VDA | Verband der Automobilindustrie

6

Quality Management in the Automotive Industry

Process audit Part 7

- Production equipment –

Product creation process / unit production

2nd edition, November 2012

Process audit

- Production equipment –

Product creation process unit production

2nd edition, November 2012

Verband der Automobilindustrie e.V. (VDA)

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Translations

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

Preface

Increasing requirements in the buying market result in new and more complex tasks for quality management in companies.

In many areas of the economy these days, a "comprehensive" quality - management system is an integral part of the company strategy and creates the organisational conditions required in order to meet high quality demands on products and processes. System audits are carried out at planned intervals, to check the effectiveness of the quality management systems.

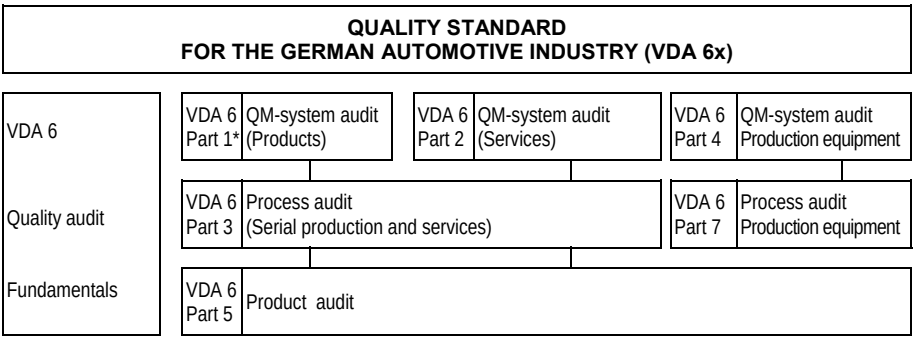
Ever shorter time spans, from the initial concept to the new product or service, ready for the market, constantly demand greater parallel execution of work sequences and operations in a wide range of areas of the company. This means that greater demands are placed on the processes.

Checks by the operators themselves and reductions in the amount of inspection, while still meeting increasing quality requirements, can be achieved only by the use of capable and controlled processes.

Of course, this applies to the product creation process & production / the service creation process & provision of the service.

Company processes must be monitored constantly in order to ensure their reliability and to introduce prompt control mechanisms and corrective action if non-conformances are detected.

An important instrument for monitoring processes is the process audit. This is an integral part of the VDA strategy "Quality standard for the German automotive industry (VDA 6)“ as shown in the following illustration.



* equivalent to ISO/TS 16949

Notes regarding the revision of 2012:

In association with the up-dating of publications VDA 6.2 and 6.4 in 2011 and in view of the adjustments to DIN EN ISO 9001:2008, the terms used in this present publication have been aligned accordingly.

In section 7 "Evaluation" the classifications and rules covering downgrading have been harmonized with VDA Band 6.3 "Process audit“ and forms 1 and 2 in section 13 have been adapted accordingly.

References to standards and addresses have been up-dated.

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Verband der Automobilindustrie e.V. (VDA)

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1 Objective and purpose of the publication

This present publication deals with the importance of process audits and where they should be used. It explains the associations between system, process and product audits. In this way, a common understanding and an agreed procedure for the use of this management instrument can be achieved within the automotive industry and its suppliers.

Within the framework of the process audit, reasonable consideration is given to aspects of environmental protection which are oriented to a significant degree to the customer's requirements. This does not involve any claim to the auditing of compliance with legislation in specific countries; this is frequently demanded of the supplier in the form of separate evidence.

The publication is a guide for carrying out internal and external process audits. Any process specifications and details are included only as examples since, at times, they must be carried out by the auditor with the involvement of process experts.

An aim of the publication is to provide a high level of comparability between different companies with regard to the execution of the process audit, based on the questionnaires provided, in order to reduce the amount of work involved in the audit.

Acceptance of an audit result by a third party is possible but this will depend on a detailed analysis of the audit report and other documents as appropriate. The decision must be that of the third party.

