VDA | Verband der Automobilindustrie

Quality Management in the Automobile Industry

Joint Quality Management in the Supply Chain

Product creation, product manufacture and product delivery

- Minimizing risks in the supply chain

1st edition, October 2011

Non-committal VDA recommendation regarding standards

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References to standards

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Translations

This document will also appear in other languages. Please contact the VDA-QMC for the latest position.

We thank the participating organisations and their employees for their contributions in the compilation of this document. The following companies were involved in drawing up the volume:

Audi AG

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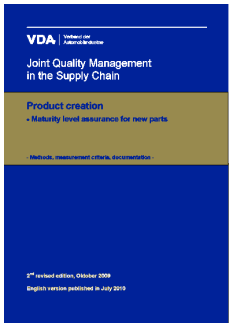
Berlin, October 2011

VERBAND DER AUTOMOBILINDUSTRIE E.V. (VDA)

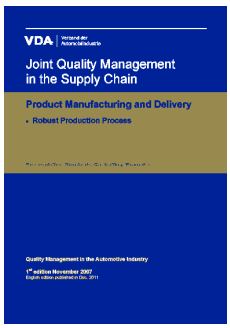
Reference is made principally to the following VDA publications:

Maturity level assurance for new parts – Product creation



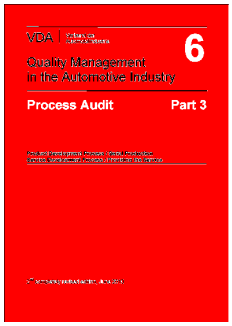
Product creation – Maturity level assurance for new parts
2nd revised edition, October 2009

Robust production process – Product manufacture



Product manufacturing and delivery – Robust production process
1st edition, November 2007

Volume 6 Part 3



Volume 6 Part 3: Process audit
2nd completely revised edition, June 2010

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1 Initial situation

Quality problems cost money and **damage the image of the automobile industry** – this applies to the whole value creation process and supply network, from the OEM down to the raw material supplier.

The task of **filtering out and combating quality risks** in the entire supply chain can be achieved only by manufacturers and suppliers working together, in a **cross-manufacturer system for quality and risk management**.

This guideline: "Minimizing risks in the supply chain" **supports** joint operations in the customer-supplier relationship in the supply chain.

Significant motives for this guideline document on the part of the automobile manufacturers and their suppliers were:

- **Increasing complexity** in the supply chain
- **Globalisation** of supply markets and the accompanying **increase of quality risks in the supply chain**
- Up to 40% of field returns caused by problems in the supply chain before the Tier 1 supplier
- A drop in the **qualification levels** of employees in the lower links of the supply chain

2 Objective

The objective of this guideline is to describe a procedure for the **preventive detection** and **elimination** of **quality risks** in the **entire value creation chain** of automobile development and manufacture.

In this, major reference is made to **existing methods** used in the German automobile industry (VDA).

3 Premises

This guideline is based on the following premises:

- The agreed, **direct contract** between the customer and supplier applies, together with the defined responsibilities (risk elimination in the PEP – product creation process – and production)
- Responsibility for detecting and preventing possible quality risks lies with **each supplier responsible** for his products and processes in the onward supply chain (Tier n)
- The information obtained in the course of joint activities to minimize risks is **treated as confidential**

These factors form the basis for:

- **Cooperation as partners** in the supply chain, based on trust, transparency and dependability
- An extension of **active and constructive supplier management** into the lower links of the supply chain (beyond Tier 2 suppliers)
- **Intensified** use of existing, proven VDA tools and methods

This document does **not examine** the following:

- Financial risks
- Changes in legislation
- The political, social environment
- Peripheral geographic conditions

4 Guidelines for minimizing risks in the supply chain

4.1 Overall model

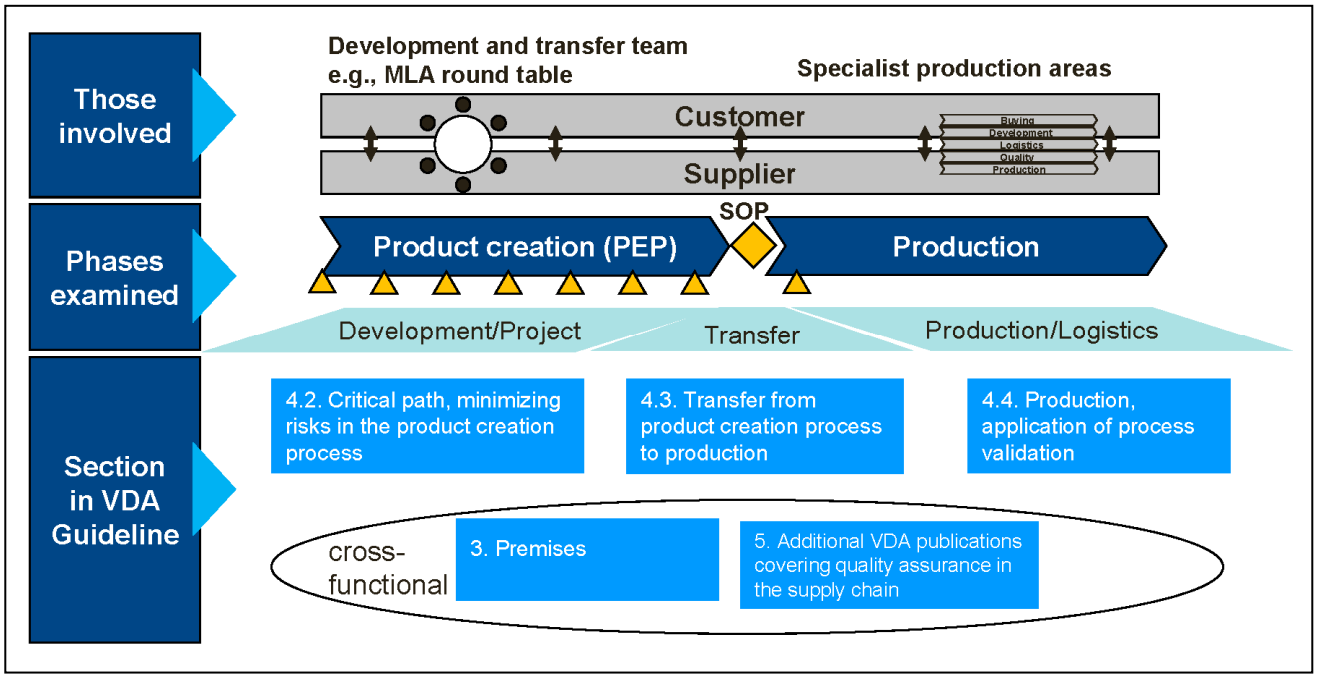


Fig. 4.1.1: Overall model for minimizing risks – broken down into phases

Minimizing risks is carried out in **three sequential time-phases** in the automobile development and manufacture:

- In the product creation process (development / project)
- At the transfer from project to production
- In production (full production / logistics)

In this – in addition to close cooperation between customer and supplier – cross-functional cooperation between development, production, logistics, purchasing and quality is essential.

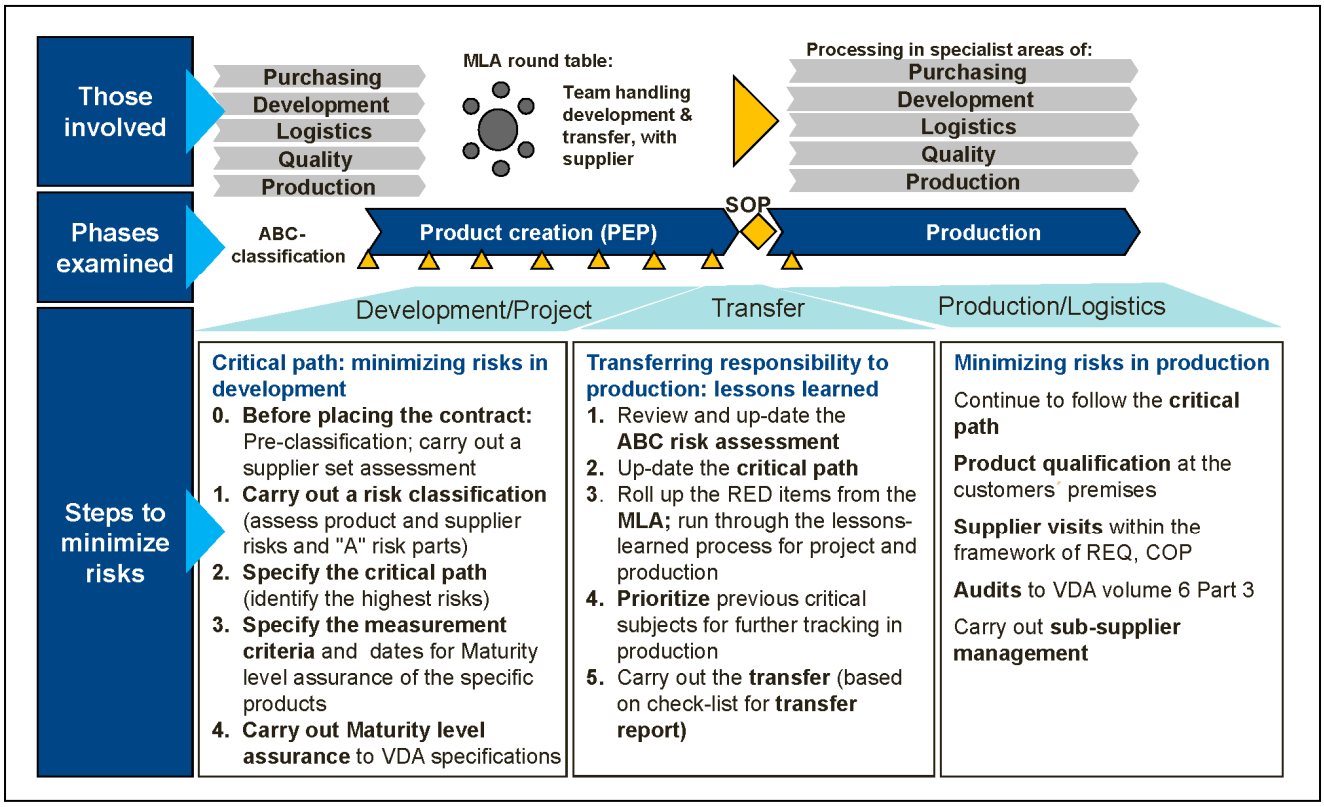


Fig. 4.1.2: Navigator for minimizing risks, using existing VDA methods

Depending on the phase a specific procedure is used, which is described in the following sub-sections.

Major reference is made to the following **VDA publications:**

- VDA publication "Product creation – Maturity level assurance for new parts", 2nd revised edition, October 2009
- VDA publication "Product manufacture and delivery – Robust production process", 1st edition, November 2007

Significant factors for the successful minimization of risks are:

- The comprehensive and considered application of elements to minimize risks in the process, from the development phase, through production launch and into full production
- The transfer of the procedures into the lower links in the supply chain - not merely to the OEM / Tier 1 level.

4.2 Using the guideline in the product creation process

The procedure for minimizing risks in the development phase is specified **jointly** by the **customers and suppliers**. Based on the VDA standard "Maturity level assurance in the supply chain" the following steps are recommended:

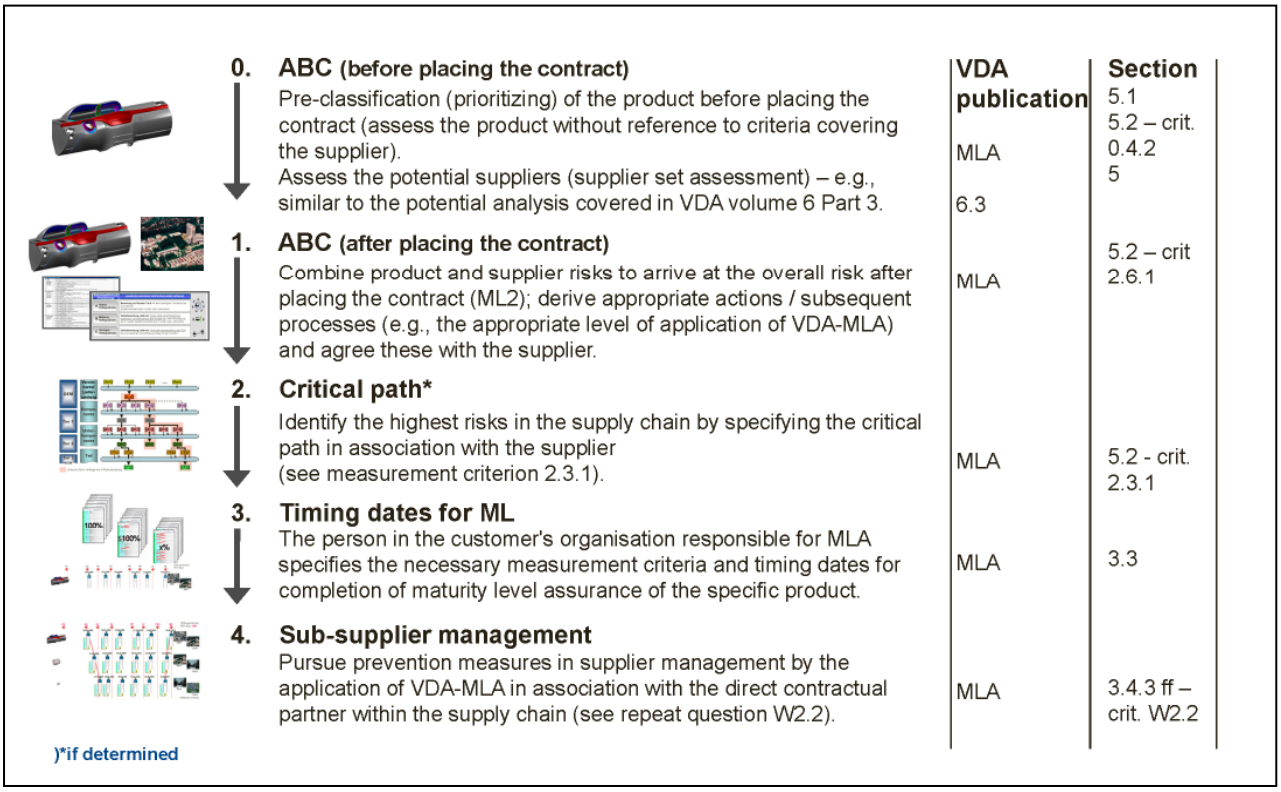


Fig. 4.2.1: Overview – Minimizing risks in the product creation process

Notes regarding measurement criteria and questions refer to the VDA publication quoted.

As a minimum, the use of this guideline is recommended:

- For products with an **identified "A" risk**
- Along the **critical path**

The central element in minimizing risks is the **identification of the "critical path"** in the supply chain (system, component, part).

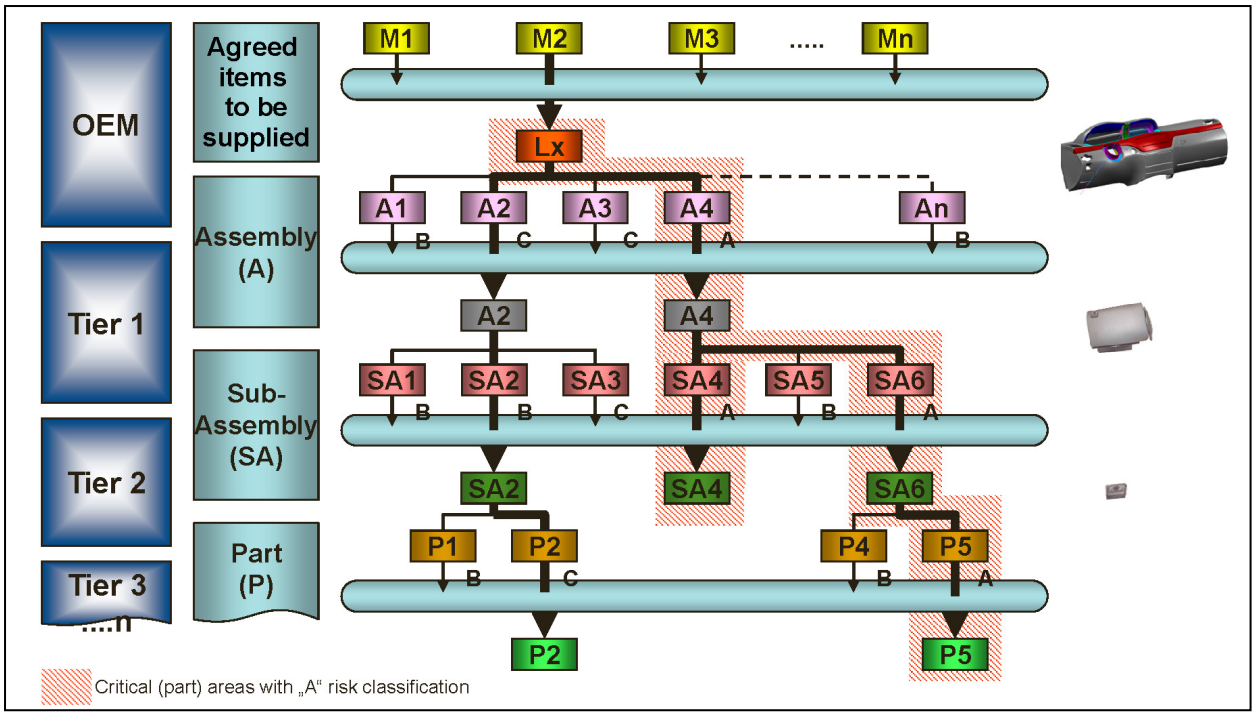


Fig. 4.2.2.: Supplier management – specifying the critical paths
(source: VDA publication "Maturity level assurance for new parts", 2nd edition, 2009)

Independent of the customers' requirements, any supplier can specify the critical path in his onward supply chain **in cooperation** with his sub-supplier and apply the principles of maturity level assurance in accordance with the VDA publication by reference to the identified risks.

