VDA QMC

Verband der Automobilindustrie
Qualitäts-Management-Center

Joint Quality Management in the Supply Chain

Product and Production Process Development
Maturity Level Assurance

Automotive VDA Component Requirements Specification Standard Structure

Recommendation for the specification of systems, software, modules, components and individual parts

2nd revised edition, October 2023

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This publication will also be issued in other languages. The current status must be requested from VDA QMC.

Note on gender

For reasons of readability, the masculine form is used throughout this text. However, all information applies to both genders.

Foreword

Companies and manufacturers in the automotive industry are faced with a dynamic environment characterized by increasingly complex products, new technologies, and challenges with regard to product quality as well as conformity. Cutting-edge technologies have to be implemented more and more quickly in the individual projects. In order to allow for successful collaboration when working on new projects, it is necessary to ensure clear and precise communication regarding the requirements and objectives for the products to be developed. The present VDA volume is a completely revised edition and is the result of major revisions and updates in terms of content. In addition to experiences from the past several years, new aspects such as agile working methods have been taken into account (among other things). New requirements regarding electronics, software applications, product compliance, functional safety, cybersecurity and other aspects have been incorporated and/or updated according to the current state of technology. Furthermore, the present volume was aligned with other VDA volumes and the regulatory requirements set out in ISO 9001 and IATF 16949.

This volume describes a new, standardized structure for a Component Requirements Specification agreed upon between a customer (the recipient of a scope of supply, irrespective of the position in the supply chain) and their resource provider (supplier). Scopes of supply and services are the contractually agreed new parts/products (all categories, e.g. hardware, services, software, and materials to be processed), including their associated development and production processes (see VDA Maturity Level Assurance for New Parts). A standardized process for the development of requirement specifications by the OEM and/or supplier is not part of the present VDA volume.

The objective of the procedure and structure described in this volume is to obtain an unambiguous and comprehensive profile of requirements for the product, and thus also for its production process. This is to be achieved by systematically considering all requirements in relation to the product.

The structure of the Component Requirements Specification can be applied along the entire supply chain between the customer and the supplier. In addition, the structure is modular. In the newly designed module I, the generic requirements for project implementation as well as the process and organization originated requirements to be met by the supplier, are described. These requirements from module I are meant to allow for structured project work, and to standardize the interfaces for collaboration. The relevant

project and product-specific requirements regarding the project to be developed are described within the new module II.

As part of the product specification, the Component Requirements Specification provides important “input” for the further product development process. Within the Component Requirements specification, the quality of the requirements descriptions in relation to a product provides a fundamental basis for the effective development of safe products and processes. Applying this VDA volume is meant to encourage those involved to specify definitions, engage in communication, reach agreements and meet the relevant requirements early on, thus ensuring conformity of the development and implementation processes as well as conformity of the relevant product within the scope of the objectives agreed upon.

Contents

List of Illustrations

1 Introduction

Within the automotive industry, vehicle projects and the required parts, components, software, services as well as assemblies are implemented in collaboration with external providers of required resources (external suppliers). The vehicles do not only present challenges in relation to the relevant markets, they also feature the latest technologies. In addition to the expectations of the end users, the relevant statutory requirements or requirements imposed by regulatory bodies/approval authorities must be met and taken into account. Even during the product development process, important proofs of conformity regarding the product and its implementation processes must be available. Given these current challenges in the automotive industry, car manufacturers (OEM) as well as the suppliers they work with have to meet various objectives in terms of requirements management (see Figure 1):

- Management, definition, description, agreements on requirements at the various levels of abstraction (vehicle, system, module, component, part, software),
- Keeping records of proofs and managing information regarding the requirements
- Ensuring that requirements are met along the upstream value and supply chains.

A requirement specification bundles the customer's requirements regarding a product, based upon which the customer orders the actual (series) development. The quality of the requirement specifications thus has a significant impact on the quality of the components to be developed and delivered, as well as the required cost and effort for release and system integration. The time and expenses necessary for rectifying errors or retroactively specifying requirements increase exponentially as the development progresses and are relevant in terms of achieving project targets (SOP and time to market) with shorter and shorter development times.

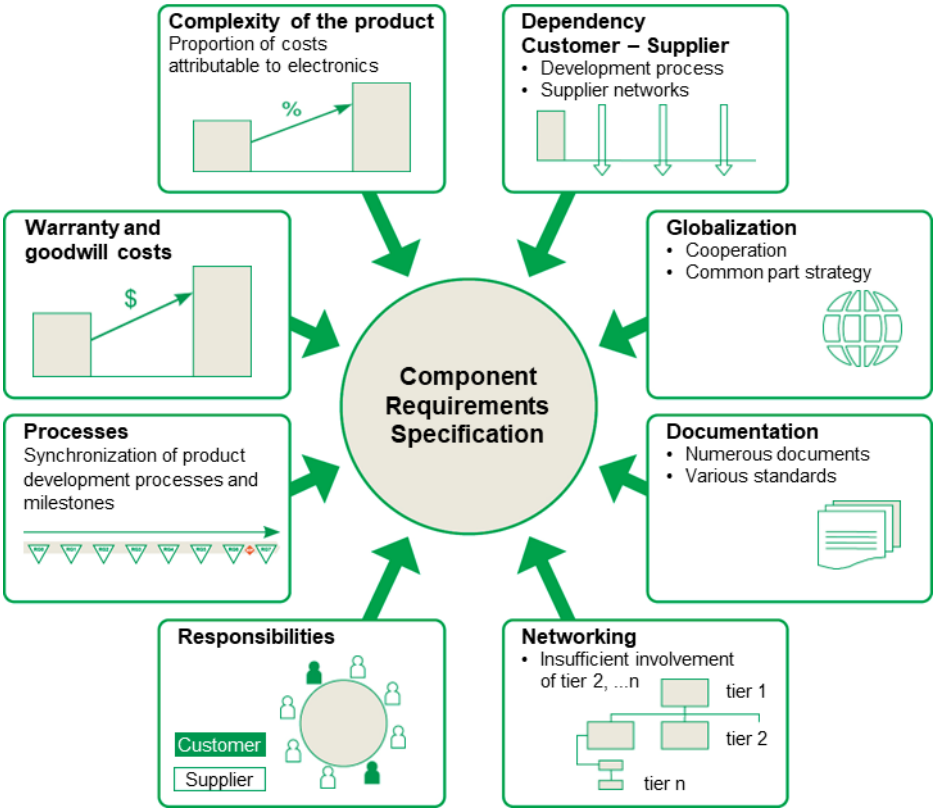

Figure 1: Challenges in the product development process

The customer is responsible for specifying the product from the perspective of the vehicle manufacturer and the end customer. This specification must be unambiguous and comprehensible, such that it is clear what the supplier has to do in order to meet the customer's requirements regarding the product.

When it comes to the development of new technologies in the automotive industry, there are usually more and more changes the further the development of the project progresses. The customer and the supplier can therefore agree upon and fine-tune the requirements iteratively over time. The objective is to fully describe and agree upon the product and the required implementation processes.

