RESEARCH OPPORTUNITIES IN PROCESS & PERFORMANCE IMPROVEMENT

AMPLIFY

APPLY

CREATE

At the Carnegie Mellon University Software Engineering Institute (SEI), we actively seek collaboration on research into key technical challenges facing developers and managers of current and future software-reliant systems.

Our mission is to deliver results that are demonstrated to solve U.S. Department of Defense (DoD) needs, shown to improve software-reliant system capabilities or to cut the time needed to deploy them, and adopted by practitioners who then achieve measurable improvements in their practices.

"The SEI's product is the knowledge we create and capture, apply to real-world problems, and distribute to the global software and systems engineering community."
— Paul Nielsen, Director and CEO

The SEI achieves its goals through technology innovation and transition. The SEI creates usable technologies, applies them to real problems, and amplifies their impact by accelerating broad adoption.

Current focus areas
Based on our understanding of critical challenges, we are conducting research in the following areas:

Securing the cyber infrastructure
- Malware & forensics analysis for mobile platforms
- Moving target defenses
- Secure C language compiler
- Semantic malware analysis
- Threat metrics

Advancing disciplined methods for engineering software
- Data-driven software assurance
- Early life-cycle cost estimation
- Scalable static analysis of real-time concurrent software
- Scheduling theory for multicore
- Standards in cloud computing interoperability
- System-of-systems architecture patterns
- TSP-Secure (Team Software Process)

Accelerating assured software delivery and sustainment for the mission
- Agile acquisition
- Architecture-focused testing
- Situational process engineering
- Strategically managing technical debt

Innovating software for competitive advantage
- Context-aware network analysis in resource-constrained environments
- Software producibility for future architectures

data **Analysis**

TSP Data Benchmarking and Project Data Analysis

Objective: Analyze detailed empirical data from the software development process. Use results of this analysis to develop benchmarks, describe state of the practices, build predictive models, and support software engineering process research.

Description: The Team Software Process (TSP) is a framework for planning and tracking software development projects using well-defined metrics, process, and quality practices. All work is estimated, planned, and tracked to completion by the developers who perform the work. TSP gathers data on the effort, defects injected, and defects removed for all development phases including planning, design, personal review, inspection, code, and test activities. Our database contains over 100 projects spanning portions of the software development life cycle, and we are incrementally increasing the data set.

Collaboration Opportunities
We are looking for collaborators to help us analyze this quantitative data to answer research questions about the efficiency and efficacy of practices in software engineering and software project management.

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Quantifying Uncertainty in Early Lifecycle Cost Estimation (QUELCE)

Objective: Quantify expert judgment of anticipated program execution uncertainties and enable more accurate inputs to existing cost models.

Description: The QUELCE project is developing a novel method to enable cost estimation before Milestone A. The resulting QUELCE solution embodies principles from scenario planning, cause-effect dependency modeling, probabilistic modeling, and Monte Carlo simulation to quantify the uncertainty of potential events and conditions that may cause substantial changes in program execution and cost.

Collaboration Opportunities
- Calibrating expert judgment in a group setting – Hubbard-style calibration to create more stability in elicited parameters
- Designing and mapping "glue" nodes to cost model inputs
- Defining and classifying program change drivers

