

1 Introduction and Overview

This chapter consists of three parts: Section 1.1 deals with the question of why there is an increasing trend in the application of maturity models. Section 1.2 briefly explores the history of the maturity models, in particular with regard to the competing models CMMI^{®1}, SPICE, and Automotive SPICE^{™2}, and emerging trends. Section 1.3 explains the basic structures of Automotive SPICE that are needed to understand subsequent chapters.

1.1 Introducing the Subject Matter

In today's globalized world economy, products and services are rarely developed in isolation by a single company. Manufacturers are increasingly forced to develop their products within a whole network of in-house development centers, suppliers, and equal partners. The key driver is continually increasing costs, which forces companies to shift development to low cost locations and to engage in strategic partnerships. Since products and services are becoming increasingly complex and sophisticated while development cycles are getting shorter and shorter, two major issues have emerged:

- How can these complex cooperations and value chains be controlled?
- What can be done to ensure quality and adherence to cost and schedules?

For many businesses this has become a major challenge with an immediate effect on market success and growth. Key success factors relating to these questions are systematic and controllable business processes, especially those relating to management, engineering, quality assurance, acquisition, and cooperation with external partners. The methodology underlying the »maturity models« lends itself ideally to tackle these problems.

1. CMMI is registered in the U.S. Patent and Trademark Office.
2. »Automotive SPICE« is a registered trademark of Volkswagen AG, Wolfsburg.

Maturity models such as SPICE, Automotive SPICE, and CMMI, offer suitable methods (by means of tried »good practices«); they have a strong focus on processes³ and have, for many years, been successfully applied to address the issues stated above. In the Nineties, the CMM^{®4} and later CMMI models became a real success in the U.S. The initial push came from the US Department of Defense which suffered from enormous cost and budget overruns caused by its software and system suppliers and achieved significant improvements applying CMM/CMMI. Today, it is common practice in the U.S. to require a certain CMM or CMMI level from suppliers and certification through audits⁵. No bid will be accepted without such a level. A similar situation has emerged in the car industry with regard to Automotive SPICE.

1.2 Automotive SPICE and Other Maturity Models: History, Background, and Trends

The idea of the maturity models was also taken up in Europe. Particularly SPICE and, more recently, Automotive SPICE are being applied there, in addition to CMM and CMMI.

Figure 1–1 shows the most important maturity models and their historical development. The oldest model is CMM (see [CMM 1993a], [CMM 1993b]), which used to be very extensively deployed internationally but which has now been superseded by CMMI. In the car industry, CMM has never played an important role, although it was used by one car manufacturer for a short period to try out approaches to supplier evaluation. A few pioneers among the suppliers to the car industry used BOOTSTRAP, a model compatible to SPICE that never really caught on as an alternative to SPICE and was discontinued in 2003.

SPICE (see [Hoermann et al. 2006]) evolved from an ISO⁶ project of the same name and was published in 1998 as ISO/IEC TR 15504, whereby TR (Technical Report) is a forerunner to a later International Standard (IS). The different parts of the International Standard ISO/IEC 15504 were successively published from 2003 onwards. Part 5, which from a practical point of view is the most important part, was issued in 2006.

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3. It has been a proven principle for some decades that good and controlled processes (in addition to qualified staff and command of the technology) have a demonstrably positive influence on quality and cost.
 4. The term CMM is registered in the U.S. patent and Trademark Office.
 5. So-called »assessments«, »evaluations« and »appraisals«.
 6. International Organization for Standardization.

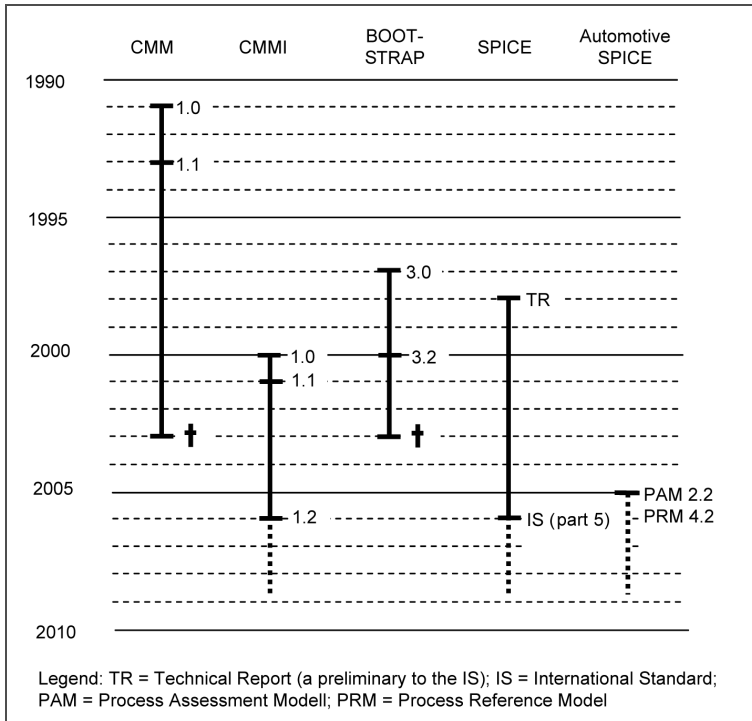


Figure 1-1 History of the most important maturity models used in Europe (only published models that have been applied in practice)

The breakthrough in the use of maturity models in the car industry came in 2001 with the decision of the OEM software initiative (HIS⁷) to use SPICE for the evaluation of suppliers in the software and electronics sector. Since then the application of SPICE has spread throughout the car industry. One of the big advantages of SPICE is that it allows the creation of domain-specific models consolidated under one common umbrella. Besides the space industry, the car industry also made use of this feature: In 2005 the Automotive Special Interest Group⁸ (AUTOSIG) of the Procurement Forum published the Automotive SPICE-Model (see [Automotive SPICE]). This model is now being applied by participating car manufacturers to perform assessments of their software and electronics suppliers. Figure 1-2 shows how the processes required by the HIS group, based on ISO/IEC TR 15504, correspond to the new requirement based on Automotive SPICE.