Finally, the publication is intended as an educational and training document, as well as working instructions for process auditors and companies which do not have previous experience of process audits.

2 The association between system, process and product audits

System, process and product audits are types of audits - this does not imply there are no other types of audits.

Comparison between audit types

Audit type	Items to be audited	Purpose
System audit	QM system	To assess the comprehensiveness and effectiveness of the basic requirements
Process audit	The processes involved in producing unit products	To assess quality capability relating to special products and their processes
Product audit	Products (including services) at the various stages of creation	To assess the quality characteristics

The different types of audits are individual, independent and can be applied separately. However, there are areas of overlap in some aspects.

A comparison matrix covering process and system matters is shown in the main section of Section 12.

Further explanatory notes regarding types of audits are provided in VDA Band 6, which also covers associated explanations, definitions of technical terms and principles governing the qualification of auditors, literature, etc.

3 Specifications for the process audit

3.1 The task

Process audits are carried out in order to assess quality capability. They should lead to capable and controlled processes which are not sensitive to interference factors.

This is achieved by:

3.1.1 Prevention

The term "prevention" covers the detection, illustration and introduction of actions to prevent non-conformances from occurring in the first place.

3.1.2 Corrective actions

Corrective actions include the analysis of non-conformances which have occurred and carrying out actions to prevent their recurrence.

3.1.3 Continuous improvement process

This term covers detailed improvements introduced in order to optimize the overall system. Actions derived from the process audit and put into practice improve the process, making it more capable and robust.

3.1.4 Efficiency of processes

By checking the suitability of processes to produce the end-product free from defects, the efficiency of the processes can be measured and continuously improved, so that quality products can be manufactured under cost-effective conditions.

3.1.5 QM evaluation

Process audits enable top management to draw conclusions regarding the effectiveness of different areas of the QM system.

3.2 Audit timings

Process audits can be carried out to a plan (based on a system or a project) or as a result of events.

3.2.1 Planned process audits

System-oriented

Process audits are carried out to an audit plan as an integral part of the QM system of an organisation.

Existing and potential suppliers whose QM systems are already certified are audited by product groups. Consideration is given to these processes which directly affect or are planned for the product group (to reduce the work involved).

Project-oriented

Process audits are carried out for specific projects/orders in order to detect non-conformances at an early stage – for example, in the development, manufacturing and/or work-site phases – so that suitable actions can be introduced.

3.2.2 Unplanned process audits

Event or problem-oriented

Process audits are carried out in each product phase for problematic processes, to eliminate non-conformances and to ensure the compliance of critical process characteristics.

They are also helpful in containing the causes of defects and the introduction of corrective actions.

Unplanned process audits can be caused by:

- Customers' complaints and rejects
- Changes to peripheral conditions
- Insecure areas of a process
- The need to achieve cost reductions
- The needs of in-house areas
- New projects, processes and products
- The need to provide evidence of compliance with quality requirements.

3.3 Application

Process audits can be used in-house and externally, across the whole of the quality function, in all processes, including

Project management
Product development
Sourcing
Production
Processes after shipment

The following table gives a number of examples:

Process	**Organisation unit**	**Concrete process step**
Project management	Sales	Processing enquiries
Sourcing	Development	Selecting development suppliers
Production	Production	Mechanical manufacturing Assembly Disassembly; packing
Work-site	Production or service	Assembly Acceptance checks

For clarity, the concrete process steps within the process can be evaluated separately and shown separately in the report.

3.4 Execution requirements

3.4.1 Basic requirements within the organisation

When carrying out a process audit, specific preparations must be made regarding the actual conditions in the organisation and the process.

This requires the detailed planning and provision of basic requirements and their constant improvement.

