

Empirical Software Engineering Research Roadmap

Discussion and Summary

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1 Roadmap Discussions

The Dagstuhl working groups' discussions provide many insightful perspectives and suggestions for defining a roadmap for Empirical Software Engineering (ESE) research. This summary attempts to consolidate these ideas into an overall roadmap. As emphasized in the roadmapping introduction, defining a roadmap is an ongoing process and the resulting roadmap needs to be considered a "living document." New ideas and changing environments will continue to influence the roadmap, and consequently, the roadmap will need to be updated periodically to incorporate these new ideas and environments.

2 Roadmap Categories, Dimensions, and Progress Indicators

Each roadmap dimension defines one important aspect of ESE research. The overall ESE roadmap consists of four categories that organize and group together nine different dimensions. The ESE roadmap categories and dimensions are as follows with dimensions indented below categories:

- Maturity
 - Cohesiveness of field
 - Research methodology
- Coverage
 - Process/technique/phase
 - Problem domain
 - Artifact scale
 - Subject expertise level
- Understanding
 - Evidence
- Impact
 - Science/engineering
 - Industry

Each of the nine dimensions has several "signposts" or indicators that signify progress along the dimension, and each dimension has a final progress indicator that defines the ultimate goal for the dimension. The ordering of these progress indicators suggests a logical path or maturation along a dimension. In some cases, researchers may pursue many steps in parallel so the definition of a strict linear ordering of steps

can be challenging. The overall ESE roadmap consisting of four categories, nine dimensions, and numerous progress indicators is outlined as follows with progress indicators indented below dimensions and listed in ascending order of progress:

- Category: Maturity
 - Dimension: Cohesiveness of field
 - Individual research plan
 - Common terminology
 - Guidelines
 - Standards
 - Common research plan
 - Handbook
 - Dimension: Research methodology
 - Subjective views
 - Isolated techniques
 - Understand technique tradeoffs
 - Integrated techniques
 - Repeatable methods
 - Objective framework, standards
- Category: Coverage
 - Dimension: Process/technique/phase
 - Single technique/phase
 - Multiple techniques or phases
 - Multiple techniques and phases
 - Comprehensive processes, techniques, and phases
 - Dimension: Problem domain
 - Single artifact
 - Single project
 - Single domain
 - Multiple domains
 - Comprehensive domain coverage
 - Dimension: Artifact scale
 - Units/components
 - Subsystems
 - Small-scale systems
 - Large-scale systems
 - System-of-systems
 - Dimension: Subject expertise level
 - Junior expertise
 - Intermediate expertise
 - Advanced expertise
- Category: Understanding
 - Dimension: Evidence

- Research conjectures
- Supportive observations
- Common patterns/similarities
- Replicated results
- Validated theories
- Category: Impact
 - Dimension: Science/engineering
 - Subset of Empirical Software Engineering
 - Empirical Software Engineering
 - Software Engineering
 - Computer Science
 - Systems Engineering and/or Information Technology
 - Dimension: Industry
 - Isolated examples
 - Organizational adoption
 - Multi-organizational adoption
 - Industry-wide shift

3 Roadmap Visualization

Figure 1 displays a Kiviat-style or “spiderweb” graph of the ESE roadmap. Researchers can assess progress along each dimension by evaluating research activities and results according to each dimension’s progress indicators. An overall assessment of the ESE field emerges when researchers assess all the dimensions simultaneously. One such combined assessment calibrates the ESE field as follows:

<u>Dimension</u>	<u>Current Progress Indicator</u>
Cohesiveness of field	Individual research plan
Research methodology	Isolated techniques
Process/technique/phase	Single technique/phase
Problem domain	Single project
Artifact scale	Units/components
Subject expertise level	Junior expertise
Evidence	Supportive observations
Science/engineering	Subset of Empirical Software Engineering
Industry	Isolated examples

Future workshops will need to update the proposed ESE roadmap and reassess progress. ESE continues to be a very fruitful area for rich software engineering research, and we look forward to continued progress in the field.

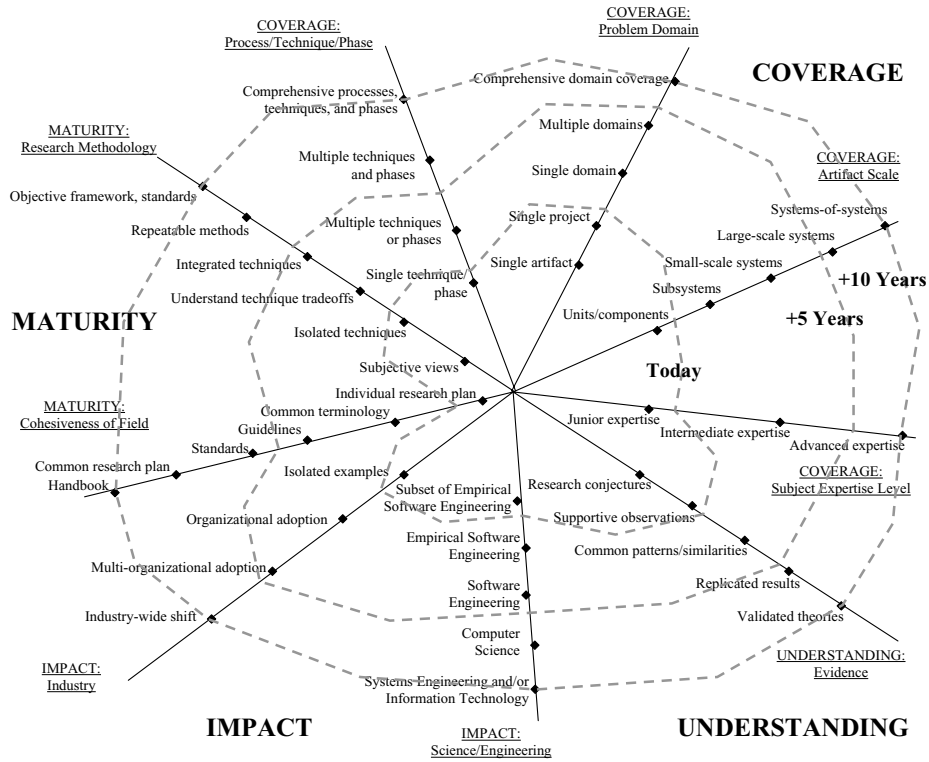


Fig. 1. Empirical Software Engineering Research Roadmap