The maturity of the delivered product and its production process can be evaluated within the scope of project implementation according to VDA Maturity Level Assurance for New Parts (MLA) and VDA Volume 2.

The quality of the Component Requirements Specification does not depend on the length of the requirement description. Rather, it is necessary to unambiguously specify the product ideas and functions, such that they can be clearly understood and implemented. Data management for controlling, providing, and archiving data, information as well as proofs is absolutely necessary and must be agreed upon between the customer and the supplier.

2 Objective and purpose

2.1 Significance of the Component Requirements Specification

The Component Requirements Specification results from the specification process and becomes the central document for agreements between the customer and the supplier. Thus, the Component Requirements Specification is the basis for starting contract award negations or awarding a contract to a supplier in relation to a particular scope of development.
It is necessary to keep the documentation of the requirements in a Component Requirements Specification up to date, not only at the time the contract is awarded, and to introduce adjustments by means of a change management process.

2.2 Objective and purpose of the VDA Component Requirements Specification standard structure

The objective is to obtain a standardized structural template regarding the contents that are required as a minimum in requirement specifications. The structure of the templates for the modules of the Component Requirements Specification should be understood as a checklist which is meant to ensure that the requirements from all areas involved are taken into account. In addition, the added value of the VDA Component Requirements Specification standard structure can be considered from two angles, namely from both the customer’s and the supplier’s perspectives (see Figure 2).

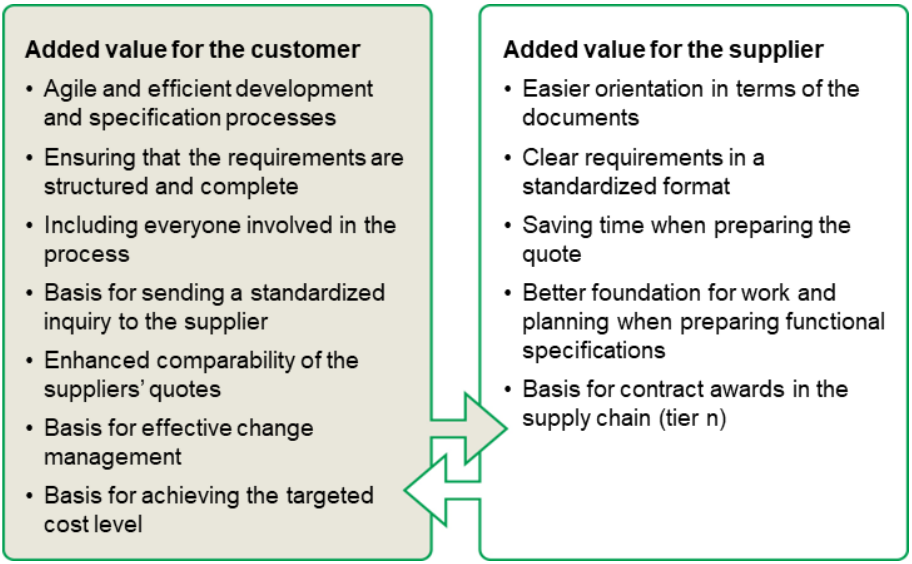

Figure 2: Added value of a standardized Component Requirements Specification

The VDA Component Requirements Specification standard structure provides the basis for a uniform interface for communication between the customer and the supplier.

2.2.1 Added value for the customer

For the customer, the Component Requirements Specification is a standardized template for new projects. It helps the customer when describing requirements and information. Risks can thus be avoided, the use of resources can be optimized, and communication with the suppliers and the supply chain can be made more transparent.

The template already includes various aspects that are important and have to be taken into account when it comes to describing to the supplier the requirements regarding a specific component. The user can focus on the component-specific parts of the technical specification.

All users are advised to check every project-specific aspect and to fully present it in the description of requirements.

2.2.2 Added value for suppliers

The added value of a Component Requirements Specification for the supplier is that they obtain information and defined requirements regarding technical, logistical, as well as quality and production-related aspects etc. in a standardized form for the planned project.
The Component Requirements Specification provides the basis for further planning and implementation regarding the project work on the supplier's side and along the supply chain.

3 General description and definition

3.1 General description

Requirement specifications are created in an early phase of the product development process and are an integral part of the inquiry documents. Figure 3 shows where the Component Requirements Specification is situated within the product development process as a basis for invitations to tender, tenders, and agreements/contracts.

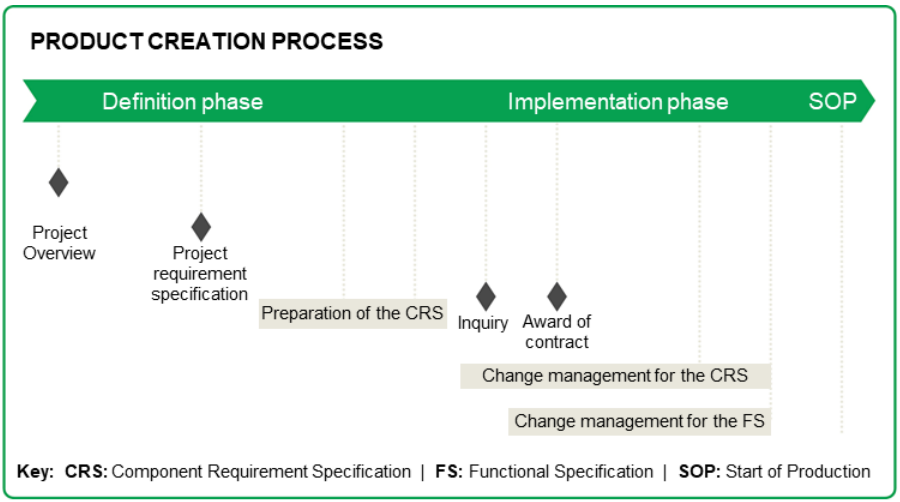

Figure 3: The Component Requirements Specification within the product development process

3.2 Definitions – Component Requirements Specification and functional specification

The Component Requirements Specification defines WHAT solution or product is needed and FOR WHAT PURPOSE. It serves as a basis for invitations to tender, tenders, as well as agreements/contracts, and can be a system requirement specification, a module requirement specification as well as a requirement specification for a component or individual part. The customer's requirements, including all framework conditions, must be described in it. In addition, the requirements must be met in a quantifiable and verifiable way.

The Component Requirements Specification provides the basis for the customer to send an inquiry to the supplier as well as for the supplier to prepare quotes and functional specifications.

The functional specification specifies the plans as to how all valid requirements in the Component Requirements Specification will be met[1].
The functional specification describes HOW and WITH WHAT the requirements will be met. The functional specification does not constitute development documentation, in which the solution is precisely described. Instead, it only contains as much information as the customer needs in order to be able to assess and evaluate the solution proposed by the supplier.

