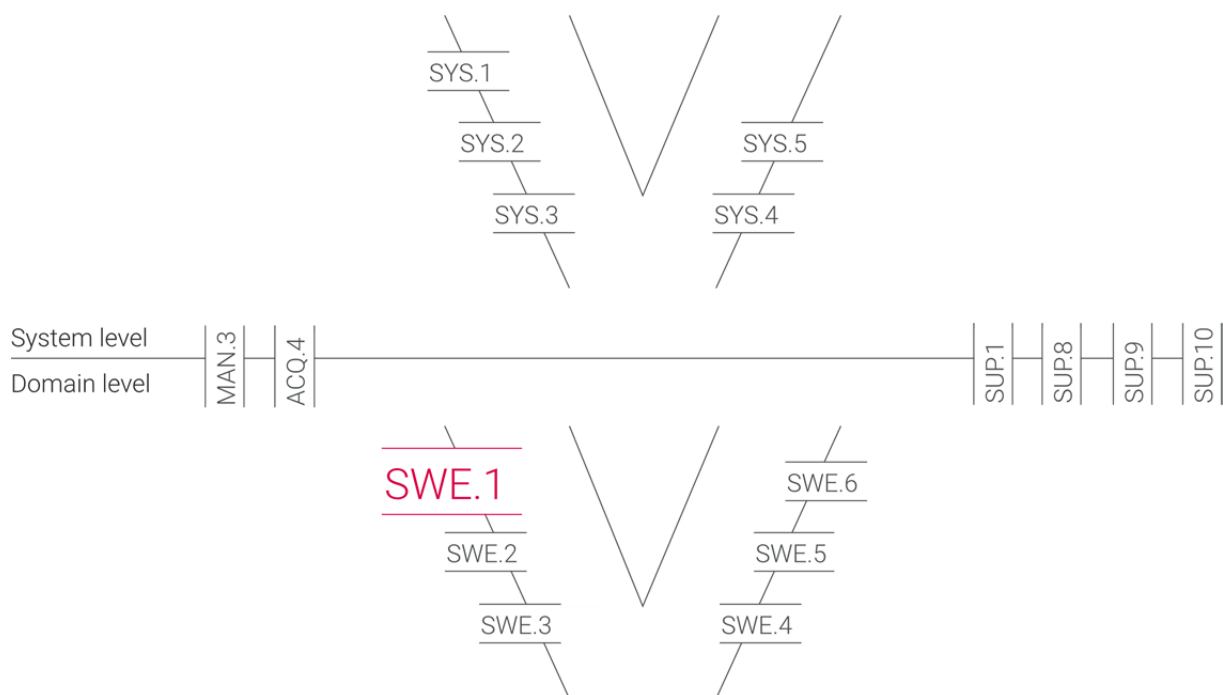


# SOFTWARE REQUIREMENTS ANALYSIS – SWE.1

## in Automotive SPICE®

### an introduction

**Dr. Bhaskar Vanamali**



Learn Automotive SPICE® with Kugler Maag Cie GmbH

*1<sup>st</sup> version – January 2020*



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# About this white paper

This white paper extends the materials I have covered in my Automotive SPICE® tutorial for Beginners on YouTube.

<https://youtu.be/crz9WmoUoKc>

Both the YouTube tutorial and this document cover the core concepts and they are not complete by any means. This publication has been prepared for general guidance only. Please do not act according to any information given in this document without receiving specific professional consultancy. The publisher, KUGLER MAAG CIE GmbH, shall not be liable for any damages resulting from any use of the information contained in this report.

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## About the author



Bhaskar Vanamali is Principal and Partner at Kugler Maag Cie GmbH. He has been working on process improvement for nearly 20 years and was secretary of the working group 13 of VDA QMC.

He is Principal Assessor and Trainer for Automotive SPICE<sup>®</sup>, and a co-author of books. He has performed more than 140 assessments and trained more than 250 assessors.