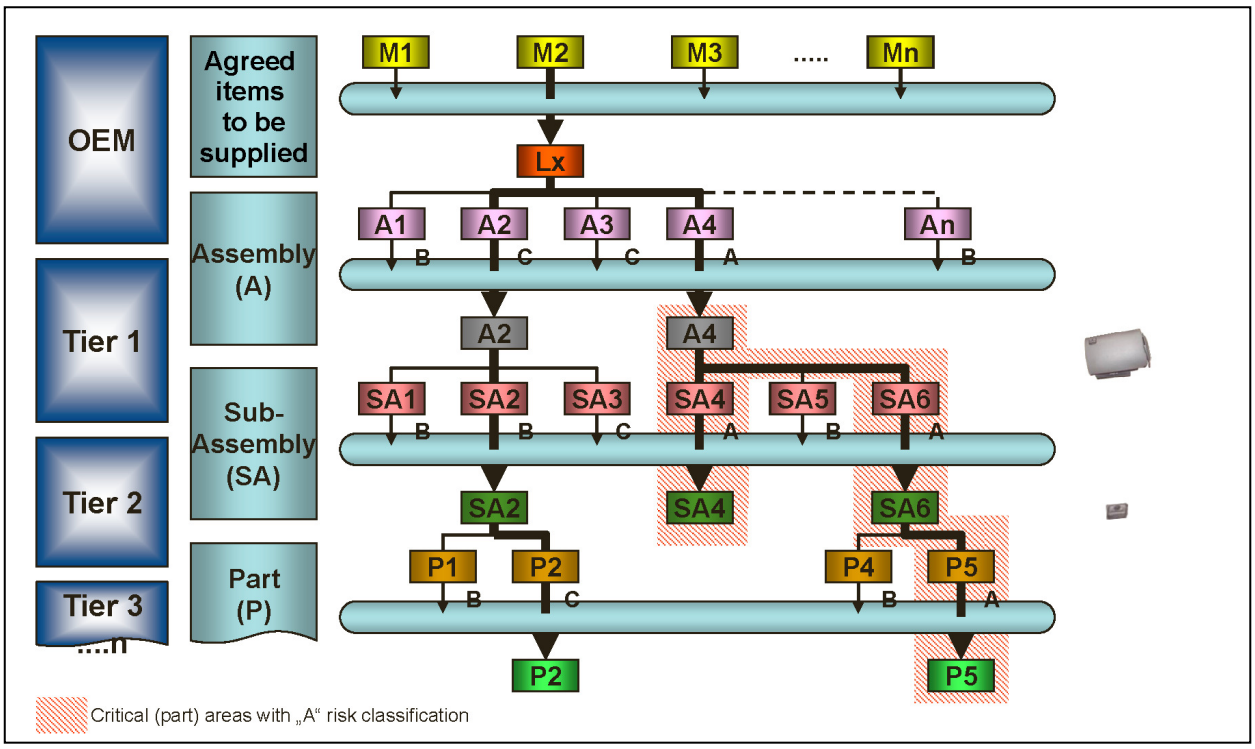


Fig. 4.2.3.: Sub-supplier management – specifying the critical paths
(source: VDA publication "Maturity level assurance for new parts", 2nd edition, 2009)

No matter what the method selected, risk identification and, if appropriate, minimizing risks must be applied in the supply chain.

4.3 Using the guideline when transferring from the product creation process into production

For a comprehensive concept for minimizing risks it is essential to transfer the experience gained in the development phase into the production phase. In this process, it is important that no vacuum occurs regarding responsibility. It must also be ensured that no important information is lost. In the course of the transfer, MLA (Maturity level assurance) is used to address any questions, particularly regarding the status of the ABC risk analysis and also the critical path and the status of the MLA measurement criteria.

The procedure is described in the following steps:

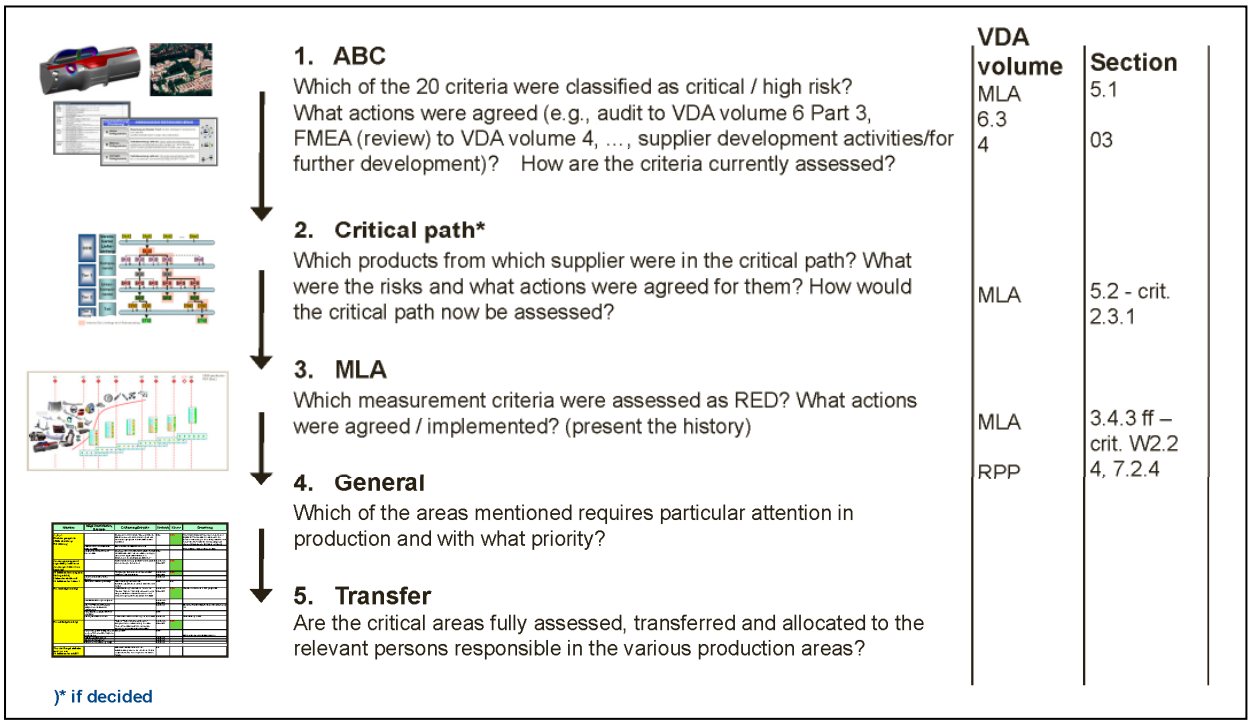


Fig. 4.3.1: Overview: minimizing risks in the transfer from the product creation process to production

The following points must be ensured:

- The **production process and product release** must be fully and successfully completed
- **Deviations** from agreed performance levels (particularly regarding quality and capacity) must be **communicated** between supplier and customer
- **Responsibilities** for production must be clearly **specified** and any changes in responsibilities must be communicated to the customer.