7. The working group established by Audi, BMW, Daimler (previously DaimlerCrysler), Porsche and Volkswagen.
8. In addition to Audi, BMW, Daimler (previously DaimlerCrysler), Porsche and Volkswagen, other participating car manufacturers are Fiat Auto, Volvo Car Corporation (together with Ford Europe, Jaguar, and Land Rover).

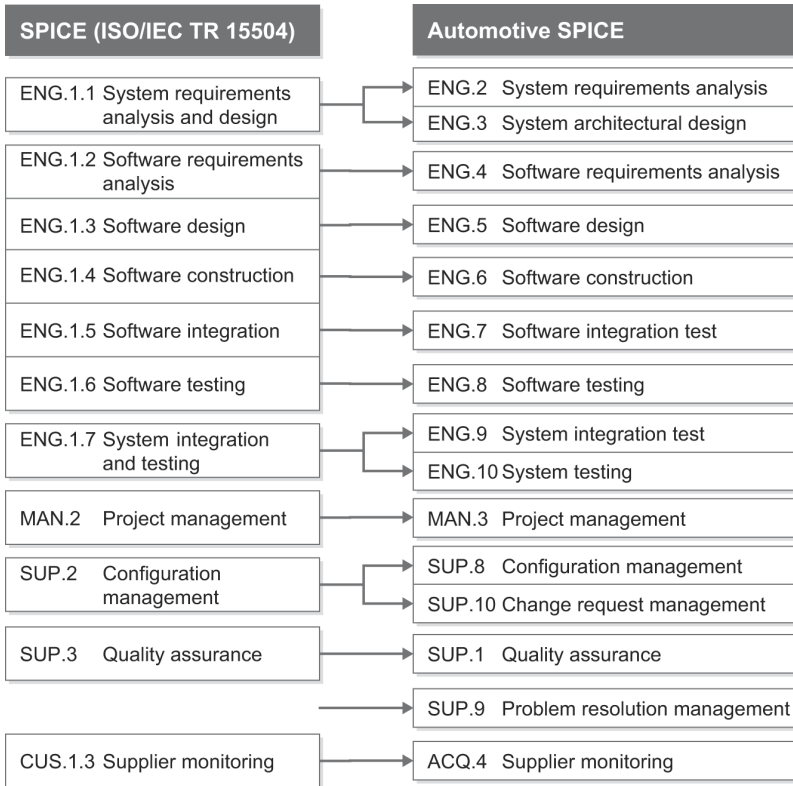


Figure 1–2 Mapping of processes required by the HIS working group based on ISO/IEC TR 15504 processes to the new requirement, based on Automotive SPICE (no mapping for problem resolution management)

Besides SPICE and Automotive SPICE, CMMI has also become increasingly prevalent in the motor industry (see [Kneuper 2006, Ahren et al. 2001, Chrissis et al. 2003, CMMI 2006]). In fact, in a survey of the »Hansen Report on Automotive Electronics« [Hansen], CMMI is mentioned more often than SPICE (see figure 1–3). The data shown refers to internal application, i.e., in-house development. With respect to suppliers, SPICE and Automotive SPICE are usually requested. The reason for CMMI’s wide-spread market penetration is due to the advantages of the model⁹, its good, world-wide support (see [SEI], [SEI Rep]) and the fact that its rapid growth since 2000 has made it evolve into a kind of quasi-standard. Even if there are no official figures available for SPICE and its derivatives we may assume the figure for CMMI to be considerably higher: by April 2007, approx. 61,000 people had attended the official three-day CMMI introductory course world-wide, and the figures show a sharply increasing trend.

9. Examples are the models’ degree of detail, its comprehensibility, and generic applicability for software, hardware, systems, and services alike.

Many organizations require expertise in several models:

- Vehicle manufacturers require Automotive SPICE accreditation from their suppliers, but if they are presented with CMMI appraisal results because supplier processes are geared to comply with CMMI, then manufacturers must be in a position to evaluate them.
- Suppliers whose processes are designed primarily to comply with the CMMI model must design their processes to satisfy the requirements of other models, too.

In the next section we are going to discuss the differences between SPICE and Automotive SPICE, whereas in chapter 4 we shall consider CMMI, SPICE, and Automotive SPICE.

From an application point of view, in particular, the emerging trends are of interest. Currently known facts are:

- SPICE: Work is in progress for the following new parts of the standard:
 - ISO/IEC TR 15504 Part 6—Exemplar Systems Life Cycle Processes Assessment Model—Working Draft
 - ISO/IEC 15504 Part 7—Assessment of Organizational Maturity—Working Draft
 - Official and reliable due dates are not yet available.
- Automotive SPICE: Since the release of PAM 2.3¹⁰, no further development has been announced.
- With version 1.2, CMMI received a new architecture that combines domain specific models (called »constellations«) by means of commonly used model components. The CMMI constellations for »Development« and »Acquisition« were released in 2006 and 2007, respectively, and in 2008 the constellation for »Services« is supposed to be available. For many organizations this may be very interesting from a strategic point of view, as this will make it possible to standardize principal processes of different business divisions (development, IT/services, purchasing).