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[1] see DIN 69905 “Procedure of Projects; Concepts“, VDI 2519 Blatt 1 “Procedures for the compilation of tender and performance specifications”.

4 Application

4.1 General information

The VDA Component Requirements Specification standard structure provides an overview of the necessary contents for specifying requirements regarding developments/products within the automotive industry. It consists of two modules. Module I describes the process and organization originated requirements with regard to project organization, whereas module II comprises the project and product-specific requirements.

The descriptions of the chapters in modules I+II provide the authors of the Component Requirements Specification with important indications regarding the requirements and system-levels which can be taken into account. In the finished Component Requirements Specification, these descriptions must be deleted.

No downloadable documents are provided, given that this VDA volume serves as a guideline for structuring requirement specifications.
The customer and the supplier are advised to exchange requirements in a tool-based manner using an agreed-upon process.

4.2 Overview of the modules

4.2.1 Module I – Process and organization originated requirements

Module I **“Process and organization originated requirements”** describes the overall requirements regarding the organization and the implementation of the project (see Figure 4). These requirements can be used for various projects. Modules I and II are provided to the supplier within the scope of the inquiry process.

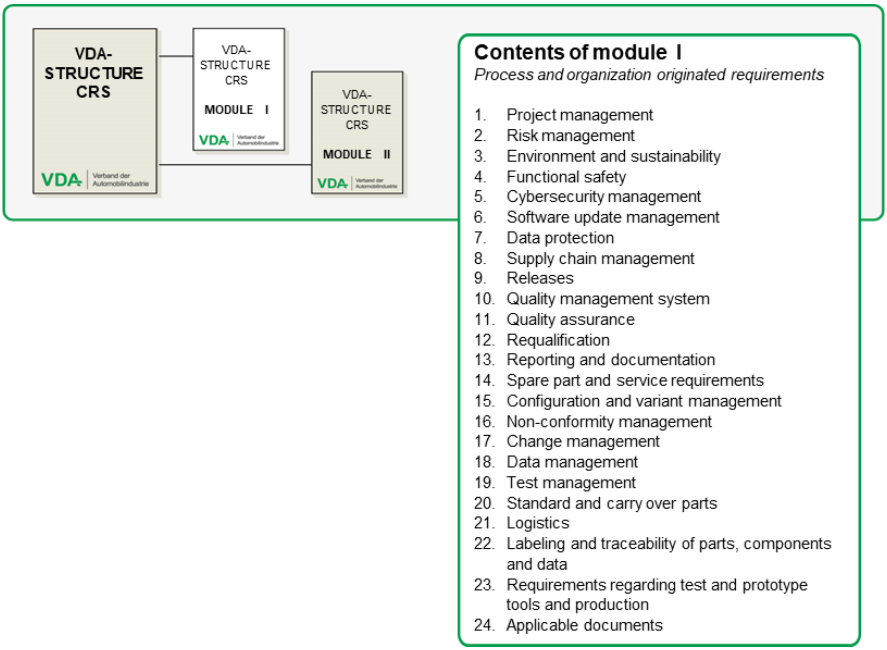

Figure 4: Overview of the contents of module I

4.2.2 Module II – Project and product-specific requirements

Module II “Project and product-specific requirements” is a template for product implementation (see Figure 5) and includes functional as well as non-functional requirements with regard to product/module development. The structure of the module is oriented towards the Automotive SPICE® reference model. It also includes aspects such as safety and security within the scope of product compliance.
Customer-specific project requirements are described in the respective chapters. If necessary, chapters and sub-chapters can be added.

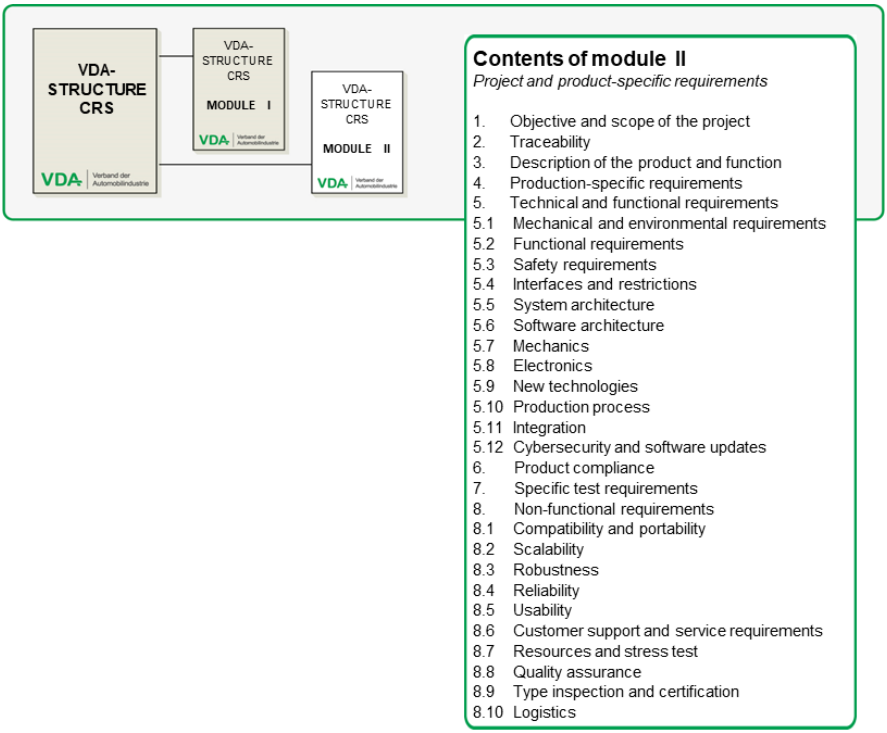

Figure 5: Structure of module II in the VDA Component Requirements Specification

5 Formulating precise requirements

5.1 Objective and purpose

Requirements must be formulated precisely, so that everyone involved can understand them and so that correct implementation is ensured.
When formulating requirements, the following steps are typically followed (see Figure 6).

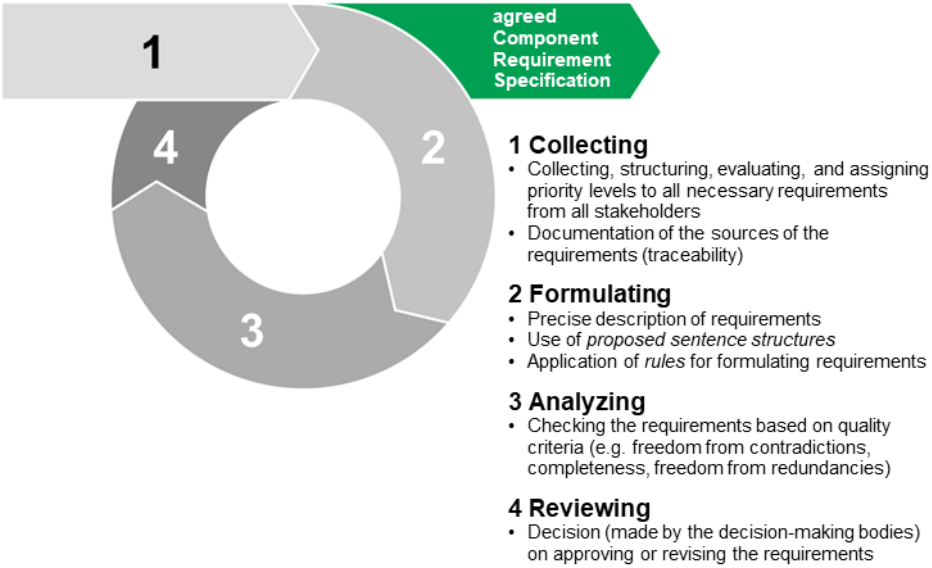

Figure 6: Standard process in requirements engineering

5.2 Quality criteria

The following quality criteria provide a guideline for formulating precise requirements in order to ensure that they are of adequate quality in terms of content.