Transfer criteria are specified on the basis of the following list of questions:

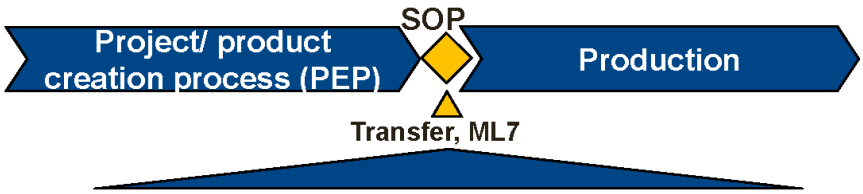
Criterion	Possible sub-criteria, examples	Explanations / examples	Must/ can	Comments
A, B, C classification result specified (risk classification / prioritization)		Assessment of individual criteria; documentation of main areas of risk at the time of the classification; what would be the classification result now; critical path up-dated	Must	Team: Q engineer process, development, buying, logistics; person responsible for the product (usually the development engineer) ; assessment within the team. The Q engineer then drives the process; The Tier 1 supplier should receive the classification result and the reasons for it
	Critical path in the supply chain (if determined)	Documentation of main areas of risk	Can	What risks ? Document them again.
	Transfer the "lessons learned" documentation	Main areas of risk obtained from MLA measurement criteria; history of progress with ML: what was critical, how long did it last and how was it eliminated? Relevance for monitoring in production?	Can	
Change management organised; outstanding changes known and completion dated agreed		Production change process started; production changes already planned are known	Must	
Sub-supplier management is organised; supplier structure with sub-suppliers is known		Production transfers are known and documented; certificate for new location is available	Must	
	Internal/external contact personnel are known		Can	
	Supplier qualification has been completed	If necessary, what were the qualification needs and what is the status at present?	Can	
Process release is complete		Audit targets achieved; no points outstanding from VDA volume 6 Part 3. Procedure/proposals if deviations occur? All basic process weaknesses in the supply chain have been eliminated; e.g., positive 2 days' production, R@R	Must	VDA volume 2 (everything which is covered in the product/process release)
	Capacity verification completed		Can	
	100% end-of-line tests still outstanding (not in accordance with the specified process)		Can	
	Production control plan has been up-dated		Can	
	No systematic errors	In manufacturing, with deliveries and in full production	Can	Requirement for product & process release
Product release is complete		Procedure/proposals if deviations occur? Proven achievement of function (function, fit, material, colour); all design weaknesses in the supply chain have been eliminated	Must	
	Requirement for RPP: maturity level traffic light must be "green" for "A" parts and "green" for all "x" questions regarding "B" and "C" parts	Example of RPP	Can	
	Variants overview is known		Can	
	Tolerance concept is known		Can	
	Reference (master) sample alignment is complete		Can	
Have all sub-suppliers also achieved the transfer criteria?		Random samples; proof of achievement of criteria (where can I look?); not simply "yes and no" - ask about outstanding items	Can	

Fig. 4.3.2: Transfer criteria

Further information on the transfer is provided in the VDA publications:

- Maturity level assurance for new parts: ML 7 (Project closure;, transfer of responsibility to production; start requalification), Section 5.2.VIII
- Robust production processes: check-point, Sections 4 and 7.2.4

The **sequence** of the transfer is organised as follows:



Subject	Proposal
Initiator	Person responsible for Maturity level assurance
Acceptance of the transfer	Responsible personnel in production; overall responsibility for the quality of bought-in parts for production
Participants in the transfer discussion	Project team (development, buying, quality, logistics) and personnel from the departments accepting the transfer
Main points for consideration	Transfer check-list completed in advance (can be defined for the specific company – see example) Identified risks and points outstanding (including their contents) must be handled and recorded in a report). Specify actions
Decision / result	Discharge / do not discharge the project team from is responsibility – different handling decisions are possible, depending on the points in question, the risks and the standards in the company Decisions in individual cases on what is to be transferred and how (e.g., sample submission, outstanding points from audit,...)

Fig. 4.3.3: Organising the transfer process

The transfer can take place in two ways:

- **Complete transfer** at **fixed point in time**
  The transfer takes place when all outstanding points from the development project have been cleared completely. Only then is the project team discharged.

- The **transfer takes place as a process** over a **period**
  The transfer takes place in successive stages to the departments responsible for production and is completed only when all the various points have been cleared and responsibilities have been allocated in production.

4.4 Using the guideline in production

In addition to the risks already detected in the product creation and transfer processes, the **new identified risks** in the production phase are taken into consideration by the relevant departments. Notes on identifying risks in production are provided in the VDA publication "Robust production process".