A possible trend can be recognized: the expansion from the successful application in software development to further domains, in particular to system development, mechanics, and hardware development. It stands to reason to apply in other development areas what has been tried and tested in the software domain. Whereas SPICE is currently preparing to expand towards system development with its new part 6, CMMI has already completed this move (software, hardware, systems, services). Whether and in which way the HIS initiative or the Automotive Specific Interest Group (AutoSIG) will follow this trend is unknown but not unlikely. After all, quality problems are not only caused by software components. Some companies, such as Bosch (see figure 1–3) have obviously recognized this trend very early and are already proactively extending in the direction

10. In this book we refer to PAM 2.3.

towards hardware and mechanics development. Another trend is that organizations are moving to higher levels. Many enterprises, especially in Asia, did this with CMMI, thereby demonstrating their ability to develop high quality software efficiently. Now this trend is also beginning with Automotive SPICE. One example is Continental Automotive Singapore, Pte Ltd who recently achieved Automotive SPICE Level 4 in several processes.

	Organization	Favored Process
BMW	E/E Process Chain	CMMI in addition to specific BMW targets
Chrysler	E/E Core Engineering	CMMI/SPICE
General Motors	Powertrain, Vehicle Engineering	GM-specific, based on parts of CMMI
Honda	E/E Systems R&D	Considering CMMI and other technologies
Mercedes Car Group	USA Germany	CMMI SPICE
Toyota		Proprietary, based somewhat on CMMI
Volkswagen	E/E Engineering R&D	SPICE
Bosch Automotive	All software business units, plus component development departments	CMMI/SPICE
Continental Automotive Systems	All business units that deliver software	SPICE
Delphi	Electronics & Safety	CMMI
Siemens VDO	All 13 divisions	CMMI
Valeo	All divisions that deliver software	CMMI/SPICE
Visteon		Visteon Engineering Process (VEP), which uses elements of CMMI and SPICE

Figure 1-3 Distribution of maturity models in the car industry (excerpt)
source: [Hansen], July 2005, p. 8

How will the models' market shares develop? SPICE will probably continue to lose ground as a practical application, due to the motor industry's turn towards Automotive SPICE, while the latter will become firmly established in the supplier evaluation domain. In many organizations, CMMI will probably continue to gain ground and be used as an internally applied instrument, especially with regard to the strategic aspects described earlier.

1.3 Automotive SPICE: Structure and Components

Automotive SPICE consists of two components, a **process reference model (PRM)** and a **process assessment model (PAM)**. For practical use it is sufficient to be familiar with the process assessment model; therefore we shall confine ourselves here to a discussion of the process assessment model.¹¹

11. See [Hoermann et al. 2006] for a detailed discussion of the wider context.

The process assessment model contains all the details needed to evaluate process capability (so-called indicators) and is organized in two dimensions:

- **Process dimension:**
 The process dimension contains indicators for all processes to evaluate the extent to which these processes are performed. These indicators differ from process to process and form an important prerequisite for the achievement of level 1 (described in section 1.3.2).
- **Capability dimension:**
 The capability dimension contains the indicators for the evaluation of the different capability levels. These indicators are identical for all processes.

1.3.1 The Process Dimension

Automotive SPICE processes are shown in figure 1–4.