These basic requirements will include, for example:

- Requirements set out in DIN EN ISO 9001
- Organisation/company structure, process landscape
- Data on the organisation and its departments (its range of product and services, references, etc.)
- questionnaire
- Audit plan
- Quality management manual; procedural instructions, work instructions, test / inspection instructions (depending on whether the work is carried out in-house or externally)
- requirements in VDA stipulations (VDA 6.4)
- Requirements arising from legislation and contracts
- Customers' requirements
- Significant product characteristics
- Significant process parameters
- Quality history

3.4.2 Qualification of auditors

3.4.2.1 Technical training

Process auditors must be fully trained in elementary quality techniques, methods and standards, as well as audit techniques to the requirements of ISO 19011.

In addition, they must have knowledge and abilities regarding products and processes, so that they are able to understand the technological associations under which the audit is carried out. Knowledge and experience in this area should include:

– sector-specific processes and practices
– technical characteristics of products and processes, including services, and
– sector-specific terminology

3.4.2.2 Professional experience

The process auditor must have at least 5 years industrial experience in the manufacturing areas of unit production (machine manufacture, tool-making, aircraft manufacturing, weapons technology, nuclear technology, the automotive industry). These 5 years must include at least 2 years practical experience in process and quality management.

3.4.2.3 Audit experience and maintaining qualification

In order to be licensed, the process auditor must have carried out at least 3 process audits on his own authority, where appropriate with the support of a technical specialist (process engineer, procedures specialist) in the typical process area.

To maintain the qualification, evidence must be provided of at least 3 complete process audits per year to VDA 6.7 in organisations in the production facilities sector.

3.4.3 Responsibility

3.4.3.1 Responsibilities of the auditing organisation / functional unit

- Selection of suitable auditors, based on professional experience and qualifications
- Issue an audit contract

3.4.3.2 The auditor's responsibilities

- To carry out a process audit to the audit plan or event-oriented:
  - Agreement on details with the organisation unit/functional unit to be audited (define the process, interfaces, etc.)
  - Audit preparations (inspecting documents, creating a questionnaire, involving specialists or knowledge data-bases)
  - Execution of the audit
  - Evaluation

- Closing discussion and report
- Initiate corrective actions
- Verify the effectiveness of corrective actions
- Duty of confidentiality

- To maintain his/her qualification:

  - Knowledge of current standards and regulatory works
  - Specialist auditor knowledge
  - Knowledge of processes.

3.4.3.3 Responsibilities of the audited organisation / functional unit

- To provide all necessary information
- To involve those responsible for the process
- To make available technically competent personnel
- To specify corrective actions
- To carry out the corrective actions
- To verify the effectiveness of the corrective actions.

4 Audit sequence

The sequence of a process audit always follows the same system:

- Preparation
- Execution
- Closure and report
- Actions and monitoring until evidence of effectiveness is provided.

The following flow chart (Fig. 1) shows this sequence.

