

ABOWD · HOERMANN · VANAMALI · WALL

# AUTOMOTIVE SPICE Essentials

Automotive SPICE v3.1 – at a glance

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## Imprint

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## Foreword

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We wrote this book for people who

- have little time,
- want to learn the basics quickly,
- don't want to compromise on quality and depth.

This compact book should help you gain an overview quickly. You will be able to evaluate whether Automotive SPICE is suitable to improve the development processes in your company.

The first chapter gives an overview of the basic idea behind Automotive SPICE, how to introduce the model in a company as well as business issues.

The second chapter covers the structure and contents of the model. As experienced assessors and practitioners we explain not only the structure of the model and its relationships, but also provide practical guidance to achieving the goals of the model, as well as avoiding some of its common pitfalls.

In chapter three, we consider the relevant processes in detail: We explain the core processes relevant to the carmakers and their suppliers, discussing their benefits and requirements. Furthermore, we present experiences and common problems in the application that we met in our ten years of experience with Automotive SPICE. For each of these processes we show the original text of the model and interpret their crucial aspects.

The fourth chapter is devoted to assessments which are used to evaluate the process quality of organizations systematically. We explain procedures and roles as well as the necessary preparation of a typical assessment.

With the final chapter we discuss how Automotive SPICE integrates with other models and approaches such as functional safety according to ISO 26262 and agile methods and practices.

*Peter Abowd, Klaus Hoermann, Bhaskar Vanamali, Dan Wall  
May 2018*

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# 1. Automotive SPICE – the essentials in brief

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## 1.1 The basic idea of Automotive SPICE

### *What is the basic idea?*

The Automotive SPICE Model<sup>1</sup> is a structured collection of best practices for the automotive industry. It enables companies to improve processes either for themselves or for their suppliers. Automotive SPICE is used by many automobile manufacturers and suppliers as a means of qualifying their suppliers and also assessing the risks associated with their suppliers. Often they are required to achieve a certain capability level in selected processes to even get a contract. Reaching the level is checked through performing assessments.

### *What the »levels« stand for*

In Automotive SPICE the »capability levels« partition the model into clusters of best practices that build on each other and describe the ascent to better command and control of the development. There are levels from zero to five. Achieving a level often requires cultural changes and can therefore take considerable time and effort. To achieve, for example, level three in a larger organization typically three to five years are required, if starting at level zero (0).

### *How assessments work*

Whether one has achieved a particular level is determined in an assessment. An assessment typically focuses on a project and investigates a pre-determined set of Automotive SPICE processes. Results are statements of strengths and weaknesses, improvement recommendations and level ratings. An assessment can be carried out by oneself (»self-assessment«) or by independent persons. For assessments to be recognized in the automotive industry they must be carried out by qualified specialists. The only training system recognized by the VDA is intacs<sup>2</sup>.

### *Automotive SPICE: origin, source, rights, organizations involved*

Automotive SPICE was published in 2005 by the Automotive Special Interest Group<sup>3</sup> (AutoSIG) within the Procurement Forum<sup>4</sup>. The brand »Automotive SPICE« is owned by the Association of the Automotive Industry (VDA)<sup>5</sup>. The model can be obtained free of charge from the official Automotive SPICE website<sup>6</sup> after registration. The Automotive SPICE pocket guides (small booklets containing the most important subset of the model) can be ordered through the web shop of Kugler Maag Cie.<sup>7</sup>

### *How Automotive SPICE relates to other models*

Automotive SPICE is an ISO/IEC 330xx compliant process assessment model,

which was derived from the ISO 15504-5 originally. The ISO/IEC 330xx standard family is also known as »SPICE«. Automotive SPICE has certain similarities with CMMI, but also many differences in detail. In the automotive industry there have been numerous companies that have implemented CMMI and Automotive SPICE in combination.