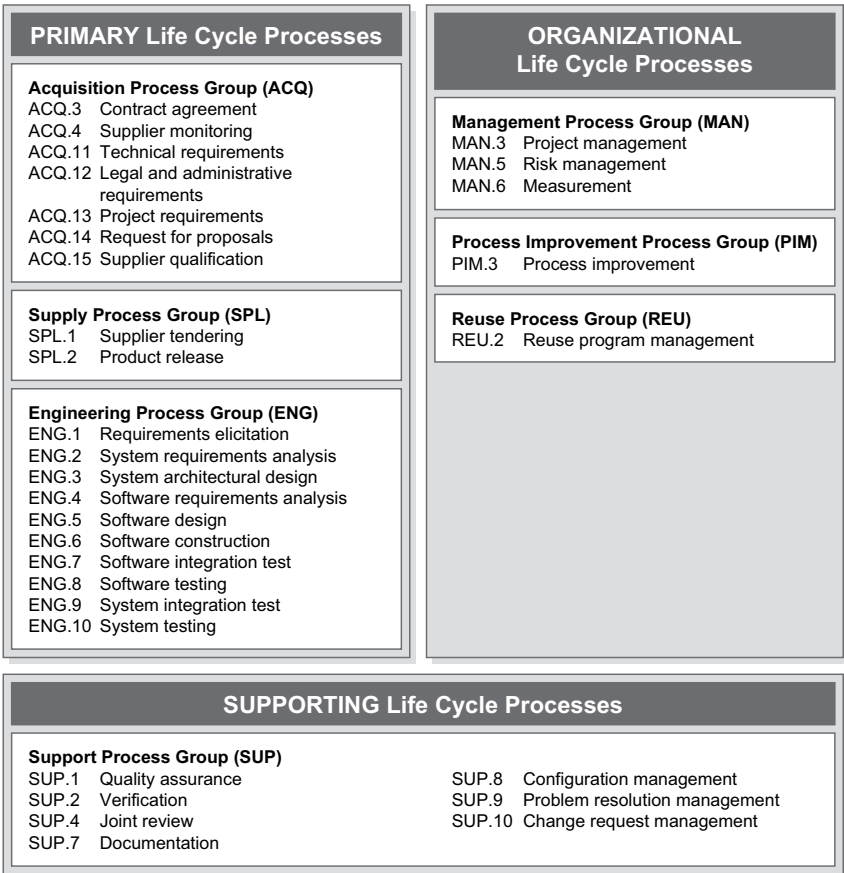


Figure 1–4 Processes in Automotive SPICE

Each process is structured in the same way, as shown in figure 1–5. Base practices are exemplary activities¹² needed to accomplish the process outcomes. Process outcomes are the detailed results of the achieved process purpose specifying what is to be accomplished by the process. Output work products are exemplary, typical results of a process; however, they are not mandatory. Together with the base practices they are the objective proof that the process has achieved its purposes. For that reason they are called process performance indicators and constitute the criteria for the achievement of Level 1.

Process ID	
Process Name	
Process Purpose	
Process Outcomes	
Base Practices	
Output Work Products	

Figure 1–5 Process structure in Automotive SPICE

1.3.2 The Capability Dimension

Automotive SPICE uses six capability levels for processes (see figure 1–6):

■ **Level 0: *Incomplete***

The process is not implemented, or the purpose of the process is not fulfilled. Project successes are a practical possibility but based solely on the individual efforts of project staff members.

■ **Level 1: *Performed***

The implemented process fulfills the purpose of the process. This means that basic practices are implemented and that defined process results are being achieved.

12. All Automotive SPICE model elements are exemplary, i.e., they specify, »what« needs to be implemented, but not »how«. They are requirements on an organization's processes. The processes of an organization may, however, be named and structured quite differently.

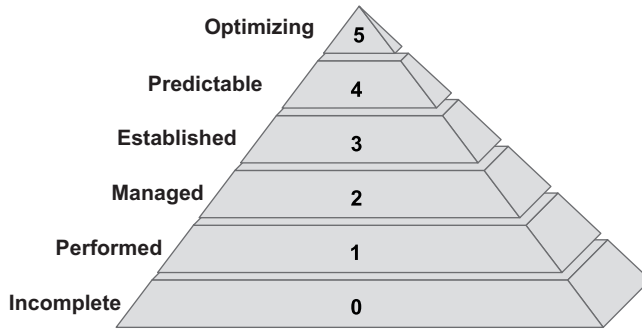


Figure 1-6 The six capability levels

■ **Level 2: *Managed***

Process performance is now additionally planned and tracked, and planning is continuously adjusted. The work products of the processes are adequately implemented; they are under configuration management, quality assured, managed, and adjusted.

■ **Level 3: *Established***

A standard process is now established and valid throughout the organization. Projects use an adapted version of this standard process (a so-called »defined process«) that is derived by means of »tailoring«. This process is able to achieve defined process results.

■ **Level 4: *Predictable***

While performing the defined process, detailed measurements are performed and analyzed, leading to a quantitative understanding of the process and improved predictability. Statistical methods are applied to control the defined process between upper and lower limits. The quality of work products is quantitatively known.

■ **Level 5: *Optimizing***

Quantitative process objectives are defined based on the organizations' business goals, and are permanently tracked. Processes are continuously improved, innovative approaches and techniques are tried and replace less effective processes to better achieve predefined objectives.

Whether a particular process capability level is achieved is determined by means of process attributes. Process attributes are assigned to capability levels and characterize them as regards content (see figure 1-7). Each process attribute defines a particular aspect of process capability. Level 2, for instance, is defined by the attributes »performance management« (i.e., planning, assignment of responsibilities and allocation of resources, monitoring etc.) and »work product management« (i.e., ensuring that the requirements on work products are fulfilled).

Capability level		Process attributes
5	Optimizing	PA 5.1 Process innovation attribute PA 5.2 Process optimization attribute
4	Predictable	PA 4.1 Process measurement attribute PA 4.2 Process control attribute
3	Established	PA 3.1 Process definition attribute PA 3.2 Process deployment attribute
2	Managed	PA 2.1 Performance management attribute PA 2.2 Work product management attribute
1	Performed	PA 1.1 Process performance attribute
0	Incomplete	

Figure 1-7 The process attributes

Details of process attributes and their evaluation are discussed in chapter 3. Processes are evaluated according to a four-point **rating scale**:

- N Not achieved
- P Partially achieved
- L Largely achieved
- F Fully achieved

The process capability level is calculated based on the process attribute evaluations following a simple calculation rule (see chapter 3). In order to reach a particular capability level, the rating of process attributes of that level must be at least L, and all process attributes of the lower capability levels must be rated F.

2 Interpretations Regarding the Process Dimension

It would go beyond the scope of this book to try and cover all the processes of Automotive SPICE; this is why we must confine ourselves to a useful selection. We decided to concentrate on processes which, based on our experience from improvement projects and many assessments, were typically of central relevance for most users—at least at the beginning of their improvement activities. Furthermore, we wanted to cover at least those processes that are evaluated by the OEM¹ software initiative (HIS) (see chapter 1) in the context of supplier assessments, as they constitute by far the largest volume of assessments. The results are shown in figure 2–1, and processes covered in this book are marked with a bullet.

Every process in Automotive SPICE consists of a standardized structure (see figure 1–5) and a set of individual process elements:

Process ID: Unique process identifier, consisting of a combination of three letters, a period, and one number between 1 and 12 (e.g., »MAN.3«).