Due to his background he is trying to shed light on new approaches from different perspectives. He is actually a veterinary by profession but is working in IT for 24 years.



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# Short summary of the YouTube tutorial

<https://youtu.be/crz9WmoUoKc>

The Software Requirements Analysis process in Automotive SPICE<sup>®</sup> (also known as SWE.1) helps your organization to transform the software related parts of the system requirements into a set of software requirements.

Why should you document the software requirements? As a rule, you already have system or customer requirements, so why invest time and effort to document additional software requirements? In a project, you want to deliver the agreed results on time, within budget, and in the quality required by the customer. If you do not document your software requirements, you may overlook the functionality or completely misinterpret your customers' expectations. This causes additional effort, costs and delays. You can also overlook aspects of your software that are essential to the functionality or non-functional aspects of your software. This can lead to false starts or even additional development cycles.

This process has strong links upstream to SYS.2 System Requirements Analysis, SYS.3 System Architectural Design, and downstream to SWE.2 Software Architecture and SWE.6 Software Qualification Test. Other processes with strong dependencies are Project Management (MAN.3) and Configuration Management (SUP.8), for instance because of release management, and Defect Management (SUP.9) and Change Request Management (SUP.10). The connection here is that defects



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identified in tests must be addressed and bug fixes and change requests have to be addressed in regression tests.

The following are the most important aspects of Software Requirements Analysis in Automotive SPICE®:

- **You need to consider more than just your customer's requirements!** An important reason for documenting software requirements is that you need to consider more than your customer's expectations. The software must meet standards, norms, and other regulations that increase the number of requirements. For documentation purposes, map the system requirements or in case of software development only, the customer and other stakeholder requirements to your software requirements that reflect your internal view of the software. The software requirements in turn form the basis for the Software Qualification Test and all downstream processes, e.g. Software Architecture.

The Software requirements describe the software as a black box, the "what". What should the software do, not "how" should it do something. So, we identify the following: the software requirements describe what are the signals that the pins of the microcontroller reach, what the Software should do with these signals, and what output signals we expect at the pins of the microcontroller.

Part of this approach is also to structure the requirements in such a way that they are meaningful for the internal organization and support the distribution of the requirements to different areas of interest.

This ensures that each organizational unit knows which requirements are relevant to it. These may be attributes, e.g. to classify



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requirements according to ISO 26262, it could be a functional structure to support distribution to function groups, etc.

Typically, requirements management is supported by appropriate tools such as a requirements database.

- **Make sure you analyze and understand the implications of your requirements!** Another aspect of this process, as the name suggests, is the analysis of requirements. The requirements should be analyzed for feasibility or risk. These two are closely linked. If you are not sure about the feasibility of a requirement, there is an inherent risk, because it may take time to find a solution, or there may be no solution at all. Obviously here is a strong link to the estimates which we must perform in Project management, specifically MAN.3.BP5. Another topic to analyze is testability. Of course, the support of the testers can be used to ensure this. Often the testers are also asked to review the requirements. Additionally, the analysis should cover the technical implications. This includes the assessment of dependencies between requirements.

I included an example in the video on SYS.2 System Requirements Analysis.

Finally, the analysis should also cover business aspects of the requirements. It should therefore be determined how the implementation of the various requirements affects costs and timeline. Now, you can say that you cannot document all this in the requirements database. Remember that Automotive SPICE does not say where you document this.



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For example, you could cover the first part of the analysis (feasibility and risks) in the requirements database, the technical implications in corresponding and linked change requests, and the impact on costs and schedule in your project management tools.

- **Ensure traceability and consistency!** This process also requires that you ensure traceability between your software requirements, the system requirements, and the system architecture.

However, Automotive SPICE explicitly states that a redundancy is not required. You can decide whether you prefer a traceability to the system requirements, to the system architecture or a combination of the two. It depends which approach supports your development in the best way, not on which approach is easier for you.

Traceability can be established through hyperlinks such as DOORS, through specific traceability tools such as Rectify, through traceability matrices or through other manageable means which are supported your company's tool landscape.