### *Where to apply Automotive SPICE?*

Automotive SPICE is used in the automotive industry for the development of mechatronic systems, consisting of mechanics, electronics and software. Examples are navigation systems, instrument clusters, engine control units, transmission control units. The contents of Automotive SPICE focus on software and system engineering. However, in software-only projects one would focus on software and descope the system engineering processes. Processes for other engineering disciplines such as hardware and mechanical engineering can be supplied through separate models<sup>8</sup>. However, most assessments focus on software and system engineering. The main reason is that the automobile manufacturers currently do not

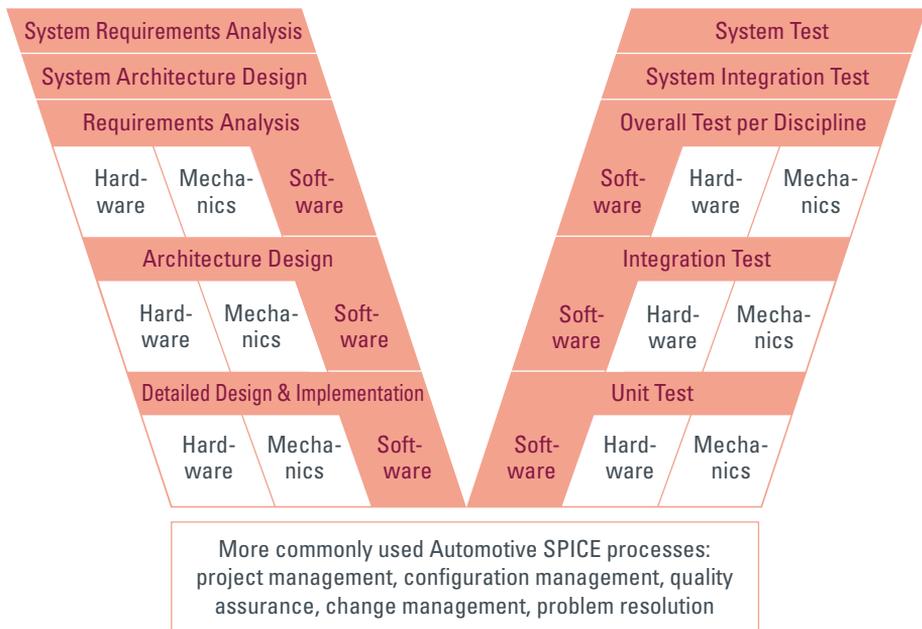


Figure 1: in a mechatronic system Automotive SPICE processes cover the red parts only. Processes for hardware and mechanics can be plugged in through separate models.

require assessments of hardware or mechanics. This is because most of the functionality is implemented by software which causes also most of the problems.

*Where Automotive SPICE is applied*

Initially, the use of Automotive SPICE was strongly influenced by the automobile manufacturers in Europe but has also been adopted by the North American OEMs. The OEMs require compliance with Automotive SPICE in their contracts. They usually also force their tier one suppliers to require Automotive SPICE from their suppliers. Because of the global supply relationships most of the suppliers all over the world need to implement Automotive SPICE. Another driving force is that Automotive SPICE is a very good basis for implementing the ISO 26262, the Automotive safety standard. Automotive SPICE is enforced by OEMs of passenger cars and also by OEMs of commercial vehicles.

*Which vehicle manufacturers require which processes?*

Most manufacturers require from their suppliers within their contracts particular processes and process-specific levels. A standard scope has emerged over the years (the »VDA Scope«, formerly called the »HIS Scope«), see fig. 2. However, on occasion also other OEMs than FCA require additional processes (e.g., MAN.5, SYS.1, SPL2).

	Standard scope	FCA
ACQ.4	•	•
SYS.1		•
SYS.2 - SYS.4, SWE.1 - SWE.6	•	•
MAN.3	•	•
MAN.5		•
SUP.1, SUP.8 - SUP.10	•	•
SUP.4		•
SPL.2		•

Figure 2: Processes required by the vehicle manufacturers (VDA Scope); this scope is required by Audi, BMW, Daimler, FORD, Jaguar, Land Rover, Porsche, Volkswagen. FCA (Fiat Chrysler Automobiles) requires additional processes.

### Automotive SPICE: development, maintenance, conferences

The development and maintenance is carried out by the VDA WG 13. Development topics include a standardized assessment process, guidelines for performing assessments, and guidelines for model interpretation. The WG 13 is composed of individuals from Volkswagen, BMW, FORD Europe, Daimler, Bosch, Continental, ZF Friedrichshafen, Schaeffler, Knorr Bremse and Kugler Maag Cie. The most important conference is the yearly »VDA Automotive SYS«. Besides this conference the exchange of experiences is promoted at the Gate4SPICE events (an initiative of intacs, see next section).