Comprehensibility	A requirement is comprehensible if it is described in simple terms and can be understood using the available information.
Clarity:	Clarity means that there is only one possible interpretation for each requirement. Terms such as the ones in chapter 9.1 should be avoided.
Identifiability:	A requirement can be recognized as such and is identifiable by means of a unique number or identifier (ID) within a project.
Testability:	It is possible to prove that a requirement has been met if the requirement is described in such a way that it is quantifiable and verifiable.
Granularity	Clarity and the level of detail of a requirement; cannot be further deconstructed at the level of the system.
Validity	The scope of validity of a requirement must be checked (e.g. variant, area of application, exporting country, importing country, and country of destination) and must be described for the requirement.
Freedom from redundancies:	A requirement is free from redundancies if statements within the requirement are not repeated in other requirements.
Completeness:	Requirements are complete if the characteristics and functions necessary for the intended use have been described (internal completeness) and the requirements at the next higher level of abstraction (system, module, vehicle) have been taken into account (external completeness).
Freedom from contradictions:	A requirement is free from contradictions if it contradicts neither itself nor any other requirement in the product project.

Further definitions are for instance included in ISO/IEC/IEEE 29148.

Requirements can result from an iterative process. However, they should meet the above-mentioned quality criteria at the time of the first handover to the supplier (“baseline”).

In order to formulate requirements optimally, the proposed sentence structure can be used (see Figure 7).

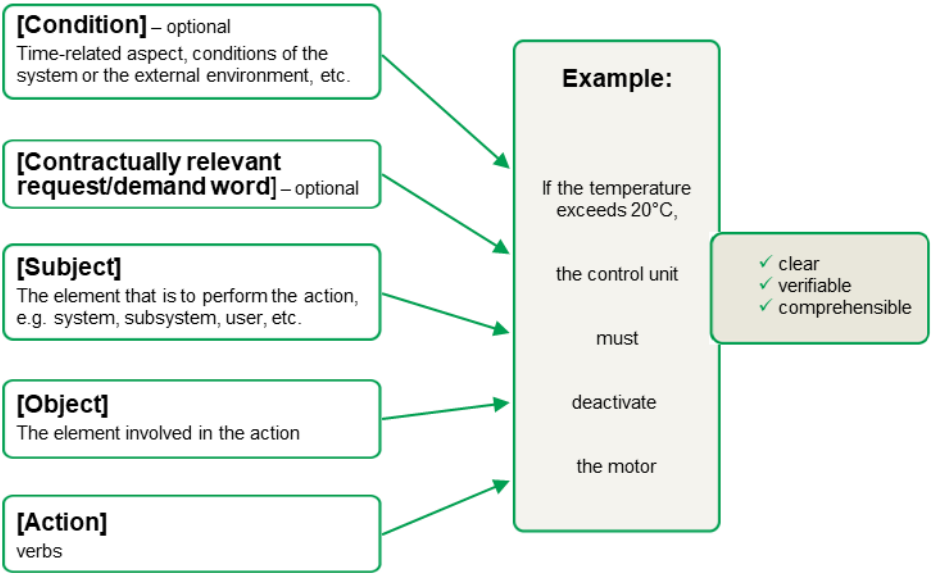

Figure 7: Proposed sentence structure

6 The Component Requirements Specification process in the supply chain

Even in the early phases of the product development process, requirements engineering is used in order to capture the valid requirements regarding a system/product. To start with, the desired characteristics and functions of a (sub)system are described, taking the stakeholders' needs into account. Afterwards, the (sub)system requirements are defined and are assigned to the functions.

A version that is consistent and approved from the customer's perspective is handed over to the supplier (baseline).

The supplier checks the requirement specification in terms of feasibility (e.g. technology, deadlines) and enters into talks/communication with the customer to reach agreements. The agreed-upon version of the requirement specification provides the supplier with a basis for implementation and for the functional specification.

The supplier (tier n) uses the customer's requirements and their own requirements to derive a requirement specification for their own supplier (tier n+1).

Changes to the requirements or iterative coordination processes must be taken into account, agreed upon and documented in the supply chain.

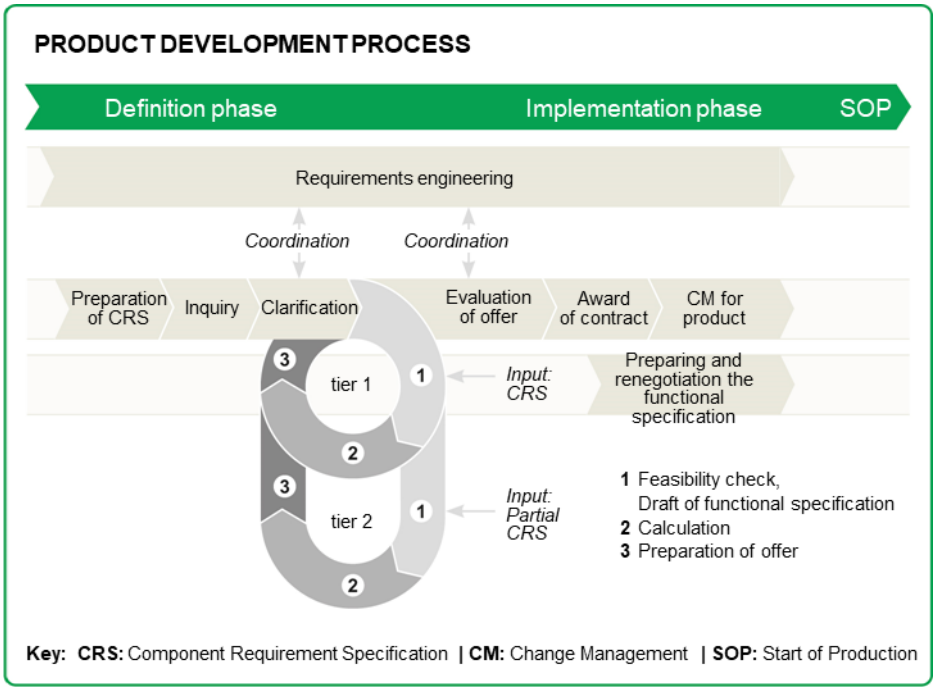

Figure 8: The Component Requirements Specification process in the supply chain

7 Requirements management with IT support

Requirements engineering tools help with versioning and linking extensive requirements.