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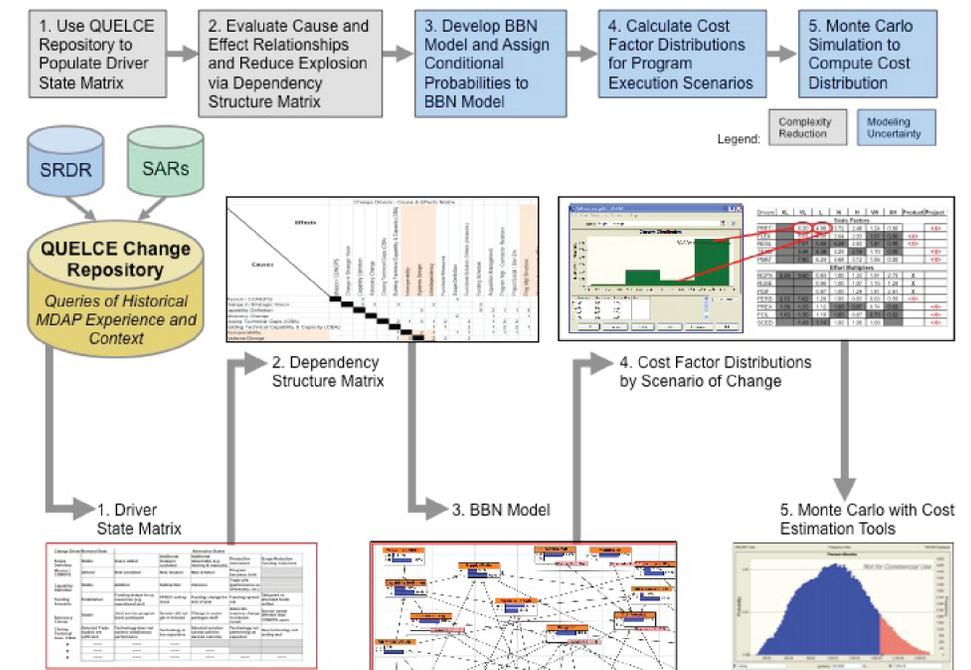
Interactive Simulation of Sustainment Investment
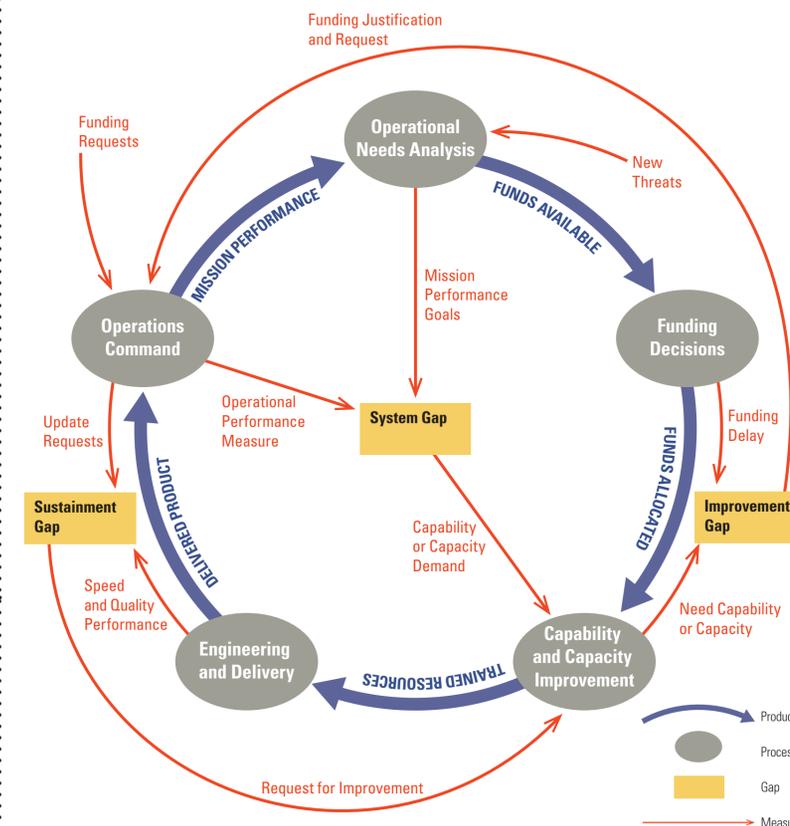
Objective: Develop an investment model for allocating sustainment budgets and resources, identify data sources that can be used as a market signal of the demand for additional product investment, and forecast the value of meeting those additional product capability and performance objectives.

Description: While many life-cycle phases have well-defined processes, the sustainment phase does not. Too many organizations are involved, and too many activities take place that have very different cycle times. The Sustainment Investment project describes the growing cost of software sustainment, models the dynamic activities occurring on a program in the sustainment phase, and shows how change in one variable causes changes that propagate through the system.

Collaboration Opportunities
- Defining and collecting the measures of performance to represent the three gaps:
  – Operational Capability Readiness
  – Sustainment Delivery Capability
  – Improvement Funding
- Extending the gap measurement and analysis to encompass a portfolio of products sustained rather than a single product
- Developing training on using the simulation to reduce the time required to justify funding for sustainment capability improvements

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