Process Name

Process Purpose

Process Outcomes: The defined process outcomes

Base Practices: Practices constituting essential functional elements of the process.

Output Work Products: Each work product has a unique WP-ID and is explained in Automotive SPICE PAM, Annex B (work product characteristics).

1. (Original Equipment Manufacturer)

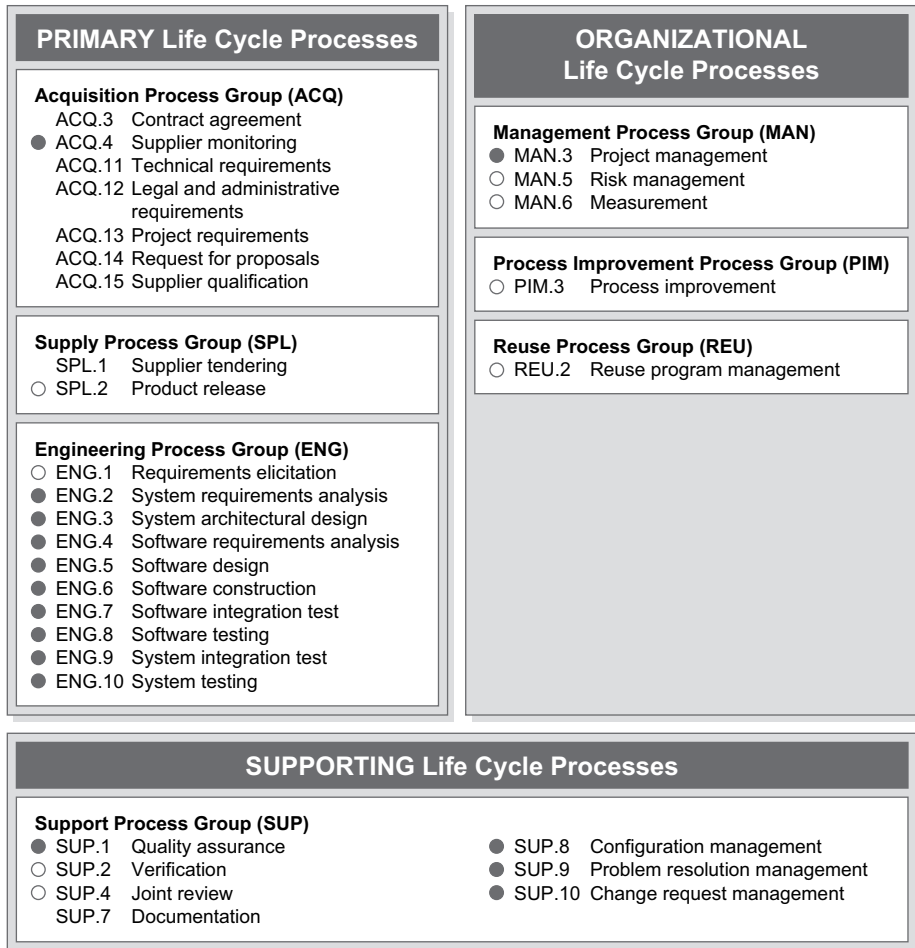


Figure 2-1 Processes covered in this book (marked with bullets); filled bullets indicate processes required by the OEMs (so-called HIS scope). In case of software-only vendors, ENG.2, ENG.3, ENG.9, ENG.10 are not applicable. If no subcontractors are used, ACQ.4 is not applicable.

The process purpose and the process outcomes are of particular importance because they are addressed by the Process Attribute PA 1.1 and the Generic Practice GP 1.1.1 (see chapter 3); as a result, they serve as the basis for capability assessments.

Each of the marked processes in this chapter is given its own section which is divided into the following subsets:

- **Purpose:** The »process purpose« as specified in Automotive SPICE.
- **Characteristics particular to the automotive industry:** This section discusses the particular nature of automotive software and system development in relation to the process.
- **Base Practices:** A step by step, detailed discussion of the base practices defined in Automotive SPICE. In Automotive SPICE, notes are of particular relevance. In most cases they constitute concrete examples or interpretational guidance added by OEM members of the Automotive SIG and are frequently checked in OEM assessments.
- **Designated Work Products:** Automotive SPICE defines a large number of work products. We have added explanations and, to some extent, examples to those work products that are essential in practice, always referencing the work product identifier and work product name. In some cases—where Automotive SPICE does not provide a relevant work product—we have suggested such work products ourselves on the basis of our own experience.
- **Characteristics of Level 2:** Since the generic practices (see chapter 3) are not defined in a process-specific fashion, we have provided process-specific interpretations to help readers gain a practical process understanding. Generally, we have confined ourselves to Level 2 since the differences at Level 3 are not so significant. Using the subheadings »Performance Management« and »Work Product Management«, we refer to the Process Attributes PA 2.1 and PA 2.2.

In addition, we use irregularly occurring design elements:

- **Excursus:** We sometimes provide additional or cross-process comments in the form of excurses.
- **Notes to Assessors:** These notes not only give practical hints for use in assessments (e.g., in the form of typical assessment questions) but also point out particular problems, frequent weaknesses, and difficult rating situations.
- **Experience Reports:** Here we describe typical real-life problems or situations.