### Training of assessors: the intacs™ organization

intacs (International Assessor Certification Scheme e.V.) is a not-for-profit organization based in Potsdam, Germany. intacs defines requirements for the training and certification of assessors for ISO/IEC 330xx-conformant models. intacs collaborates with certification bodies that perform the accreditation of training providers and certification of trainers and assessors. The current certification bodies are

- ECQA – [www.ecqa.org](http://www.ecqa.org) (for ISO/IEC 15504 PAM, ISO 20000 PAM, TestSPICE PAM) and
- VDA QMC – [www.vda-qmc.de](http://www.vda-qmc.de) (for Automotive SPICE)

intacs defines the qualification levels as shown in *fig. 3*. The qualification path distinguishes three levels: Provisional Assessor and Competent Assessor are qualified for specific process assessment models only. Principal Assessors are qualified for all models. Principal Assessors can become instructors. There are two instructor levels: provisional course and competent course levels.

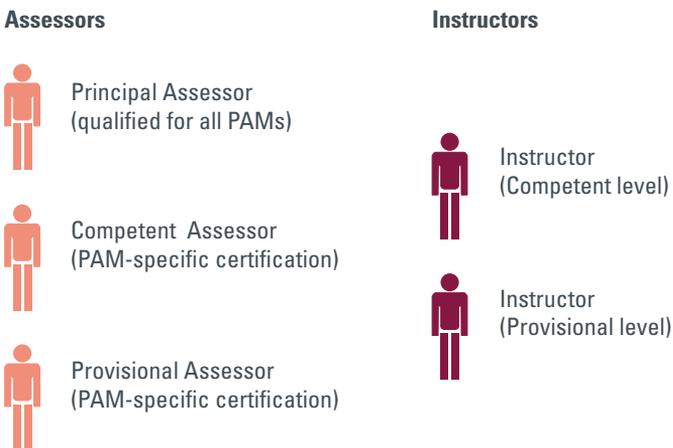


Figure 3: intacs qualification levels for assessors and instructors

## 1.2 Automotive SPICE benefits

### What is the purpose?

Regarding the benefits you have to distinguish the situation of OEMs and suppliers. OEMs are interested in

- the control of quality in electronics and software, especially as the products and supply chains become more complex
- the management of risks and problems that arise in the supplier project in order to meet the tight schedule, especially with ever shorter development cycles

Suppliers are interested in

- participating in attractive markets and the safeguarding of margins, because without Automotive SPICE they will either be excluded from project assignments or have to accept large discounts
- the control of development costs and quality problems in volume production caused by development (leading to repairs, recalls, ...)

### What are the benefits for OEMs?

Automotive SPICE requires more accuracy and precision in development. The results are fewer errors and errors being detected earlier. This decreases the number of residual errors which are not detected during development and may appear

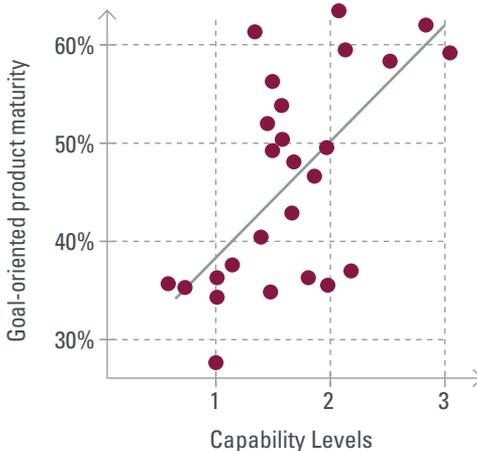


Fig.4: Correlation between Capability Levels and the ability to eliminate defects early (BMW survey<sup>10</sup>)

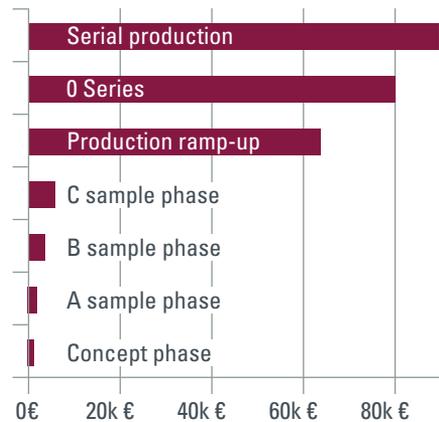


Fig.5: Defect removal cost in the Automotive industry (engineering only) (Survey<sup>9</sup>)

sometime in the field. These may lead to bad press, customer dissatisfaction and significant loss of profits. Therefore OEM's want their suppliers to avoid problems or find and remove problems as early as possible. BMW has demonstrated in a study that the ability of the supplier to eliminate errors at an early stage is well correlated with its Capability Levels, see *fig.4*.