These tools provide the following options:

- Versioning of requirements (“history”)
- Creating and comparing baselines
- Linking requirements
- Assigning attributes (e.g. responsibilities, releases, evaluations, criticality, functional safety, comments)
- Unique reference (e.g. ID number)
- Evaluation (e.g. reports)
- Structuring and grouping requirements
- Exchanging requirements in a controlled and traceable manner (including attributes) via a previously agreed-upon exchange format

Thanks to the agreed-upon exchange format, the customer and the supplier can update and coordinate requirements on a continuous basis.

8 VDA Component Requirements Specification standard structure

8.1 Module I – Process and organization originated requirements

8.1.1 Project management

In this chapter, general project management requirements are specified. These requirements include the initiation, planning, management and completion of projects.

8.1.1.1 Project organization

In this chapter, the requirements regarding project organization and the collaboration model between the customer and supplier must be defined.

Contents that are needed in order to outline the organization of the project include, for example:

- Contact persons, interface matrix, responsibility assignment matrix (e.g. RASCI chart)
- Collaboration model (e.g. VDA Maturity Level Assurance)
- Management of information for project communication and the use of tools. Information security requirements, such as TISAX certification, must be taken into account
- Organizational framework conditions such as panels, control processes, project management plans
- Agile methods and project management actions
- Standards for documenting project work throughout the project (e.g. meeting notes, status and progress reports, reviews, milestone evaluations and project completion)
- Agreed-upon number of samples for the defined sample levels

In this chapter, responsibilities and escalation paths are specified for the project. The component-specific requirements define the collaboration at various levels of aggregation (construction, system integration, diagnosis, construction of test vehicles, test drives - further details are possible, but there should be no redundancies in relation to other requirements and specifications (e.g. with regard to tests)). A list of contact persons on the customer’s side (and on the supplier’s side, if known) can be added to the information for the sake of completeness.

8.1.1.2 Feasibility

In this chapter, the requirements that the supplier must meet in order to prove the feasibility of the project and the product are described. This relates to the methods or criteria to be applied, e.g. technologies, deadlines, capacities, skills, resources.

8.1.1.3 Scheduling & checking project progress

In this chapter, the most important information for project work, including milestones, deadlines, communication and reporting are described (see Maturity Level Assurance and project-specific planning on the part of the customer).

Aspects that need to be specified include, for example:

- Milestones
  Information and possible escalation paths regarding specific milestones throughout the project should be specified here. In addition, component-specific milestones and assurance levels (e.g. by means of component-specific deadlines, component descriptions) are also defined in this chapter.

- Schedule
  Individual specification of a component-specific development and testing schedule which is different from the master schedule due to certain deviations (e.g. regarding long lead time components). Reference should also be made to a schedule that is valid for the entire project (if available) in order to avoid redundancies in the individual modules of the Component Requirements Specification.

- Sample
  Definition of samples with regard to the condition at milestones, deadlines and number of individual parts. When defining sample levels, available standards must be referred to if required (see Maturity Level Assurance for New Parts).

- Project completion
  The project is completed after a successful PPA process and a positive evaluation regarding the last milestone (see Maturity Level Assurance for New Parts).

8.1.1.4 Specifications regarding the development method, the development process, and collaboration

In this chapter, requirements regarding (joint) development processes are described, e.g. the specification of a jointly used agile framework or process model. It is important that the collaboration model, processes, roles and responsibilities are defined.

8.1.1.5 Confidentiality

This chapter describes additional requirements, if not already agreed in principle, with regard to the customer's and the supplier's rights and responsibilities in relation to confidentiality as well as the further use, processing and management of the data provided in the Component Requirements Specification are described.

Moreover, information security requirements must be met in this regard, e.g. TISAX regulations (Trusted Information Security Assessment Exchange) and the provisions according to ISO 27001.

8.1.2 Risk management

In this chapter, the requirements regarding risk management are specified. These requirements include, for example:

- Systematic and comprehensive documentation of potential risks
- Analysis and evaluation of risks
- Initiation of preventive actions
- Continuous monitoring of actions

Furthermore, general actions and methods for concept, product and process assurance should be requested (e.g. FMEA, Maturity Level Assurance, reviews).

8.1.3 Environment and sustainability

In this chapter, environmental and sustainability requirements are specified.

8.1.3.1 Sustainability requirements

In this chapter, requirements regarding the environmental footprint across the entire product development cycle are described.
This includes, e.g.

- greenhouse gas emissions due to upstream (raw) material extraction
- preprocessing
- the direct emissions of the supplier's production equipment,
- the procurement and processing of pre-materials,
- energy consumption
- the type of energy used,
- logistics

according to ISO 14040:2006 and DIN EN ISO 14044:2021.

8.1.3.2 Recycling concept

In this chapter, the requirements regarding the recycling concept for the component are described. It is necessary to refer to existing legislation and standards (e.g. VDA Volume 31, VDA 260 (Marking of Materials), ISO 22628 (Recyclability and recoverability), directives 2000/53 EG (End-of life vehicles), and 761/2001/EG(EMAS)) in this chapter.

8.1.3.3 Environmental characteristics of the product

In this chapter, the requirements in relation to permissible and prohibited materials and production processes are described, e.g.

- harmful substances,
- permissible and prohibited processing states,
- permissible and prohibited material combinations,
- flammability of materials,
- emission behavior,
- compatibility of materials,
- requirements regarding the reduction of the range of materials.

Statutory and regulatory requirements must be observed in this regard, e.g. RoHS,REACH, conflict minerals, VDA 232-101.

8.1.3.4 Disassembly concept

This chapter specifies the requirements in terms of dismantling the component in such a way that materials are separated according to type.

8.1.4 Functional safety

In this chapter, product safety requirements, such as those set out in ISO 26262, are described. The safety level for each individual requirement (e.g. ASIL level) is specified in the technical requirements (module II).

8.1.5 Cybersecurity management

In this chapter, the requirements regarding product cybersecurity are described (e.g. ISO SAE 21434) in order to observe specific regulations at the level of the vehicle (e.g. UNECE R155).

The specific cybersecurity requirements must be defined in the technical requirements (module II).

8.1.6 Software update management

In this chapter, general requirements in relation to software updates are described, including the requirements in the relevant countries, or those imposed by regulatory bodies and approval authorities (e.g. UNECE R156 (SUMS)).

The specific requirements must be defined in the technical requirements (module II).

8.1.7 Data protection

In this chapter, the requirements regarding applicable data protection regulations (e. g. GDPR) are described. It must be taken into account that separate data protection agreements may have to be concluded in case personal data is processed outside of the European Union / the European Economic Area.