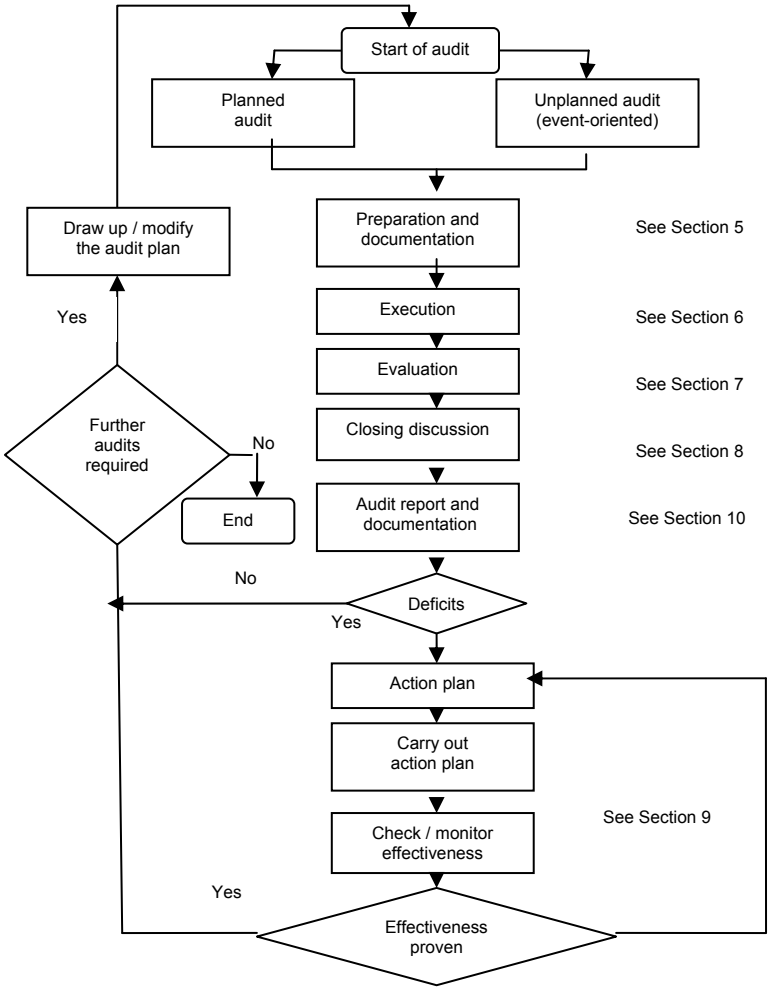


Fig. 1: Flow chart showing the audit sequence plan

5 Audi preparations

5.1 General

Thorough preparation is particularly important because it is the basis of any successful audit. In addition, the area to be audited must be given the reasons and the timing.

No matter what the type of process audit, whether

- Planned or event-oriented
- Internal or external

the preparation procedure is as shown in Fig. 2

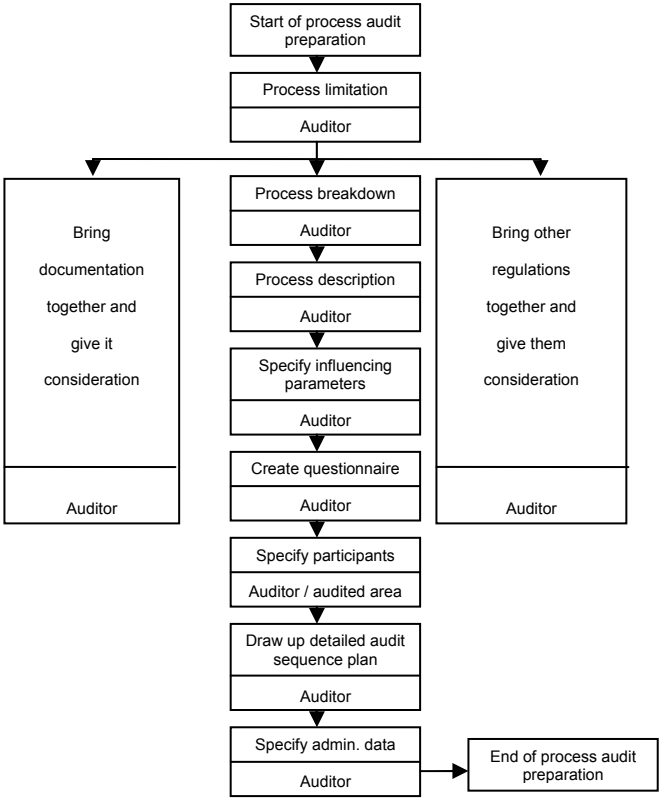


Fig. 2: Flow chart for audit preparations

5.2 Process limitation, process breakdown, process documents

The first step in preparing an audit is the **process limitation**.

The auditor or auditor team must decide which process is to be examined. This requires interfaces to external areas to be specified (Fig. 3). The auditor has the authority to restrict the process to be audited; however, he/she should agree the decision with the organisation units involved and the personnel responsible for the process. This may involve an initial inspection tour.

