

The SCR Approach to Requirements Specification and Analysis

Stuart Faulk
University of Oregon
faulk@cs.uoregon.edu

Connie Heitmeyer
Naval Research Laboratory
heimtaylor@itd.nrl.navy.mil

The Software Cost Reduction (SCR) requirements method is a practical, industrial-strength approach to requirements that leads to precise, unambiguous, and testable requirements specifications. The method scales to large applications, producing specifications that are both easy to understand and easy to change. Effectiveness of the SCR approach has been demonstrated in a variety of industrial, safety-critical applications. These include software for military aircraft, commercial aircraft, and the shutdown system of a nuclear power plant. Recent work has extended the method to include mechanical support for creation, validation, and verification of formal requirements specifications. This support is based on a formal requirements model.

Researchers have claimed that formal methods have the potential to address many of industry's problems with requirements, including ambiguity, incompleteness, and imprecision. Nonetheless, industry has been slow to adopt formal techniques because they are perceived as impractical for large, complex applications.

The SCR method was developed to provide the benefits of formal methods to industrial developers of large-scale real-time systems. It has been effective in meeting industry needs because the technical approach addresses constraints and concerns common to industrial software developers, including ease of use, scalability, and cost-effectiveness.

This tutorial gives an overview of the SCR method, its rationale, and empirical results on its effectiveness. It includes the following topics:

- The current industrial perspective on the requirements problem and why the available methods and tools are inadequate.
- Necessary characteristics of methods and tools appropriate for industrial development of requirements and why industry is skeptical of formal methods.
- How the SCR method addresses common industrial concerns, such as scalability, ease of use, fit within the software development life-cycle, and technology transfer.
- Overview of the SCR formal model and the constructs and notation useful for representing the requirements of industrial-strength systems.
- Description of prototype tool support for SCR. The tools support simulation, analysis of com-

pleteness and consistency, and analysis of application properties such as safety.

- Discussion of technology transfer efforts and the results of empirical studies
- Results and lessons learned from application of the SCR method to a commercial software development effort (Operational Flight Program for the C-130J aircraft).

The goal of the tutorial is for attendees to develop an understanding of the current problems with requirements in industry and how software engineering principles were applied to produce a practical, cost-effective approach to formal specification of requirements. The goal is not to teach the method but to convey an understanding of the underlying technical approach, how fundamental software engineering principles can be applied to address industrial problems, key features of the formal model, and the results of applying the model to the requirements specification of industrial systems and software. Principles and results will be illustrated with examples.

Instructors. Stuart Faulk is a member of the University of Oregon's Computer Science Department. Previously, he worked on the SCR project at the Naval Research Laboratory (NRL). He also headed the development of the Consortium Requirements Engineering (CoRE) method at the Software Productivity Consortium, where he successfully applied CoRE to the Lockheed C-130J. Connie Heitmeyer heads the Software Engineering Section of NRL's Center for High Assurance Computing. She leads NRL's research program in Software Requirements which is developing a formal requirements model and formal techniques and software tools for specifying and analyzing requirements based on the SCR method. Ms. Heitmeyer recently published a new book entitled "Formal Methods for Real-Time Computing."

References

- [1] Stuart R. Faulk, "Software requirements: A tutorial," NRL report 7775, Naval Research Lab, Wash., DC, 1995.
- [2] Constance L. Heitmeyer, Ralph D. Jeffords, and Bruce G. Labaw, "Automated consistency checking of requirements specifications," *ACM Trans. Software Eng. and Methodology* 5, 3, July, 1996, 231-261.