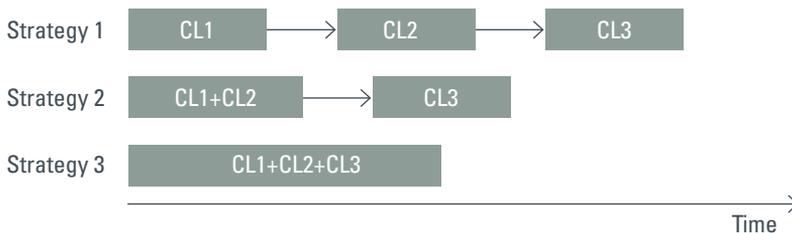
*What are the benefits for suppliers?*

Apart from the already mentioned OEM pressure there is a great chance in avoiding mistakes or finding and eliminating them early. This offers significant savings because of the increase of troubleshooting costs as shown in *fig. 5*.

## 1.3 How to achieve Automotive SPICE compliance

### *What are good strategies to achieve the target level?*

The recommended and therefore often the ultimate goal of most companies is to pursue capability level three for all processes, as this may provide the best cost-benefit ratio. Basically there are three strategies, see *fig. 6*.



*Fig.6: Strategies to achieve Capability Levels (CL) – assuming CL3 is the target, which is not always the case*

**Strategy 1:** This is sort of the naive strategy: Three levels, three phases. Unfortunately it also takes the longest time and the cost is the highest. And the longer a change project takes, the more opportunities there are to fail.

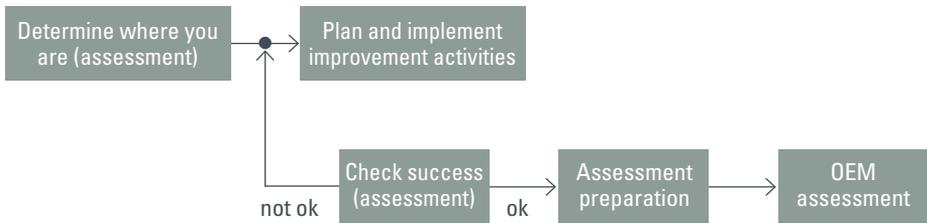
**Strategy 2:** Combining CL1 and CL2 offers advantages because there is an overlap between CL1 and CL2: the three processes of project management, configuration management and quality assurance support implementing CL2. If these processes are implemented in a very comprehensive way, one has also implemented 90% of CL2. Most organizations do not take advantage of these relationships. They would implement these processes regardless of the other processes and when they migrate to CL2 they would have to rework these three processes.

**Strategy 3:** It is initially more expensive but more efficient overall to implement all three levels in one go. The gain in efficiency can best be compared with strategy 1: In strategy 1 one has to enhance all process designs when transitioning to the next level. By contrast, in strategy 3 all processes and all three levels are designed in one go.

These strategies require work at the project level and at the organizational level (see the following sections). CL3 is dealing with process standardization and therefore requires significant organizational commitments and support. In contrast, CL1 and CL2 could be achieved on a project level.

### What are best practices for the implementation at project level?

Many companies are reluctant to introduce Automotive SPICE through a large initiative of the entire development organization. Instead, they focus on the specific project the OEM is requesting. A proven way to do this is shown in *fig. 7*.



*Fig.7: Proven strategy for the implementation on project-level*

### What are best practices for the implementation at the organizational level?

The disadvantage of the project-specific implementation is that it is often difficult to transfer achievements to other projects. The cost for many project-specific implementations is higher than the cost of a coordinated, organization-wide implementation. However, an organization-wide implementation has also numerous pitfalls.

It is also worth noting that once you have a CL3 standard process it can't be used as it is on project level. It has to be tailored to project needs and this requires organizational tailoring guidelines which take some time and effort to develop.



*Fig.8: Success factors for change projects*

Fig. 8 shows the essential success factors for organizational changes that we have gained from the support of many change projects. Typical phases of a change project are shown – somewhat simplified – in fig. 9.

