

A Perspective on the Issues Facing SPICE

Mark C. Paulk
Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213-3890

Abstract

A suite of standards for software process assessment is being developed by ISO under the SPICE project. The intent of the SPICE standard is to harmonize the numerous efforts around the world to manage and improve the software process. This work is related to the software process work being done by the SEI, and the SEI is actively participating in the ISO activities. Drafts of the standard are being trialled now, and there are several issues that will need to be resolved as the suite progresses toward standardization. This paper provides an SEI perspective on some of these issues.

1. Introduction

The International Organization for Standardization (ISO) is developing a suite of standards on software process assessment to harmonize the many existing approaches, including the Software Engineering Institute's (SEI) work with the Capability Maturity Model SM for Software (CMMSM) [Paulk95b]. This standard is being developed and trialled for ISO/IEC JTC1/SC7/WG10¹ by a project named SPICE (Software Process Improvement and Capability dEtermination) [ISO92, Dorling93, Paulk94]. Draft technical reports were released by the SPICE project to ISO/IEC JTC1/SC7 for review and balloting in June 1995. Revisions of these documents will be re-submitted as proposed standards after a two-year trialling period ends, probably in 1997 or 1998.

The SEI's involvement in ISO's SPICE project is sponsored by the U.S. Department of Defense. CMM and Capability Maturity Model are service marks of Carnegie Mellon University.

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¹IEC is the International Electrotechnical Commission. Joint Technical Committee 1 (JTC1) is responsible for information technology standards; Subcommittee 7 (SC7) is responsible for software engineering standards; and Working Group 10 (WG10) is responsible for the software process assessment standards.

The SPICE standard is designed to address software process issues, including management practices, customer support, and quality, as well as software development and maintenance practices. The international standard on software process assessment is intended to help:

- customers, who can determine the capability of software suppliers and assess the risks involved in selecting one supplier over another;
- software suppliers, who will only submit to one process assessment scheme instead of having to go through numerous schemes as is the case today;
- software organizations, who will have an internationally recognized standard that supports their continuous process improvement programs; and
- managers, who need to ensure that their software processes are aligned with the business needs of the organization.

Whether SPICE can successfully harmonize the many different assessment approaches depends on political issues as well as technical ones. Will an ISO 9001² auditor take the results of an assessment as valid inputs that can minimize the impact of the audit? Or possibly even remove the need for the audit?

The SEI became involved with the SPICE standard after a feasibility study on an international standard on software process assessment was proposed to ISO/IEC JTC1/SC7 in 1991. A standard on software process assessment could have a significant impact on our process work. SEI objectives in our participation with the SPICE project are to:

- minimize conflict between the international standard and our work, with the goal of becoming conformant with the standard when it is released;
- learn from our international colleagues and their experience in assessments and audits, as an input to our future work; and
- promote our work within the international community where it serves U.S. interests (although we are a U.S. federally funded research and development center, the software community is world-wide).

As good international citizens, the SEI hopes to make our assessment products and services SPICE conformant. We are not, however, making a firm commitment to become SPICE conformant. There are some serious technical issues in nearly all of the SPICE products at this time. Although we are providing input on these problems, the final resolution may be unacceptable. We hope that the eventual standard will be fully consistent with our work; provide useful, alternative perspectives on the software process; and support our

² Note that ISO 9001 is under TC176, and the SPICE standards are being developed by JTC1/SC7/WG10. These are different technical committees, with different scopes, in ISO.

value-added enhancements, which will be realized in the CMM and related products and services.

The primary concerns about the SPICE standard revolve around 1) conflicts with existing software process efforts, e.g., the SEI's work and ISO 12207; 2) impact on existing software process improvement initiatives; and 3) the potential for abuse of the standard.

2. The SPICE Products

There are nine parts of the proposed software process assessment standard, which are shown in Figure 1.