The purpose of traceability is to

- a) to support consistency checks, i.e. to verify the completeness and accuracy of the software requirements.
- b) to support the impact assessment in case of change requests or deficiencies.
- c) to support the reporting of implementation status.

The other part of this point is to ensure consistency.

Consistency means that you prove completeness and correctness of your software requirements against the system requirements respectively your system architecture.



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This can only be established by a review.

If you skip this review you may have incomplete or faulty software requirements. The worst part is that you may not even notice the defects in the software qualification test because this test is performed against your software requirements. If these are faulty your test may not show false behavior. So, do not skip this review!



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# Software Requirements Analysis – the process according to Automotive SPICE®

The purpose of the Software Requirements Analysis Process is to transform the software related parts of the system requirements into a set of software requirements.

**BP1:** Specify software requirements. Use the system requirements and the system architecture and changes to system requirements and architecture to identify the required functions and capabilities of the software. Specify functional and non-functional software requirements in a software requirements specification.

NOTE 1: Application parameter influencing functions and capabilities are part of the system requirements.

NOTE 2: In case of software development only, the system requirements and the system architecture refer to a given operating environment (see also note 5). In that case, stakeholder requirements should be used as the basis for identifying the required functions and capabilities of the software as well as for identifying application parameters influencing software functions and capabilities.

**BP2:** Structure software requirements. Structure the software requirements in the software requirements specification by e.g.

- grouping to project relevant clusters,
- sorting in a logical order for the project,
- categorizing based on relevant criteria for the project,
- prioritizing according to stakeholder needs.



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NOTE 3: Prioritizing typically includes the assignment of software content to planned releases. Refer to SPL.2BP1.

**BP3:** Analyze software requirements. Analyze the specified software requirements including their interdependencies to ensure correctness, technical feasibility and verifiability, and to support risk identification. Analyze the impact on cost, schedule and the technical impact.

NOTE 4: The analysis of impact on cost and schedule supports the adjustment of project estimates. Refer to MAN.3 BP5.

**BP4:** Analyze the impact on the operating environment. Analyze the impact that the software requirements will have on interfaces of system elements and the operating environment.

NOTE 5: The operating environment is defined as the system in which the software executes (e.g. hardware, operating system, etc.).

**BP5:** Develop verification criteria. Develop the verification criteria for each software requirement that define the qualitative and quantitative measures for the verification of a requirement.

NOTE 6: Verification criteria demonstrate that a requirement can be verified within agreed constraints and is typically used as the input for the development of the software test cases or other verification measures that should demonstrate compliance with the software requirements.

NOTE 7: Verification which cannot be covered by testing is covered by SUP.2.

**BP6:** Establish bidirectional traceability. Establish bidirectional traceability between system requirements and software requirements. Establish bidirectional traceability between the system architecture and software requirements.



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NOTE 8: Redundancy should be avoided by establishing a combination of these approaches that covers the project and the organizational needs.

NOTE 9: Bidirectional traceability supports coverage, consistency and impact analysis.

**BP7:** Ensure consistency. Ensure consistency between system requirements and software requirements. Ensure consistency between the system architecture and software requirements.

NOTE 10: Consistency is supported by bidirectional traceability and can be demonstrated by review records.

NOTE 11: In case of software development only, the system requirements and system architecture refer to a given operating environment (see also note 2). In that case, consistency and bidirectional traceability have to be ensured between stakeholder requirements and software requirements

**BP8:** Communicate agreed software requirements. Communicate the agreed software requirements and updates to software requirements to all relevant parties.

**Output Work Products:** Communication record, Review record, Change control record, Traceability record, Analysis report, Interface requirements specification, Software requirements specification



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# Advanced tutorial about Software Requirements Analysis

## What is the benefit of Software Requirements Analysis?

The software requirements for the software related elements and their interfaces of the system architecture are fully analyzed and documented. These provide the basis for the actual software development.