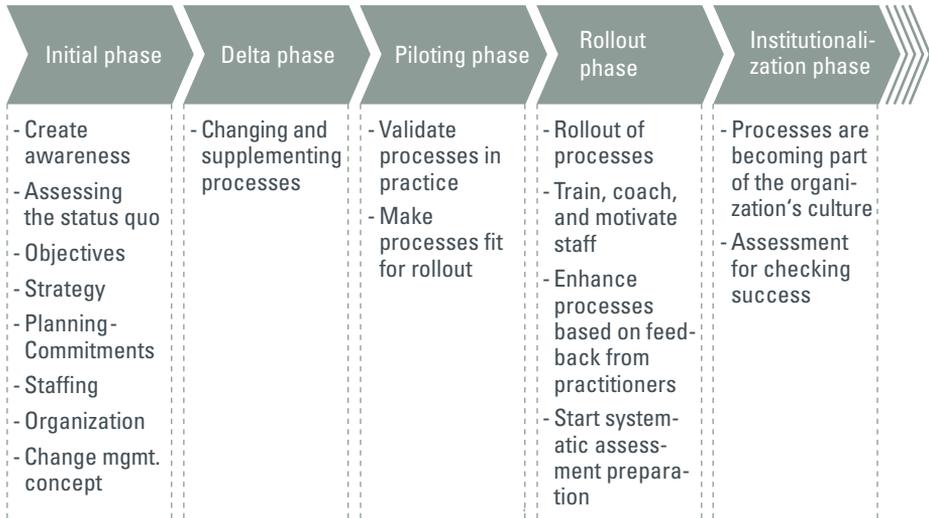


Fig.9: Principal phases of an organizational change process

## 1.4 Typical problems with the implementation

Implementation is difficult. The following applies to the implementation at the project and organizational levels.

### *How a hasty start can ruin everything*

The initial phase is neglected, and you start with an immature concept and an inadequate organization. The effort is underestimated, the right people are not involved, and objectives, knowhow, and motivation are lacking. In this phase, the intensive involvement of management is particularly important. Risk: major problems or total failure.

### *What happens if you don't link to the business objectives of the organization*

One can't communicate a clear business motivation. This leads to lack of motivation among the participants and it's difficult to align the changes to the business. The proof of success will always be missing because the definition of success is missing. Typical Example: The objective is just achieving Level 3. Risk: The project has little priority and is not getting enough management attention and resources. Hint: try to identify measurable goals, e.g., reduction of defects leaked to the customer by 50%.

### *Trying to win a race*

Sustainable changes to the organizational culture and of beliefs, attitudes and behaviors of employees need time. Unrealistic time pressure («Level 3 in one year») is nonsense, but is regularly called by top managers. Risk: overloading the project, repeated correction of the schedule, disappointment with the management.

### *Overengineering of processes*

Good processes are not built in an Ivory Tower! Instead of spending years tinkering on the perfect solution far away from practice it is better to get a lean and practical solution working and improve it iteratively with the feedback from the practitioners. Risk: «ivory tower effect» with unrealistic, much too detailed «castle in the sky processes» that do not work in practice and create resistance.

### *Half-hearted investment: the problem of the »therapeutical threshold«*

Objectives and resources of the project are often disproportionate. In other words: There is a budget but not enough to make an impact. The result is that money is burned for a long time without really achieve something sustainable. Only when the »therapeutical threshold« is exceeded long enough (grey curve) will there be an impact. If one stays permanently below the threshold there will be little impact. Risk: No success or at least a bad cost/benefit ratio.

16 // 1.4 Typical problems with the implementation

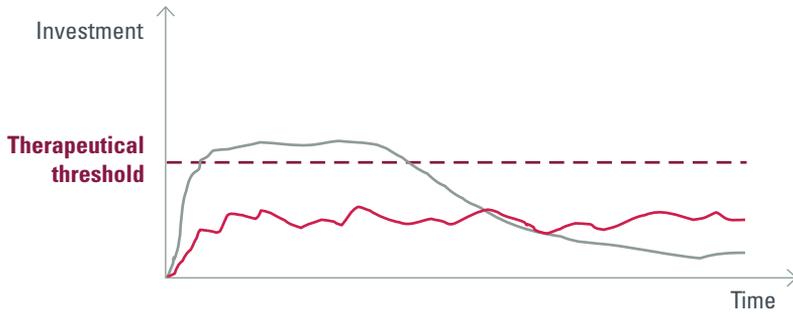


Fig.10: Concept of the therapeutical threshold: Effective (grey) and ineffective investment (red)