8.1.8 Supply chain management

In this chapter, the requirements relating to the supply chain are described. It should be ensured that the agreed-upon standards and methods are implemented, applied and monitored accordingly by the supplier and in their upstream supply chain (e.g. A-SPICE®, TISAX, cybersecurity requirements).

The relevant requirements must be contractually agreed between the supplier and the suppliers in their upstream supply chain, e.g.:

- Confidentiality agreements imposed on the contractor's external resource providers
- Project handbook, which describes how the collaboration will be handled
- Interface agreement
- RASIC / responsibility assignment matrix
- Standards regarding the documentation of project work throughout the project (e.g. meeting notes, status and progress reports, reviews, milestone evaluations, project completion)
- Information and proofs whose documentation is mandatory, such as inspections carried out, validations and verifications
- Management of information relating to project communication and the use of tools. It must be ensured that information security requirements such as TISAX certification are met
- Contractually agreed methods, such as VDA Maturity Level Assurance, VDA PPA process, etc.
- Proofs of capability to be provided by the external resource providers in the upstream supply chain (e.g. certificates, reports on 1st, 2nd or 3rd party auditing/assessment, approvals granted by authorities)
- Specification and contractual agreement regarding the capacities required from the external resource providers
- Contractual agreement whereby it must be ensured that the customer's requirements are met in the supply chain, where applicable.

8.1.8.1 Contract management, including customer and project-specific requirements along the entire supply chain

Tasks to be completed within the scope of project management, including development, administration, adjustment of contracts relating to the project, are described here.

These include among others:

- Stipulations whereby the supplier must disclose which external resource providers they use
- Verification on the part of the supplier that the agreed-upon standards and methods are applied accordingly by the supplier's external resource providers (e.g. A-SPICE®)
- Confidentiality agreements with the supplier's external resource providers
- An interface agreement.

8.1.8.2 Qualification of suppliers

In this sub-chapter, qualification requirements imposed on suppliers, sub-suppliers, as well as their employees are outlined. If available, training programs offered by the customer should be referred to.

8.1.8.3 Sub-supplier management according to contract (e.g. deliveries, interfaces and requirements)

In this chapter, the customer defines requirements in relation to the supplier's sub-suppliers.

8.1.8.4 Definition of a requirements management process with the supplier

In this chapter, requirements in relation to requirements management are defined. This includes the tools to be used as well as an agreed-upon exchange process.

- Tool
  Tool to help with requirements management
  Definition of interface and/or exchange format
  Definition of contents and attributes / responsibilities
- Exchange process
  Definition of the set of requirements to be exchanged, taking the project schedule into account.

8.1.9 Releases

In this chapter, the requirements regarding the releases of the product and the process are defined.

The customer specifies an overall project schedule (including sample levels, construction stages, market launch).
Further deliverables, necessary releases and associated requirements as well as documentation (e.g. sample folder) must be agreed upon between the customer and the supplier, and must be handed over to the customer.

The supplier must provide all necessary proofs (e.g. homologation, testing, capability) and certificates needed for production process and product approval (e.g. VDA Volume 2).

All of the necessary and agreed-upon releases must have been granted by the time the product reaches series maturity.

8.1.10 Quality management system

If not otherwise agreed upon, the requirements regarding the supplier's quality management system (including interfaces to the customer and the sub-suppliers) are defined here. If possible, this should include a reference to existing quality management agreements and standards (e.g. IATF 16949).

8.1.10.1 Ensuring process conformity

In this chapter, project-specific proofs and requirements for process conformity are defined (e.g. A-SPICE®, assessments, audits, joint review for ensuring process and product quality).

8.1.11 Quality assurance

If not otherwise agreed upon, general requirements regarding the supplier's quality assurance processes (product, project, production) and standards to be applied are defined in this chapter.

Note: Specific product requirements are described in module II.

8.1.12 Requalification

In this chapter, requirements relating to layout inspection and functional testing are defined.

8.1.13 Reporting and documentation

In this chapter, mutual reporting obligations as well as project-wide standard documentation are defined, e.g. meeting notes, data and information management (see ISO 9001:2015).
Besides formal requirements, particular attention must be paid to the supplier's and the customer's responsibilities and obligations to cooperate when it comes to reporting throughout the development process.

In addition, all documents for which there are special obligations to maintain records, e.g. documents that are relevant to safety or certification, must be listed (see VDA Volume 1 – Selection of documents with special archiving).

8.1.14 Spare part and service requirements

In this chapter, requirements regarding the spare parts documentation that the customer needs from the supplier, such as spare parts catalogs, spare and wear parts lists, drawings, isometric images/illustrations of spare parts in electronic format, etc. are specified. It must be specified that these will be provided before the start of series production.

8.1.15 Configuration and variant management

In this chapter, general requirements regarding variant management are defined.
In addition, requirements for ensuring the integrity, versioning and availability of work products and processes are described.

8.1.16 Non-conformity management

In this chapter, requirements relating to the supplier's and the customer's error management are described. (error documentation and analysis, actions to eliminate errors, checking for effectiveness, etc.).

8.1.17 Change management

In this chapter, requirements regarding the supplier's and the customer's change management are described (effort, costs, feasibility, deadlines, documentation, and procedures).

8.1.18 Data management

Project-wide retention and archiving periods have to be specified in accordance with existing standards (e.g. VDA Volume 1). Criteria and processes for creating and archiving data (drawings, inspection protocols, etc.) must be defined and must conform with the latest technical standards as well as statutory requirements. Media and formats for data exchanges between the customer and the supplier must be defined.

8.1.19 Test management

In this chapter, general requirements and specifications regarding test management and component testing are described (test planning, implementation, monitoring and documentation, see ISO 9001:2015, sections 8.2.3 and 8.3.4).

Note: *Specific test requirements in relation to the product are described in module II.*

8.1.20 Standard and carry-over parts

In this chapter, customer-specific requirements relating to the use of standard and carry over parts are defined. All relevant information in relation to the standard and carry over parts must be given to the supplier. These requirements apply to software, components that include software, and hardware.

8.1.21 Logistics

If not otherwise agreed upon, requirements regarding the logistics concept which apply to all components of a project are described here. These include general requirements regarding delivery to individual production locations or standards, e.g. relating to packaging, load carriers.

8.1.22 Labeling and traceability of parts, components and data

In this chapter, the customer's requirements regarding the types of labeling (e.g. for series and original parts, test and prototype parts) and requirements in relation to the traceability of components are specified.

8.1.23 Requirements regarding test and prototype tools and production

In this chapter, the general requirements regarding the handling of test and prototype tools are defined (ordering, development, and production of test parts using prototype tools, costs, disposal, etc.).

8.1.24 Applicable documents

This chapter specifies additional requirements that are not documented in the requirement specification but must be taken into account and are mandatory (applicable documents, edition/version).

The applicable documents (legislation, standards, industry-specific standards and guidelines, customer-specific requirements, etc.) that are referred to in the requirement specification must be listed here and sorted according to document type.