The term »customer« will be used quite frequently in this book and requires some additional explanation: Automotive SPICE uses »customer« to describe the relationship between two business partners, one being the provider or supplier and the other the recipient of a particular (development) product. In the automotive industry, »customer« is used to denote several different relationships. Using the term for internal relationships, vehicle manufacturers may use »customer« to refer to a particular product line organization or a different department. With regard to external relationships, »customer« is commonly used to denote the end user, the car buyer. On the suppliers' side, the customer is usually the vehicle manufacturer (OEM) or, in case of supplier chains, another supplier².

To help fully understand the engineering processes, some important key concepts are described in Annex D of the Automotive SPICE PAM and illustrated in figure 2–2³. These concepts are an essential basis for the understanding of the interaction of the engineering processes and corresponding Automotive SPICE work products. The central process is requirements elicitation (ENG.1), where customer requirements, system requirements (ENG.2) and software requirements (ENG.4) are collected. The system architectural design process (ENG.3) divides system requirements into mechanical, hardware and software requirements⁴. Software requirements specify a system's software with regard to its functional requirements⁵. The software design process (ENG.5) splits software up into software components and then into software units. During software integration (ENG.7), individual software units are integrated into software components which in turn are integrated to make up the overall integrated software. System integration (ENG.9) subsequently integrates the individual mechanical, hardware, and software items into the overall integrated system. Verification, e.g., test-based verification, always uses the verification criteria of the associated requirements. Finally, acceptance tests within system testing (ENG.10) validate the (software) system.

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2. For example, if in a supplier chain a tier 2 supplier works for a tier 1 supplier and both are commissioned by the OEM.
 3. In the original Automotive SPICE chart some of the words are illegible; this was compensated for in figure 2–2.
 4. According to the IEEE definition, hardware denotes the electronic components for processing, storage, and transfer of programs or data. Mechanical components, for example, are housings, engines, levers, and fixtures.
 5. For nonfunctional requirements see REU.2 and SUP.1.

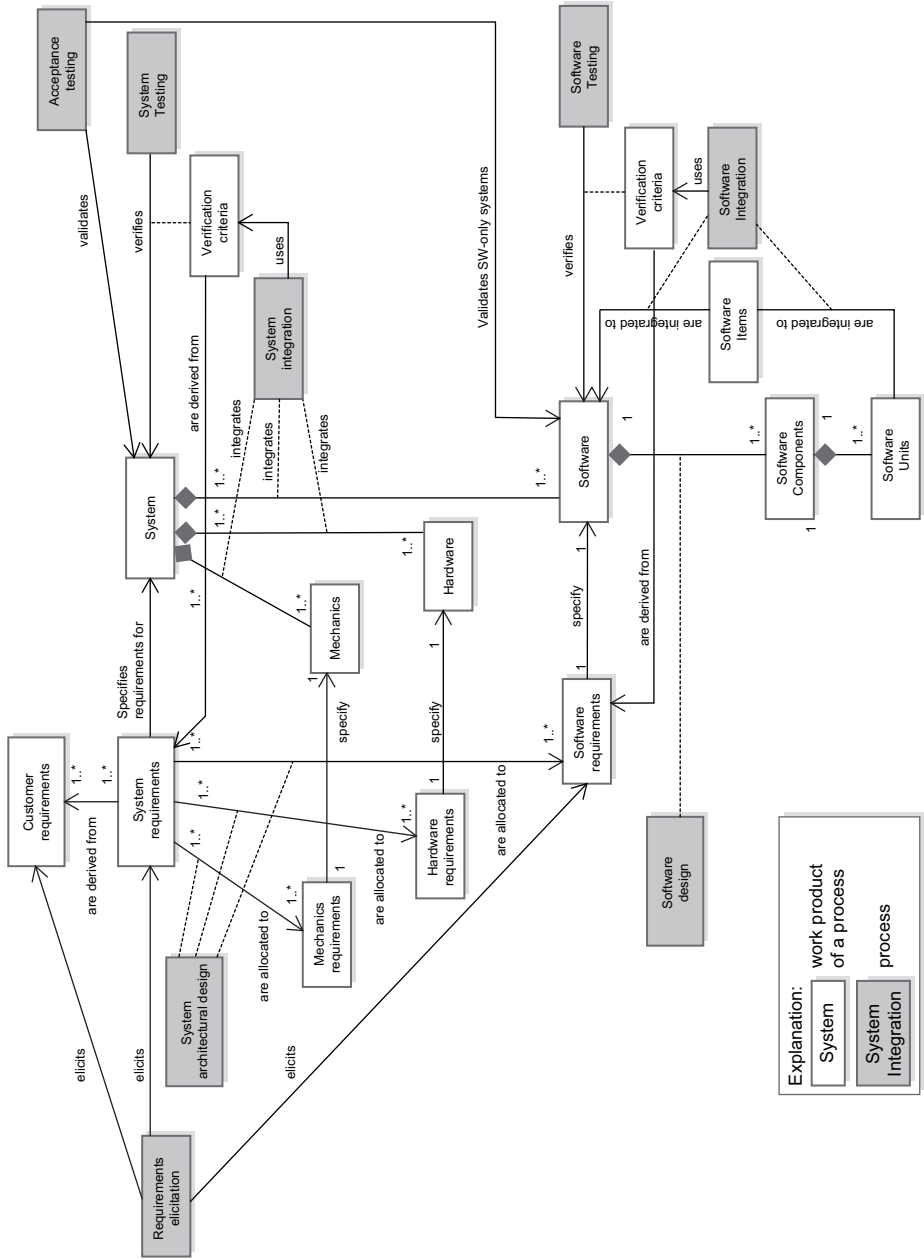


Figure 2-2 Key concepts of the engineering processes in Automotive SPICE

2.1 ACQ.4 Supplier Monitoring

2.1.1 Purpose

The purpose of the supplier monitoring process is to monitor the performance of the supplier against agreed requirements.