- 1) concepts and introductory guide
- 2) a model for process management
- 3) rating processes
- 4) guide to conducting assessments
- 5) construction, selection, and use of assessment instrument and tools
- 6) qualification and training of assessors
- 7) guide for use in process improvement
- 8) guide for use in determining supplier process capability
- 9) vocabulary

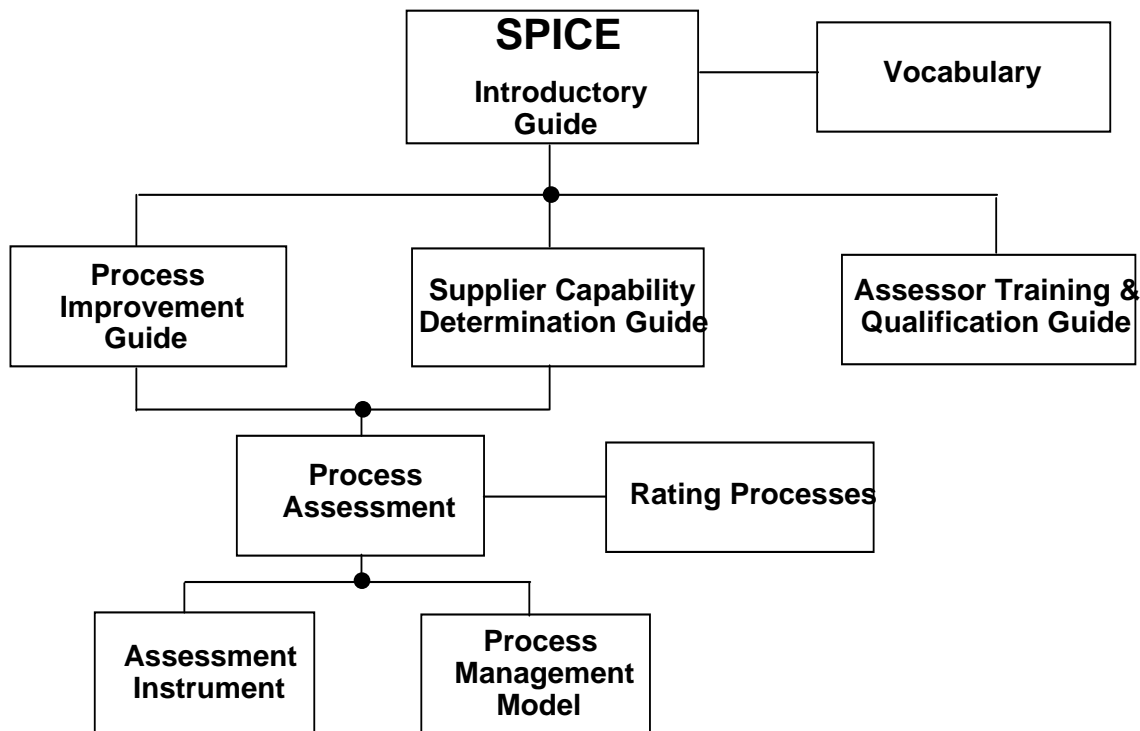


Figure 1. Relationships between the parts of the SPICE standard.

All SPICE assessments, whether for internal improvement or capability determination, must satisfy the same assessment and process rating requirements. They use a common process management model and assessment instrument. The standard is not intended to provide a stand-alone method or model; it is intended to harmonize existing approaches rather than replace them. Variants, based on existing assessment schemes, are expected to “fill out the picture” and add value, but the specific methods and models used in a SPICE-conformant assessment must satisfy the requirements in the SPICE standard.

Many issues were raised during the development of the SPICE draft standard. The draft SPICE standard is largely a “union of ideas” based on many different perspectives. When it was not possible to come to consensus, it was generally agreed to resolve differences during the trialling and balloting. The foundation of the standard is the process management model, which is analogous to the CMM. Many of our concerns about SPICE center on the model³ and how processes are rated using it.

The model provides a universal set of software engineering and management practices as a reference model for assessments. It measures processes along two axes: whether a process is performed and how capable that process is. This architecture differs from the SEI approach since it focuses on the capability of individual processes rather than organizational capability, but it is compatible with the CMM [Paulk95a].

As shown in Figure 2, the two axes comprising the SPICE architecture are: the unique base practices that are essential to performing a given process and the generic practices that describe the capability with which the process is managed.

³ It should be noted that Mark Paulk, the author of this paper, is the co-project editor for the SPICE process management model and Mike Konrad is on the model’s core team. We are senior members of the technical staff at the SEI and exerted considerable influence on the development of the current drafts, although we did not win all of the disagreements.