8.2 Module II – Project and product-specific requirements

This module contains the customer's project and product-specific requirements which are not included in module I of the Component Requirements Specification.

8.2.1 Objective and scope of the project

In this chapter, the overarching goals and the scope of the project are defined (development, production, etc.). Moreover, the customer should describe what is not the goal of the project.

Scenarios which could have an impact on the development or production of the component are described. These developments must be pointed out in terms of functional upgrades, (setup/assembly) variants, design options, alternative production processes, environmental aspects and further planning.

8.2.2 Traceability

In this chapter, requirements regarding traceability from the supplier to the customer are described. This includes, for example:

- Samples
- Series parts
- Work products in the development process (bidirectional traceability[2])

Note (traceability of parts – samples, series parts):
The traceability of series parts and samples can be ensured by various means (e.g. Identification and allocation by means of labeling, readability of information through diagnosis services, MES – Manufacturing Execution Systems, allocation of development stages to samples)

Note (work products in the development process):
This bidirectional traceability should already be ensured when the customer imposes requirements on the supplier at

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[2] *see Automotive SPICE® Guidelines 1st edition, September 2017, p. 34.*

various levels. It should be clear which level/customer requirement detailed customer requirements were derived from.
It is advisable to agree on a traceability concept before the start of the project and to include this concept in the collaboration model.
In complex projects, traceability can only be ensured by using suitable tools.

8.2.3 Description of the product and function

In this chapter, the component and scope of services to be developed are defined and described.
Component-specific information must be provided in relation to series, target markets, as well as the intended applications and purpose of use for which the component will be delivered/developed.
Specifications regarding the supplier's variant management must be included.
The planned target markets must be contractually agreed.

8.2.4 Product-specific requirements

Component-specific requirements regarding installability, handling in the production sequence, permissible adjustment work, clamping and fixing concepts etc. must be defined. If possible, specifications or requirements to be observed by the supplier regarding the planned component-specific start-up monitoring must be described.

8.2.5 Technical and functional requirements

In this chapter, the scope of development and delivery is described, meaning all services in relation to the delivery of the component (including prototypes).

All functions of the component are described in detail in the following chapter.

Note: *Depending on the component, not all chapters are necessary and can therefore be regarded as optional.*

Given that the scope of delivery may include multiple components, the term "system" is used in the following subchapters.

8.2.5.1 Mechanical and environmental requirements

In this chapter, aspects such as geometry, dimensions, weight targets, space requirements, packaging (installation location) are described.

This information must be provided for all variants, e.g. countries, motors, design.

If the system is exposed to particular media, environmental stresses or other influences, these must be specified (e.g. spray water, direct exposure to sunlight, exhaust, heat from the motor, vibrations, humidity).

In addition, the system's acoustic, haptic and thermal requirements are described (e.g. heat resistance, operating temperatures, storage temperature).

8.2.5.2 Functional requirements

In this chapter, the system's functional requirements are specified. The latter can also be grouped, e.g. according to functionality.
If the functionalities are described in separate requirement specifications (e.g. diagnosis, network management), the latter must be referenced here.

8.2.5.3 Safety requirements

In this chapter, the system's technical safety requirements are described. This includes, e.g. ASIL levels, reactions to errors, time response, and – where applicable – safety targets.

8.2.5.4 Interfaces and restrictions

In this chapter, interfaces between the system and the operating environment (e.g. value ranges for sensors, diagnosis, bus system) as well as

influences on the system are specified. When defining interfaces, efforts should be made to specify precise limit values or tolerance ranges. Among other things, electrical requirements regarding fluctuations in supply voltage, overvoltage, system compatibility and operational stability are described.

In case of a pure software solution, interfaces to other systems are described.

8.2.5.5 System architecture

In this chapter, requirements relating to the system architecture are described, if there are requirements at this level. Such requirements can relate to interfaces or elements of the architecture, such as HW/SW interfaces, plugs, power supply.

Note: *This chapter is optional. In general, the architecture is designed by the supplier on the basis of requirements and restrictions.*
If there are requirements at this level, bidirectional traceability must be ensured (see 8.2.2).

8.2.5.6 Software architecture

In this chapter, requirements regarding software architecture and the “detailed design” are described, if such requirements exist. They can, for example, include algorithms or calculation formulas.

Note: *This chapter is optional. In general, the architecture is designed by the supplier on the basis of requirements and restrictions.*
If there are requirements at this level, bidirectional traceability must be ensured (see *8.2.2).*

8.2.5.7 Mechanics

In this chapter, the requirements regarding the mechanics (including the architecture and design) of a component are specified, e.g. with regard to:

- Feel and surface finish
- Geometry and packaging
- Design (fit, gap dimensions, radii, etc.)
- Construction and joining process, including specification of tolerances and measuring instructions (reference point system)
- Load requirements (maximum forces, pressure, alternating load, predetermined breaking points, acceleration)
- Crash behavior
- Torsional stiffness and deformation
- Vibration behavior (resonance ranges in driving operation or various driving conditions, natural frequencies of the component)
- Tightness

8.2.5.8 Electronics

In this chapter, E/E requirements (including architecture and design) are described:

- Physical specifications (e.g. of the pins) and circuit diagrams for the system
- Signal characteristics (input and output signals, bus signals with signal information and load behavior)
- Interface documentation (e.g. signal type, modulation, signal amplitude, frequency range, protocol, bus)
- Electromagnetic compatibility and ESD protection (limit values, control plan, storage, among other things)

8.2.5.9 New technologies

In this chapter, product requirements that have to be met by means of new technologies (e.g. AI, CAR2X communication) are specified.

8.2.5.10 Production process

In this chapter, requirements regarding the production process, for example relating to specific production parameters, cleanliness requirements, process assurance, tools, production processes or specific methods for product implementation are described.

8.2.5.11 Integration

This chapter specifies requirements regarding the integration of a supplier sub-system into an overall customer system, e.g. integration cycles and acceptance criteria of the iteration results (DoD – Definition of Done).

8.2.5.12 Cybersecurity and software updates

In this chapter, security goals or security requirements are described. Further specifications are described in a development interface agreement (DIA) or statement of work (SOW).

In this chapter, requirements relating to the implementation of an integrity test characteristic (e.g. IVD - Integrity Validation Data, UNECE R156) are described.

Note: *When using various diagnosis tools for updating software in the field, it must be ensured that changes are mapped in the manufacturer's software update management system (and thus configuration management).*

8.2.6 Product compliance

In this chapter, the requirements relating to the component's product compliance (conformity and product safety) are defined (see VDA Product Compliance).

8.2.7 Specific test requirements

In this chapter, requirements with regard to the type and scope of testing and simulation are defined.