In this connection the following activities are required:

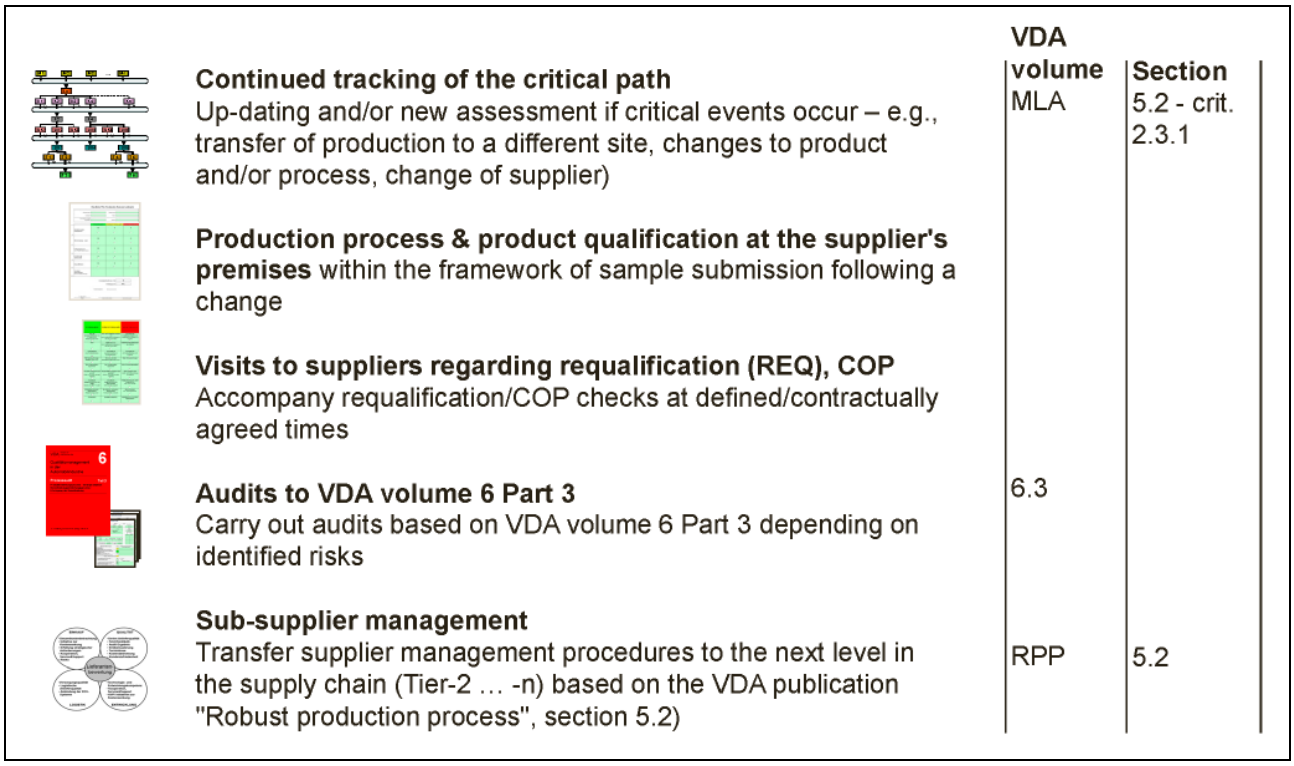


Fig. 4.4.1: Overview – minimizing risks in production

Critical path:
Tracking the critical paths is carried out in the **same way** as the procedure in the **project phase**.

Audits / supplier visits:
Regular visits to the relevant supplier are essential in order to detect potential risks in the supply chain at an early stage.

Criteria for planning supplier visits / audits are:

- **Parts / suppliers assessed as critical**
- **Critical supply chain**
  - Complexity
  - Peripheral conditions in the global supply chain
- **Supplier status**
  - Economic difficulties
  - Quality metrics, complaints, critical customer rejects (line, 0-km and field)
  - Significant history of problems
  - History of audit results, periodic monitoring
- **Critical events**
  - Management changes; sale of the company (organisational changes)
  - Change of supplier
  - Changes to products and / or processes
  - Transfer of production
  - New parts/processes
  - Personnel fluctuations and qualifications
  - Severe fluctuations in volumes / call offs
- **Significance of the product**
  - Safety-critical / certifiable parts (VDA volume 1)
  - Critical launch
  - Risk of line-stop e.g., volumes
  - Critical in the sense of warranty and goodwill payments

Fig. 4.4.2: Systematic arrangements for frequency of visits – examples of criteria for audits / supplier visits in the supply chain

Sub-supplier management:

As a further measure, systematic **sub-supplier management should be operated**. Essential features in this regard are described in the VDA publication "Robust production process", Section 5.2, page 72.

The **intensity and frequency** of the proposed methods will depend on the **risk** which has been identified.

Possible risk indicators are:

No.	Criterion	Explanation / examples
Preliminary risk assessment (from project, transfer):		
	Do items in the project phase indicate risks?	"A" risk, red MLA traffic light
Significance of the product / function:		
	Is the product safety-relevant?	Also parts requiring certification (VDA volume 1)
	Is the product linked to a vehicle breakdown risk?	
	Does the product have a great effect on production?	Effect in the event of a problem
	Have unplanned product changes occurred?	
Supply chain:		
	Is the supplier status critical?	e.g., economic problems
	Have critical events occurred in the supply chain?	e.g., change of management, sale of the company, change of supplier, transfer of production, new parts/processes, significant personnel fluctuations and inadequate qualifications, severe fluctuations in volumes and call-offs
	Is the company the only supplier?	
	Is the supply chain very complex?	e.g., a supply chain with many suppliers, both in terms of depth and width
	Are significant fluctuations in call-offs and forecasts predictable?	With regular demands
	Are logistics problems to be expected?	
	Is the supplier new in the supply chain?	
	Was the last audit / the last visit to the supplier a long time ago?	Define "a long time ago"!
	Is the business new for the supplier?	
	Do standard product checks indicate anything unusual?	e.g., re-qualification checks; goods inwards checks
	Can errors no longer be checked or detected in subsequent processes?	e.g., threaded connections, welding defects, crimping defects, surface coatings, corrosion, heat treatment/material structure and characteristics
	Do particular peripheral conditions in the global supply chain have effects on quality?	e.g., climate, transport conditions, personnel (fluctuations, qualifications)
	Do events recorded in quality control reports indicate	e.g., ppm, Cpk
	Does any other supplier information indicate risks?	e.g., scrap levels
Susceptibility to problems:		
	Does the supplier have a history of susceptibility to problems?	Problems in the production area
	Does the product have a history of susceptibility to problems?	Problems in the production area
	Is the product from a "family" with a history of susceptibility to problems?	
	Are the reaction times satisfactory?	Reaction time to complaints / rejects
	Are there significant / many 0-km problems?	
	Are there significant / many field problems?	e.g., shift line diagrams / MIS
Miscellaneous:		
	Does production of the item involve a high proportion of manual processes?	
	Which items in the process audit indicate risks in the supply chain?	
	Are there particular risks in association with warranty / goodwill payments?	

