

## The COTS Spot CMMI<sup>SM</sup> and BSCC

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The application of Building Systems from Commercial Components (BSCC) helps engineers develop detailed alternative solutions and selection criteria in the Technical Solution process area for COTS-based system development. Both CMMI models and BSCC emphasize the need to evaluate multiple design alternatives in terms of cost, schedule, and risk, as well as functionality and design qualities.

### Introduction

Since the release of *Building Systems from Commercial Components* [Wallnau 01] in July of 2001, the design and engineering team from the SEI COTS-Based Systems Initiative has developed the collection of techniques described in that book into a more prescriptive COTS-based systems design process. This evolution has been partially described in this column and other forums and will soon be offered as part of an updated tutorial. However, we have not yet described the relationship between this work and another important SEI product, Capability Maturity Model<sup>®</sup> Integration (CMMI<sup>®</sup>) [CMMI 03]. In this column, I examine how this process, newly evolved from *Building Systems from Commercial Components* (BSCC) techniques, can be used to satisfy portions of the CMMI process model.

The CMMI model is illustrated in Figure 1. The process areas are clusters of related practices in an area that, when performed collectively, satisfy a set of goals in that area. CMMI Version 1.1 models identify 25 process areas, grouped into categories.

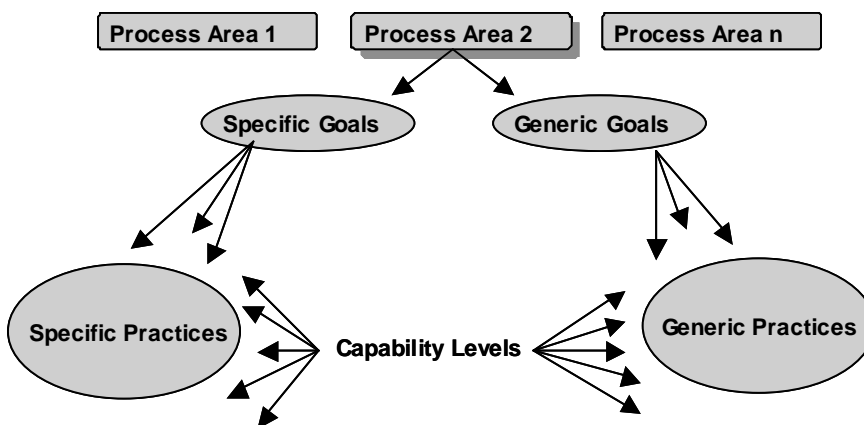


Figure 1: CMMI Model Components.

## Technical Solution

The Technical Solution practice area is defined in the Engineering process area. The purpose of Technical Solution is to design, develop, and implement solutions to requirements. Solutions, designs, and implementations encompass products, product components, and product-related life-cycle processes either singly or in combinations, as appropriate. The techniques and practices described in BSCC satisfy the following specific goals of the Technical Solution:

### SG 1 Select Product-Component Solutions

*Product or product-component solutions are selected from alternative solutions.*

### SG 2 Develop the Design

*Product or product-component designs are developed.*

The specific goal for selecting product-component solutions requires considering alternative solutions in advance of selecting a solution. This goal is supported in BSCC through the use of [contingency planning](#), a technique for managing multiple design alternatives of unknown feasibility and determining how and when to apply resources to resolve critical unknowns. [Risk/Misfit](#), another BSCC technique, is a decision aide used for determining the level of resources to be used in exploring the different design alternatives based on cost, schedule, performance, and risk. While Risk/Misfit itself may be better aligned with the Decision, Analysis, and Resolution (DAR) process area, its application here satisfies the specific goal of evaluating design alternatives against these criteria.

The specific goal of selecting product-component solutions in CMMI is supported by three specific practices:

**SP 1.1** Develop detailed alternative solutions and selection criteria.

**SP 1.2** Evolve operational concepts and scenarios.

**SP 1.3** Select product-component solutions.

These specific practices are supported by BSCC processes and techniques as described in the following subsections.

## Develop Detailed Alternative Solutions And Selection Criteria

Developing detailed alternative solutions is an essential concept of the Technical Solution process area. As already mentioned, BSCC encourages the development and management

of multiple design alternatives through contingency management. The development of detailed design alternatives is supported in BSCC through the  $R^3$  process and the use of [model problems](#).  $R^3$  stands for Risk analysis, Realize model problems, and Repair misfit. Risk analysis involves creating one or more model *blackboards* that illustrate a scenario through the design alternative containing a critical risk. If critical unknowns exist in the blackboard, model problems are realized to further assess the risk. Model problems are situated prototypes created to answer specific design questions. If specific risks still exist after creation of the model solution (to the model problem), it may still be possible to repair the misfit, either by adapting the design alternative or by changing the context (e.g., the requirements). Repair misfit is the final step in  $R^3$ .