Among other things, this includes:

- Test planning and documentation
- Inspection equipment to be used
- Provision of prototypes/test samples, data, and models by the customer
- Operating states

- Environmental factors
- Reliability and service life requirements
- Specific requirements regarding the target markets
- Testing in the vehicle

8.2.8 Non-functional requirements

In this chapter, non-functional product requirements are described. Among other things, these can include procedural, regulatory, quality, safety, and data protection requirements, but also the behavior of the product (how is the product supposed to work).

8.2.8.1 Compatibility and transferability

In this chapter, requirements regarding the compatibility and transferability of the product are described. This includes hardware and software, e.g. re-using software, reusing the whole product in other systems (model series) or downward compatibility of various software versions.

8.2.8.2 Scalability

In this chapter, requirements regarding the extensibility of the product are described. This can for example include updates or functional upgrades in case of software.

8.2.8.3 Robustness

The requirements regarding the product's robustness are described here. This can entail the behavior of a system or a component under specific conditions for a specific period of time under internal and external influences (e.g. environmental conditions or power supply, failure protection). The robustness requirements can also be described by means of test cases (e.g. LV 124 or ISO 16750).

8.2.8.4 Reliability

The customer-specific service life requirements (e.g. service life of the vehicle, mileage, software reliability requirements) regarding the component should be described here.

8.2.8.5 Usability

This chapter outlines the product requirements which are meant to ensure that the end user can operate the product. These requirements can include effective, efficient, and intuitive operation as well as satisfaction with a particular context of use, e.g. infotainment or instrument clusters.

8.2.8.6 Customer support and service requirements

In this chapter, the service requirements that must be taken into account during the development of the component are described, e.g.

- Operating and maintenance concept
- Repair concept (assembly/disassembly)
- Software updates
- Data protection

8.2.8.7 Resources and stress test

In this chapter, requirements relating to the timing and resources of the software are defined. This also includes the average and maximum response time of the system for typical user actions, and the speed of the system in case of complex, minimum or average system throughput.

Note: *If necessary, buffers for functional upgrades or updates must be specified.*

8.2.8.8 Quality assurance

In this chapter, requirements regarding the assurance of quality and reliability by means of product and process monitoring during product development, releases and production are described.

Furthermore, requirements regarding the maintenance of software quality in case of software-based products or software as a product are described.

Requirements regarding the maintainability of the software must be specified. This can for instance include documentation, scalable software architecture, clear design and coding guidelines (e.g. MISRA).

8.2.8.9 Type inspection and certification

This chapter specifies the customer requirements regarding the provision of samples and certificates for type testing and certification, which are necessary in order to meet statutory requirements and to put the product on the market. A distinction must be made between markets with type testing and markets with self-certification.

8.2.8.10 Logistics

In this chapter, component-specific requirements in relation to the logistics concept are described (series and spare parts). In addition to a description of the required delivery concept (just-in-time, etc.), they should include all data that the supplier must take into account when it comes to the development of the component:

- Delivery and storage times
- Transportability
- Batch sizes
- Packaging
- Load carriers
- Transport protection.

In addition, localization requirements to be met by the supplier, as well as potential sub-suppliers, are defined:

- Selection and release of raw materials
- Customer’s or supplier’s localization of individual parts
- Technical release(s) in the production and assembly process.

9 Definitions, terms, abbreviations

The list of abbreviations is supplemented with a standardized glossary in which the must important terms used in the requirement specification are uniformly defined. The glossary shall include the same terms that have been used in other VDA volumes for the same concepts.

Component Requirements Specification - Module I	Component Requirements Specification Module I - Process and organization originated requirements
Component Requirements Specification - Module II	Component Requirements Specification Module II - Project and product-specific requirements
Conformity	Conformity of the produced vehicle with the approved vehicle type within the scope of homologation
EEprom	Electrically Erasable Programmable Read Only Memory
EMAS	Environmental Management and Auditing Scheme
FMEA	Failure Mode and Effects Analysis
GDPR	General Data Protection Regulation
HW	Hardware
ISO	International Standards Organization
MISRA	Motor Industry Software Reliability Association
OEM	Original Equipment Manufacturer
QM	Quality management
SW	Software

9.1 Weak word list[3]

The following list contains a selection of words or expressions that should not be used in Component Requirements Specifications or when defining requirements. They are too undefined (literally too “weak”) and thus not suitable when it comes to accurately describing a product requirement.

A a bit, a few, a little, a while, actually, against, ago, and, and when, at, at all, at one time, about (like approx.), absolutely, any, anything, anyone, anywhere, abundant, almost, advanced, among other things, accomplished, accordingly, amazingly, absolutely, at best, at first, at most, at times, at the time, at the same time, as if, as of, as well, apparently, already, apparently, approximately, approx.

B bad, barely, because, but, by way of exception, better, best, best possible,

C carefully, certain, certainly, currently, classic, clearly, close, closely, conditionally, colossal, common, conceivably, contemporary, countless, customary, customarily,

D depending on, differently, difficult, definitely,

E enough, especially, essentially, estimated, erstwhile, elementary, every once in a while, extensively, extraordinarily, enormously, entirely, even, exactly, exceedingly, extremely, etc.

F fantastic, far, fast, fabulous, fairly, few, for the most part, for the time being, formerly, frequently, from anywhere, from time to time, further,

G generally accepted, great, good

H hard, hastily, however, huge, hopefully

I if necessary, if need be, if possible, in case, in no case, in part, in principle, in the near future, imperceptibly, incidentally, inconsiderable, individually, innumerable, intuitively, incredibly, isolated,

J just,

L lately, less, likely, little, long, long ago, loud, light,

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[3] see Dreher, Marion: „Konstruktive und analytische Methoden zur Qualitätssicherung von Anforderungen in der Softwareentwicklung“. [Constructive and analytical methods for quality assurance in relation to software development requirements] Degree dissertation, January 2004)

M many times, mainly, maybe, meanwhile, moderately, more, more or less, more often than not, moreover, multiple, most, mostly, most likely, modern, much,

N nearly, next to, novel, now and then, not long ago, not quite, numerous, never,

O one (someone), one day, overly, other, otherwise, operable, optimal, only, only just, once, obviously, often, occasionally, or so,

P particular, persistently, perhaps, perfect, periodically, perplexing, partly, partially, plausible, potentially, practically, pretty, presumably, possible, possibly, preferably, probably, promptly,

Q quiet, quite, quite a few,

R rather, rarely, really, recently, regular, remaining, roughly,

S several, several times, soon, sweeping, similarly, simply, seemingly, simultaneously, slow, small, such as, some, sometimes, something, somehow, someone, somewhere, self-explanatory, surely, so, such, short, so to speak, specially, strongly

T temporarily, then, thus, tiny, to some extent, terrible, the other day, to some extent, thoroughly, total, tremendous, tremendously,

U understandable, usual, usually,

V very, various,

W wide, well, wonders how, whole,

Y yes, yet,

Quality Management in the Automotive Industry

The current versions of the VDA publications covering quality management in the automotive industry (QAI) can be found on the Internet under http://www.vda-qmc.de.

You may also order via this homepage.

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