies to gather evidence regarding best practices related to high performance computing and agile software development. This activity will also assess our approach in industrial settings.

(6) Packaging of the system and methods for widespread dissemination. We will continue the process used by the open source Hackystat Project of making our technology available to the software engineering community. In addition, we will package and disseminate our experimental methods to support external evidence-based software engineering efforts.

(7) Development of curriculum materials regarding continuous, evidence-based discovery and assessment of software engineering best practices. As with the Hackystat Project, we will develop software engineering curriculum materials and assignments that enable the study and analysis of this approach in academic settings.

The intellectual merit of this research includes the application of novel data gathering and analysis techniques for the discovery and evaluation of software engineering best practices, and the evaluation of this technique through classroom and industrial case studies.

The broader impact of this research includes the development of a sophisticated, freely available, open source software system for use by researchers and practitioners to study software engineering best practices, the generation of new evidence-based research results, and curriculum materials to support education and technology transfer. As the University of Hawaii is a university with 75% minority students in an EPSCOR state, this project will provide novel research opportunities to underrepresented groups.