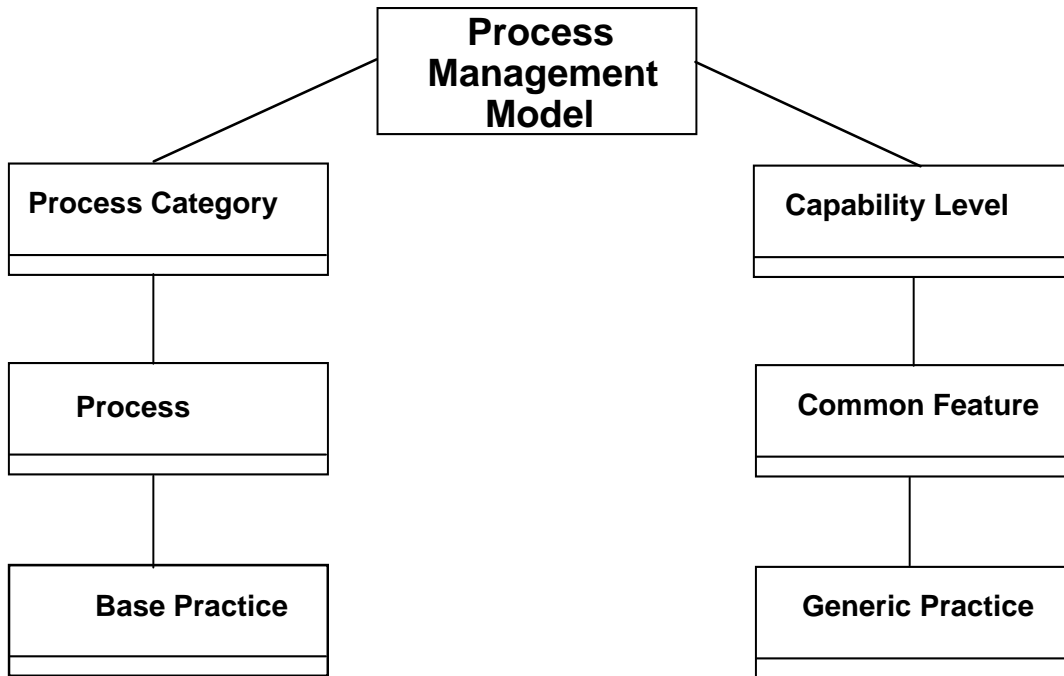


Figure 2. Process and capability axes in the SPICE model.

The base practices axis categorizes activities into base practices, which comprise processes, which in turn are grouped into process categories. A base practice is a software engineering or management activity that directly addresses the purpose of a particular process and contributes to the creation of its output. There are 201 base practices in the current draft of the model. A process is a statement of purpose and an essential set of practices (activities) that address that purpose. There are 35 processes. A process category is a set of processes addressing the same general area of activity. There are five process categories: customer-supplier, organization, project, engineering, and support.

The generic practices axis categorizes process management activities into generic practices, which are grouped into common features, which in turn form capability levels characterizing the process capability of a given process. A generic practice is a process management activity that enhances the capability to perform a process. There are 26 generic practices in the current draft of the model. A common feature is a set of generic practices that address an aspect of process implementation or management. There are 11 common features. A capability level is a set of common features (i.e., generic practices) that works together to provide a major enhancement in the capability to perform a process. There are six capability levels in the SPICE model: 0) Not-Performed, 1) Performed-Informally, 2) Planned-and-Tracked, 3) Well-Defined, 4) Quantitatively-Controlled, and 5) Continuously-Improving.

The two axes intersect at capability level 1, the Performed-Informally Level, which contains only one generic practice: perform the process. Assessing a process against capability level 1 implies assessing the base practices of that particular process.

3. Issues for SPICE

Over the past several years, the SEI has struggled with some of the same issues that SPICE is now attempting to address, but we have been unable to identify wholly satisfactory solutions. These issues have been extensively discussed within the SPICE project, but full consensus has not been achieved. Representatives of many different approaches are participating in the development of the SPICE products. Harmonizing these different perspectives is challenging, especially since many of the requirements for SPICE are subject to interpretation.

As major technical issues were raised, they were discussed and documented in the SPICE Technical Issues Register. Many issues were resolved. For others a position was taken, with the expectation that trials and ballot comments during the standardization process will provide further input. Whatever the ultimate resolution, the answers must be acceptable to the SPICE user community – software engineering organizations doing process improvement – if the standard is to be broadly accepted.

3.1 Length of the assessment's on-site period

The most controversial issues center on usability. Based on the phase 1 pilots conducted so far, the length of time to rate processes completely and rigorously is much too long. A full-blown assessment could take hundreds of hours.