## What is the content of the Software Requirements Analysis Process?

- Functional and non-functional requirements for the software are determined, taking into account the system requirements and the system architecture (BP1).
- All software requirements are examined for technical feasibility, testability, risks, effects on the operating environment and interdependencies. They are structured in a logical order according to the needs of the project (BP2, BP3, BP4).
- Verification criteria are developed for each requirement which give hints how requirement should be verified (BP5).
- The requirements are prioritized, structured, and assigned to releases (BP2).
- Consistent bidirectional traceability is established between software requirements and system requirements and architecture (BP6, BP7).



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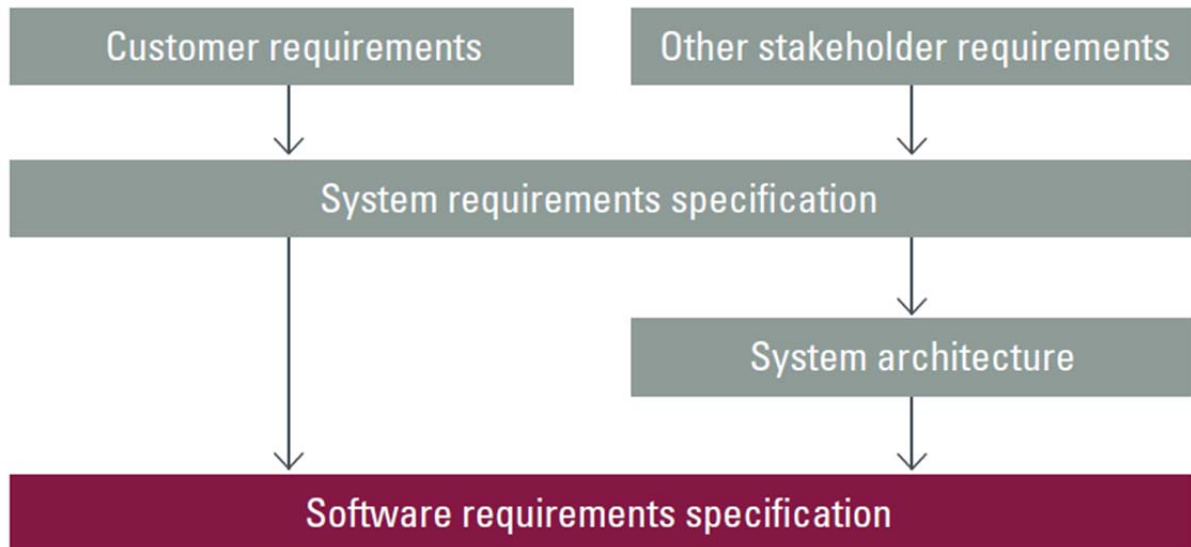
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- Software requirements and their updates are agreed upon and communicated to all stakeholders (BP8).



Sources for the determination of software requirements

### Experiences, problems and hints:

- In many cases, customer requirements are so detailed that they can be used as they are or with little modifications as software requirements. However, an analysis has to be performed to determine if there is any system impact. Also, full coverage of and traceability to the customer requirements need to be demonstrated.
- In the case of a software only product the customer requirements are linked directly to the software requirements, as there is no need for System Requirements in this case.



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- Regarding traceability between software requirements and system requirements and between software requirements and system architecture: redundancy is not required. The project can decide whether they implement it one way or the other.
- If the project is based on a platform, the software requirements of the platform can be carried over. However, these platform requirements should be carefully analyzed to insure they are fully relevant and accurate for the new project requirements.
- Traceability is not enough by itself, consistency has to be demonstrated. Consistency checks (through reviews) have to assure that software requirements are correct interpretations of system requirements and that traceability and links are correct and complete.
- In some systems, functions may involve two or more disciplines, e.g. hardware and software. It must be clear which portion of the function is covered by the software requirements.
- In software-heavy systems, the requirements on system and software level may be overlapping, but they should never be the same.



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