Besides discussing supplier monitoring, this process also deals with cooperation and communication with the supplier. The basis for cooperation is that a supplier selection has taken place and that a contractual agreement exists between the customer and supplier.

Methods from the MAN processes and SUP processes can be applied for supplier monitoring, such as project management, risk management, measurement and change management, except that they are applied here by the customer to monitor and control the supplier.

If development is contracted out to the supplier, the process interfaces must be coordinated. Besides the engineering processes, support processes in particular, such as configuration management, change management and quality assurance, should be coordinated.

For further information on supplier management see:

- [SA-CMM 1999] Software Acquisition Capability Maturity Model
- [DoD 1998] Software Acquisition Best Practices Initiative
- [PPSM 1998] Process Professional Supplier Management part 1-7

2.1.2 Characteristics Particular to the Automotive Industry

During the development of ECUs, vehicle manufacturers and suppliers frequently work in close cooperation. In some cases, development is done almost exclusively by the supplier, whereas other vehicle manufacturers may purchase already developed components requiring only small adaptations.

Sophisticated electronic vehicle components are often developed by several collaborating suppliers. Such networked developments frequently result in business partnerships. Typically, one of the suppliers is commissioned to act as the system supplier whose tasks include controlling the other suppliers.

Quite often this results in a whole hierarchy of supplier relationships, i.e., where one supplier (»tier one«) acquires further system components from his own subcontractors (»tier two«) but remains in control of the cooperation. Often a customer stipulates that the supplier subcontracts particular tier-two suppliers. In vehicle development, the selection and control of suppliers is generally of particular significance.

Note to Assessors

This process is only assessed in an OEM supplier assessment if the supplier (tier-one) has subcontractors (tier-two). It assesses how the supplier monitors and controls its own suppliers. The process is applied if development is subcontracted or if product components are purchased that need to be adapted to a project's requirements. If only resources are purchased^a for development activities (often called »body leasing«) or if standard products are purchased that do not require any adaptations (»COTS products«^b), assessment of the process does not make sense. This is because ACQ.4 requires a strong interconnection of the development processes, which in these cases does not apply.

- a. In this case leased staff work in accordance with customer processes; if required, they are questioned in an assessment in the same way as internal staff.
- b. COTS Commercial off-the-shelf.

2.1.3 Base Practices

BP1: Agree on joint processes and joint interfaces. *Establish an agreement on joint processes and joint interfaces, responsibilities, type and frequency of joint activities, communications, meetings, status reports and reviews. Agree on processes and interfaces at least for change management, problem management, quality assurance and customer acceptance.*

*NOTE: The term customer in this process refers to the assessed party. The term supplier refers to the supplier of the assessed party.*⁶

During project execution the processes and interfaces between the customer⁷ and supplier must be coordinated and documented. This comprises the following:

- Agreements regarding regular meetings and reviews (see BP2 to 4)
- Planning and control of communication and interfaces, e.g., by means of a communication plan (see figure 3–5 and chapter 3, deliberations on GP 2.1.6)
- Rules concerning the exchange of work products and information, e.g., which work products are to be made available, data exchange formats, method of transmission (e.g., e-mail encryption or communication via a common server with mutual access to joint project data and documents)
- Coordination of roles and responsibilities
- Planning and coordination of processes and work flows for common activities. The base practice requires this at least for change management and problem resolution management, quality assurance, and acceptance. It is also

6. For instance, if a tier-one supplier is assessed, the primary concern is how this supplier monitors and controls its own (tier-two) suppliers.

7. The customer can be the ordering party or not, e.g., if the OEM is formally the ordering party to the tier 2 supplier and obligates the tier 1 supplier to control the tier 2 supplier.

advisable to have rules for joint tests—at least regarding a jointly coordinated test strategy—as well as rules for configuration management, including release planning of customer supplied products and for consistent traceability across organization boundaries (see also section 2.24).

- Definition of escalation paths to handle problems; this is of particular importance if more than one supplier is involved.⁸ A steering committee comprised of representatives of all involved parties may serve as the highest decision-making body.
- Tracking of open issues, for instance, using a common open issues list (OIL, see figure 2–3). In case of several suppliers the same problems may arise as explained in the footnote to the previous bullet.
- Rules regarding project status reports issued by suppliers to the customer and the exchange of project plans
- Cooperation between the customer and supplier⁹ regarding quality assurance

It is good practice to set up a joint project team between the customer and supplier. This way dependable (major) roles (e.g., engineers in charge of ECU function development) can be assigned on both sides who can cooperate right from project start.

BP2: Exchange all relevant information. *Establish and maintain communications between customer and supplier for all agreed information, processes and interfaces.*

As agreed in BP1, information is regularly exchanged. Agreed communication must be retained throughout the project's duration.

BP3: Review technical development with the supplier. *Review development with the supplier on the agreed regular basis, covering technical aspects, problems and risks.*

Permanent communication in the project must be kept up, especially where technical aspects are concerned, to ensure that the supplier understands the technical requirements and that all work is done properly and according to plan. This is primarily done by means of regular project meetings focusing on technical issues, problems, and risks. In most cases there are a lot of technical questions and prob-

8. One frequent problem is that the responsibility for detailed analysis and correction of defects is ping-ponged between several partners, one passing the buck to the other. The customer must pay particular attention to this. It makes sense to establish an across-the-board defect management process that all suppliers have to apply and to which they have to jointly assign one person with overall responsibility.