The problem appears to have two causes:

- 1) The model is too complex, containing too many processes and too many practices, and there is difficulty interpreting the generic practices consistently and reliably. There are potentially over 1000 rating decisions in a full-blown SPICE assessment. By comparison, there are only 316 key practices in the CMM, and most assessments scope that to under 150.⁴
- 2) Process rating is too detailed, requiring that each practice be rated “within each selected process instance for each process and/or extended process

⁴ One analogy that has been made is that the SPICE model is a map of the terrain, where the CMM, which prioritizes improvement actions for the organization, describes a road through the terrain.

identified within the assessment scope.” There are far too many rating decisions per process to be intellectually manageable.

The tradeoff between reliability and consistency versus usability is a difficult one, as we observed in developing the CMM Appraisal Framework [Masters95]. The more detailed a decision, and the more guidance that is provided, the more repeatable that decision will be. Unfortunately, it is very easy to specify a method that is then unusable in the field for most practical purposes.

3.2 Compatibility with other standards

There are a number of other international standards which will impact, and be impacted by, the SPICE effort. Specific examples include ISO 12207 (Software Life Cycle Processes), ISO 9001 (Quality Management Systems), and other standards currently under development. Although mappings have been provided between the practices in the SPICE model and both ISO 12207 and ISO 9001, some reviewers still consider this a major concern, especially since ISO 12207 is the “flagship software engineering standard” for SC7. Theoretically the generic practices can be applied to any process, including those listed in ISO 12207.

From an SEI perspective, the more flexibility provided by the SPICE process management model, the easier it will be to format the CMM as a variant model that complies with the SPICE requirements.

3.3 Process guidance that may not be generally applicable

The SPICE assessment instrument incorporates “adequacy indicators” intended to provide objectivity in determining process adequacy. This has been very controversial within the SPICE project, given the inherent difficulty in identifying objective indicators that span different application domains and organizational cultures. The adequacy indicators can be considered analogous to the subpractices in the CMM. This level of detail, which we provide as guidance in understanding the key practices and goals of the CMM, leads some to conclude erroneously that the CMM can only be used in large-project and large-organization environments.

The SPICE standard is required to apply to any size organization or project in any kind of software sector (application domain). The proposal to create the SPICE project stated that sectors could build conformant variants of the standard to provide specific, objective criteria for applying SPICE within that sector.

The concept of adequacy indicators appears to clash with the focus on describing processes that are generally applicable and which can be extended with specific criteria for judging different sectors. From the perspective of objective auditing, the more detailed a practice is, the easier it is to form an objective, and defensible, judgement of conformance to the standard. Too much detail, however, could lead to a standard that prescribes what software process should be followed. Resolving this tradeoff between objectivity and flexibility requires feedback from the users in the field.

3.4 The danger of certification

Although there is a SPICE position to the contrary, there is a danger that SPICE will be used for certification. The topic comes up repeatedly, and there are differences within the international community regarding whether certification should be encouraged or discouraged. Most members of the SPICE project oppose certification, but ISO cannot prevent certification mechanisms being established by the user community, as occurred for ISO 9001.

The SEI has investigated the possibility of certifying maturity levels several times, but we have been unable, as of yet, to identify acceptable solutions to the practical difficulties of establishing an effective certification mechanism.

3.5 The threat of competition

There is also a concern that SPICE will inappropriately replace existing assessment approaches, although the SPICE goal is to harmonize existing approaches rather than replace them. Direct use of the SPICE standard is certainly possible, although not advisable. Similar to certification, ISO can exert little control over how its standards are used.

Certainly the SEI does not intend to replace the CMM and its related products and services with SPICE products and services, although we hope to make our products and services SPICE conformant.

4 Conclusion

ISO has begun an effort to harmonize the software process improvement efforts being done around the world. Although the SEI's work is probably the best known example of these efforts, there are many others that are contributing to an international standard with the potential of changing the way software is developed and maintained throughout the world. The SEI is participating in this standardization effort and hopes to take advantage of the contributions of our international colleagues.

Although there are many good ideas embedded in the current SPICE drafts, there are also many significant issues that must be resolved as the standardization process proceeds. This should involve a major simplification of the parts of the standard; hopefully, the value-added concepts in the standard will survive the rigorous review and balloting process.

For further information on SPICE, contact:

David Kitson
U.S. SPICE Technical Center Manager
Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213-3890
Internet: dhk@sei.cmu.edu

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