Fig. 4.4.3: Risk indicators in production

5 Additional VDA publications covering quality assurance in the supply chain

In recent years a series of new VDA tools and methods has been developed, which inter-act to make a significant contribution to minimizing risks in the supply chain. Fig. 5.1 shows these in their relation to the individual phases in the value creation chain.

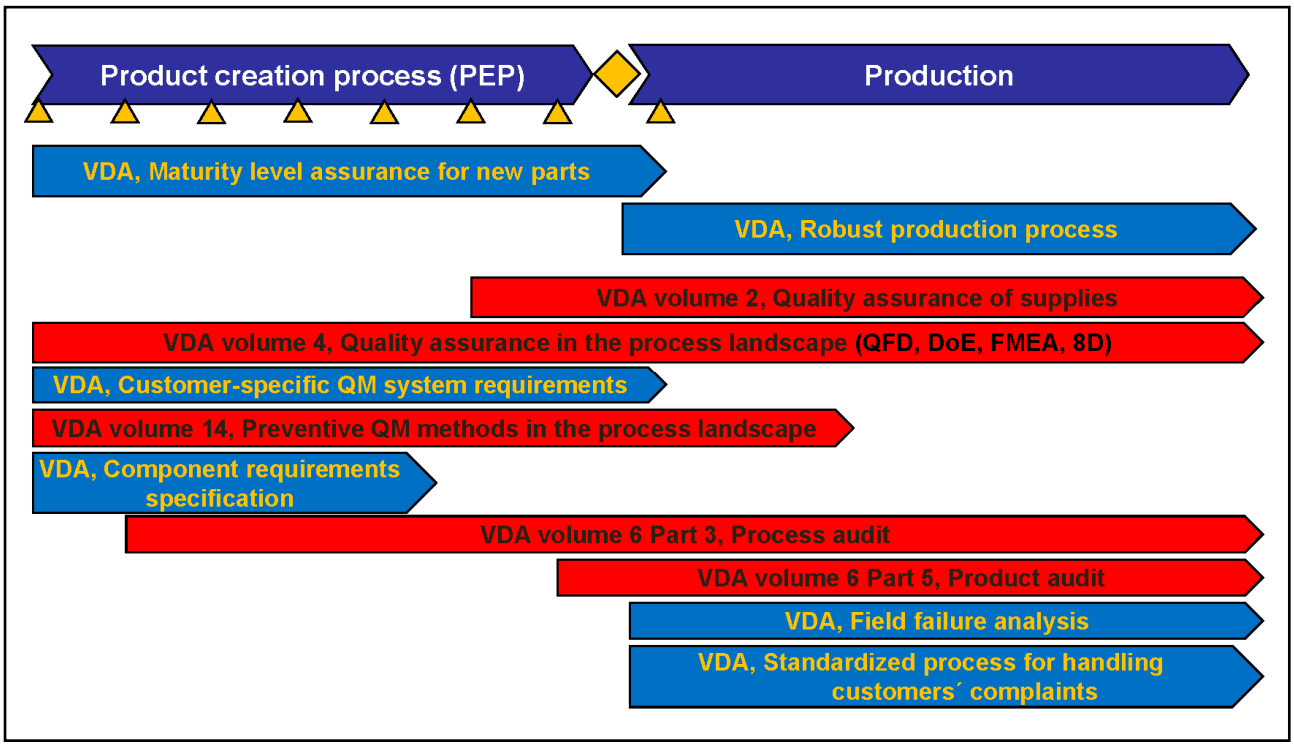


Fig. 5.1: Additional VDA publications covering quality assurance in the supply chain

As the central and cross-functional tool for maturity level management, the **VDA publication "Maturity level assurance" (MLA**) is expanded by the use of the VDA standards shown in Fig. 5.1, as the project progresses from the award of the contract to the transfer of responsibility to production, depending on the risks currently identified. The requirements for robust production processes are also established in this phase.

The **VDA publication "Robust production process" (RPP)** is the core description for ensuring stable processes from SOP (start of production) to EOP (end of production). This document is supported by the use of other VDA standards listed in Fig. 5.1, as well as company-specific supplier management procedures.

6 Contact details

The VDA QMC will be pleased to provide further information on "Minimizing risks in the supply chain".

Your contact is:

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7 Appendix

7.1 Maturity level indicators and measurement features with significant relevance to the minimization of risks

Overview of measurement criteria for maturity levels ML 2 - 7.
ML indicators and measurement criteria to minimize risks

	Project:		
No.	ML indicator	Measurement criteria	Comments
2.2.3	**Procurement process**	**Legally sustainable order placement** has taken place on time.	Commercial agreements relating to the project have been reached (e.g. production locations, the supplier's logistics, material prices, cost allocation for tools, allocation of development costs, gauges and templates, shipping containers / shipping container development, service materials, training needs). Features: - Nomination letter - Development and delivery agreement - Conclusion of purchasing contract.
2.3.1	**Supply chain / Supply of parts**	The **relevant supply chains** have been **specified** and reviewed with respect to their **critical paths.**	Measures have been derived and scheduled. Responsibilities have been assigned. Locations, suppliers, relocations, logistics concepts (Tier 2 to Tier n). Supplier provides evidence of a consistent supply chain management concept (supplier nomination process, definition of critical suppliers, monitoring, delivery performance, supplier enablement / deviation management). Relates fundamentally to product and process *(VDA volume 6 Part 3, VDA publication "Robust production process").*
3.1.2	**Product development**	The **product** development status meets the **stipulations laid down in the requirements specification / performance specification.** **Technical specifications have been released.**	TECHNICAL SPECIFICATIONS are a comprehensive description of a component (or software) including: - Data model release (surfaces, radii, gap quality, component interfaces) - Drawings - Standards - Dimensioning / functional dimensions (Functional dimensions are used to determine the form, size and position of form elements or spacings between components or sub-assemblies. When applied to the vehicle, functional dimensions are those which are relevant to the achievement of significant quality characteristics such as, for example, gap dimensions, flush fit, door closing forces) - Confirmation of significant product characteristics - Material requirements - Design requirements (colour, material, grain finish, gloss) - Quality stipulations / requirements - Part identification - Handling error safety study for the product - Specified scope of spare parts and repair concept. PRE-REQUISITES: a) Positive test results (component and complete system) b) Positive implementation results (E/E) *(DIN 69905, VDA volume 6 Part 1, VDA volume 6 Part 3, VDI/VDE 3694, VDA publication "Requirements Specification")* .
4.1.1	**Process development**	The **production process planning** has been released and is available. **Manufacturing facilities have been authorized**.	Manufacturing feasibility has been verified by means of prototype components (also for innovations) / comparable components. Material flow and process layout have been confirmed. Handling error safety planning (e.g. "Poke-yoke") taken into consideration. All official regulations (requirements, where applicable) and approval pre-requisites, e.g. electro-plating, coating system, taken into consideration *(VDA volume 4, VDA volume 6 Part 1, VDA volume 6 Part 3, ISO/TS 16949, VDA publication "Robust production process")* .