Selection criteria are an inherent part of BSCC. The major selection criterion used in BSCC is design risk; for example, that the design does not satisfy stakeholder needs. Project-level design risk is assessed at the beginning of the process. Design alternatives are continually assessed against these risks throughout the  $R^3$  process. The ability of each design alternative to address these risks is considered along with the costs and benefits of each approach in identifying a path for continued design-space exploration. Continued application of these criteria in the design process prevents unnecessary expenditure of resources on unfeasible solutions.

## **Evolve Operational Concepts And Scenarios**

SP 1.2 evolves the operational concept, scenarios, and environments to describe the conditions, operating modes, and operating states specific to each product component. Operational concepts and scenarios are also a critical element of BSCC. Scenarios are developed and used in the creation of blackboards within  $R^3$  to assess specific design risks.

Typical work products for this specific practice include product-component operational concepts, scenarios, and environments for all product-related life-cycle processes (e.g., operations, support, training, manufacturing, deployment, fielding, delivery, and disposal); timeline analyses of product-component interactions; and use cases. BSCC includes work products such as ensemble descriptions and blackboards that emphasize timeline analyses of product-component interactions. Use cases are used in BSCC to discover critical unknowns in a design alternative and to explore design risk in the  $R^3$  process.

## **Select Product-Component Solutions**

The final specific practice for SG 1 selects the product-component solutions that best satisfy the criteria established. Since integration problems are a major source of risk in COTS-based systems development, COTS components must be selected in the context of a feasible design solution. Consequently, evaluation in BSCC is an inherent part of the

design process. Successful execution of BSCC results in the selection of a feasible design alternative that consists of a collection of components and design decisions.

## Summary

The application of BSCC satisfies the specific goal of developing detailed alternative solutions and selection criteria in the Technical Solution process area for COTS-based system development. Both CMMI models and BSCC emphasize the need to evaluate multiple design alternatives relative to cost, schedule, and risk, as well as achieving the required functionality and design qualities.

I will explore, in a future column, where and to what degree BSCC satisfies the specific practices of SG 2 (developing the design).

## References

[**CMMI 03**] Capability Maturity Model® Integration (CMMI<sup>SM</sup>), Version 1.1 CMMI<sup>SM</sup> for Systems Engineering, Software Engineering, Integrated Product and Process Development, and Supplier Sourcing (CMMI-SE/SW/IPPD/SS, V1.1) Staged Representation CMU/SEI-2002-TR-012/ESC-TR-2002-012, March 2002.

[**Wallnau 01**] Wallnau, Kurt; Hissam, Scott; and Seacord, Robert. *Building Systems from Commercial Components*. New York, NY: Addison-Wesley, 2001.

## About the Author

**Robert C. Seacord** is a senior member of the technical staff at the SEI and currently leads a team researching software sustainment. He is coauthor of 2 SEI Series books, *Modernizing Legacy Systems: Software Technologies, Engineering Processes, and Business Practices* and *Building Systems from Commercial Components* as well as more than 40 papers on component-based software engineering, Web-based system design, legacy system modernization, component repositories and search engines, security, and user interface design and development. He has over 20 years of development experience and was previously a technical staff member at the X Consortium and IBM.

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The Software Engineering Institute (SEI) is a federally funded research and development center sponsored by the U.S. Department of Defense and operated by Carnegie Mellon University.

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<sup>SM</sup> Architecture Tradeoff Analysis Method; ATAM; CMM Integration; COTS Usage Risk Evaluation; CURE; EPIC; Evolutionary Process for Integrating COTS Based Systems; Framework for Software Product Line Practice; IDEAL; Interim Profile; OAR; Operationally Critical Threat, Asset, and Vulnerability Evaluation; Options Analysis for Reengineering; Personal Software Process; PLTP; Product Line Technical Probe; PSP; SCAMPI; SCAMPI Lead Assessor; SCAMPI Lead Appraiser; SCE; SEI; SEI-Europe; SEPG; Team Software Process; and TSP are service marks of Carnegie Mellon University.

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