9. In connection with this one must take care that the quality assurance and quality goals of the subsuppliers are consistent with those of the customer, i.e., the customer's qualitative requirements can only be extended but not be restricted by a subsupplier's local guidelines.

lems to be clarified during the course of a development project and all of them, according to BP5, must be tracked to completion.

Moreover, technical work products and documents should be evaluated in joint technical reviews, especially with regard to the following types:

- Customer requirements specification / System requirements specification
- System architecture (in the case of system suppliers)
- Software architecture
- Interface specifications
- Test plans
- »Test readiness«
- User documentation and other development documents that have been agreed upon
- Acceptance test (regarding customer acceptance)

In our opinion it is beneficial to conduct technical reviews with appropriate review methods (e.g., inspections) as early as possible¹⁰ during the development processes (see also SUP.4).

BP4: Review progress of the supplier. *Review progress of the supplier regarding schedule, quality and cost on the agreed regular basis, also tracking problems to successful completion and performing risk mitigation activities.*

Supplier progress is regularly checked.¹¹ Project progress is checked against the plan and significant problems (including quality problems), risks, and schedules (in particular deadline shifts and forecasts) are discussed. If work is billable on a time and material basis, accrued costs are also checked against the cost plan. In addition, cost projections are evaluated.

Automotive SPICE requires furthermore that mitigation activities are initiated for identified risks and that identified problems and measures are tracked to completion (see BP5). Risk management (see MAN.5) in the project must therefore be extended to also cover risks that arise from a customer's cooperation with the supplier.

This practice gains particular relevance if several suppliers are to be integrated and coordinated in a customer project. In that case both the overall project status of all supplier activities and the activities of the customer must be combined and monitored as a whole. Open communication of the overall status (to all stakeholders) is advisable in this case so that everyone understands their contribution to the overall effort. This transparency has the added advantage

10. This means immediately after creation and prior to release of the review object.

11. It helps a project with subsuppliers if they themselves provide relevant information on a regular basis (push principle) rather than having to react to the customer requesting it (pull principle).

that it indirectly creates competition which promotes project progress (nobody wants to be last). In order to be able to objectively track a supplier's project progress we recommend progress tracking by means of metrics (see MAN.6 and figure 2–27).

Progress monitoring should also include monitoring of agreed improvement measures (BP6) in the running project.

Experience Report

Suppliers often present project progress in a very optimistic light. Customers should, therefore, critically question these estimations (e.g., in status reports or in the project plan). Moreover, initial deliveries should be agreed upon early to allow for better tracking of the current project status.

Frequently, problems are caused by poor customer cooperation; often the supplier has to wait a long time for an answer (e.g., to technical questions), it may take a long time for decisions to be made, or urgently required domain experts are unavailable or only partly available. Another problem with networked development is the fact that components provided by the customer are often not available on time or insufficient (e.g., prototypes for test purposes).

BP5: Track open items. Record open items found, pass them to the supplier and track them to closure.

In order to ensure that all identified open items are closed as planned, a common open issues list (OIL, see figure 2–3) should be used to allow systematic tracking of such points.¹² This list can be used to track open issues of both the customer and supplier.

Open Issues List Project XYZ											
No.	Category	Issue Description	Action/Solution	Prio.	Responsibility	Due Date	Status	Entry Date	Entry by	Source	Classification
1	CAN	problem description, e.g., CAN signal not on ...	description of required action	high	Jackson	03.28.2008	in progress	02.15.2008	McCabe	e.g., risk management workshop	change request
2	HMI			medium			open				open issue
3	trial			low			closed				defect
4	–										
5											

Figure 2–3 Example layout of an open issues list (OIL)

12. For systematic problem tracking see also SUP.9 BP8.

BP6: Act to correct deviations. Take action when agreed targets are not achieved, to correct deviations from the agreed project plans and to prevent reoccurrence of problems identified.

If, in the course of a project and during monitoring of its progress, deviations from the plan are noticed which indicate that agreed targets cannot be met, appropriate measures must be taken. Besides requiring measures to correct such deviations from the plan, Automotive SPICE also requires measures that remove or obviate their causes.

BP7: Agree on changes. Changes on agreed activities proposed by either party are negotiated and the results are documented in the agreement.

A defined and systematic change management process (see SUP.10) must be deployed between the customer and supplier for the entire lifecycle of a project. Besides the coordination of changes, documentation of the results is also required. It must be pointed out here that changes may not only involve technical questions but also defined processes, practices, agreements, contracts, etc.

Experience Report

In fixed-price projects, the customer-supplier relationship often suffers if the implementation of changes causes cost increases for the supplier. For this reason many customers shy away from issuing formal change requests; instead, requests for changes are passed on to the supplier informally or are concealed as error reports. In system development this situation is aggravated if new technologies are being applied and if the project outcome is the result of an evolutionary process. In this case requirements can only be defined insufficiently (i.e., incomplete or with insufficient detail) and can only be passed on bit by bit to suppliers during development. In such cases the change management process must be adapted accordingly. For instance, an agreement may be made that change requests are formally introduced via the change management process but that they only become cost effective under specific conditions.¹³

13. For example, changes may become cost-relevant if a change is of a functional nature and if the associated subsystem has already been provisionally accepted.