Overview of measurement criteria for maturity levels ML 2 - 7.
ML indicators and measurement criteria to minimize risks

	Project:		
No.	**ML indicator**	**Measurement criteria**	**Comments**
4.2.2	**Process validation**	**The supplier's gauges / testing equipment** have been authorized and ordered.	Integral part of the production control plan.
4.2.3	**Process validation**	**Production tools** have been ordered and started in accordance with the timing plan.	
5.4.3	**Process validation**	The supplier's **gauges / testing equipment** have been accepted and are available.	Evidence of capability available; the gauge's full production capability has been verified *(VDA publication "Robust production process", VDA volume 6 Part 3)* .
5.4.5	**Process validation**	**The products to be delivered are from full production tools**. The revision status (issue level) is documented.	Parts made with production tools are manufactured with the tools to be used in the subsequent full production process. Production tools must be capable of manufacturing the components in such a way that they meet the requirements for the component (tolerances, function, quality, fit in the assembly etc.) in accordance with the requirements specification. Revision status is documented. Start of part optimization (coordination of tools and dies) *(VDA publication "Robust production process", VDA volume 6 Part 3)* .
5.4.6	**Process validation**	The **production facilities** are available. Provisional machine capability has been established.	Provisional machine capability can also be provided by the manufacturer of the facilities *(VDA publication "Robust production process", VDA volume 6 Part 3)* .
6.1.3	**PPA (Production process and product approval)**	The **customer has carried out all the tests for approval of the product**. Results are available.	Assembly trials; crash tests and test-rig tests, material checks, laboratory checks; dimensional cross-checks, etc..
6.1.4	**PPA (Production process and product approval)**	**Approval of the production process** at the supplier's premises (proof of process capability; maximum production capacity, etc.) has been carried out **under full production conditions**.	The approval procedure for the production process completes the initial sample submission procedure *(see also "Production process and product release", VDA volume 2, VDA publication "Robust production process" and customer-specific check-lists, VDA volume 6 Part 1, VDA volume 6 Part 3, ISO 9000)* .
6.1.5	**PPA (Production process and product approval)**	**The production process and product approval (PPA)** has been issued	Process and product approval to PPA, PPAP (Production Part Approval Process) is available. VDA publication "Robust production process"
7.2.2	**Project management**	**Implementation of all requirements** from the previous maturity level measurement criteria has been completed. There are no points outstanding.	Transfer report *(VDA publication "Robust production process")* .
7.2.3	**Project management**	**"Lessons learned"** documentation has been drawn up. The results are **incorporated** into the **relevant products and processes**.	Feedback of experience from the project completed with RG7 – with the integration of existing data (e.g. field failures, feedback from after-sales service, project data-base, know-how carrier file) must be assured as the input for new projects or developments. Ensured within the framework of workshops with all of the parties involved in the "round table" within the supply chain *(ISO/TS 16949, VDA volume 6.1)* .
7.4.1	**Full production verification**	**Requalification** including monitoring in full production **(CoP)** has started.	CoP: Conformity of Production. Requalification: In accordance with the production control plan, all products must be subjected to a comprehensive dimensional and functional check, taking account of the customer stipulations to be applied for materials and function *(VDA publication "Robust production process", ISO/TS 16949, VDA volume 6 Part 3)* .
R2.2	**Supply chain / Supply of parts**	**The supply chain** has been **up-dated**. **The maturity level of all sub-components** has been assessed as **GREEN**.	In the event of any deviations, measures have been drawn up, including an assessment of the effects on the scope of delivery. Locations, suppliers, relocations, logistics concepts *(VDA volume 6 Part 3)* .

8 Glossary and abbreviations

Term	Definition
"A" risk parts	Items supplied (systems, assemblies, parts) which have been assessed to the VDA standard for Maturity level assurance and have been classified as having a high risk
ABC risk assessment	Classification (prioritization) by the customer of a supply item at the beginning of a project into one of 3 levels: - A (high maturity level risk) - B (medium maturity level risk) - C (low maturity level risk) which determine the intensity of cooperation in the supply chain. For further details, see the VDA publication "Maturity level assurance for new parts", 2nd edition, October 2009, sections 2.2.1 and 2.2.2.
COP	Conformity of production
ML	Maturity level
MLA	Maturity level assurance (abbreviation covering the VDA publication "Maturity level assurance for new parts"
Supplier set assessment	Procedure for the preliminary selection of suppliers for an item to be supplied
REQ	Requalification
RED themes	Maturity level criteria which have been assessed with the traffic colour RED. For further details, see the VDA publication "Maturity level assurance for new parts", 2nd edition, October 2009, section 3.4.2.
RPP	Robust production process (abbreviation covering the VDA publication "Robust production process")
Sub-supplier management	Planning, assessment, monitoring and control of the influencing factors which are determined by sub-suppliers, production materials and services with an effect on quality. (based on the VDA publication "Robust production process", 1st edition, November 2007, section 5.2.
VDA	German Association of the Automotive Industry

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