The next step is the **process breakdown** (splitting the process into individual process steps) and an examination of the interfaces (see Fig. 3). By this step at the latest, the auditor or auditor team must discuss the **process documents**.

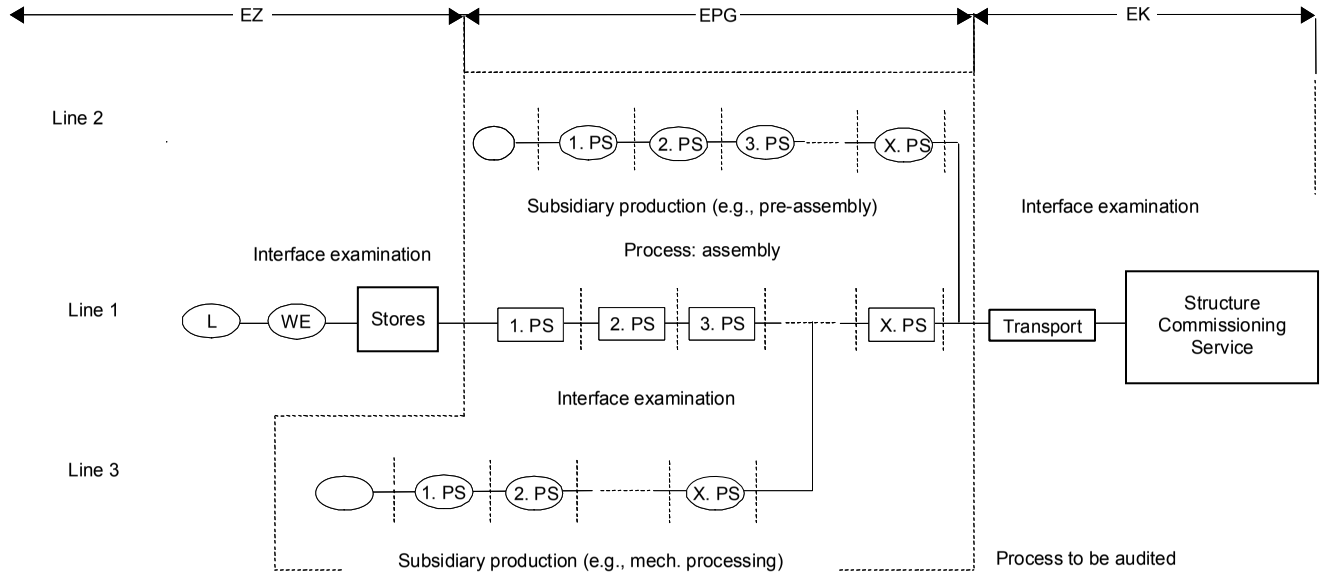
A sensible **process breakdown** and an adequate **process description**, as well as a **specification of influencing parameters** can be achieved only with the appropriate documents – that is, the auditor describes his understanding of the process to be audited and specifies influencing parameters. Using systematic, methodical procedures (e.g., cause & effect diagram, "6 M") the main influences are described in detail, as far as is possible and reasonable. In this way, with the aid of the questionnaire, the auditor will be able to ask targeted questions on site in the course of the audits.

With external process audits the documents needed for preparing the audit are generally not available to the extent required, for reasons of competition. For this reason, the audit preparations must be carried out with the documents which have been made available.

The process description is generated from the process documents which are available, such as:

- Process instructions
- Work plans and test/inspection plans
- Work instructions test/inspection instructions

Fig. 3: Process limitation, process breakdown, process interfaces



EZ = Incoming material / components
EPG = Mean value of production PS
EK = Customer activity
PS = Process stage
L = Supplier
WE = Goods Inwards

Further sources of information may be:

Standards, specifications, target stipulations, FMEAs, lists of non-conformances, maintenance manuals, audit results, action plans, results of Goods Inwards inspections and supplier performance, layouts, questioning of employees and customers, project plans, statements regarding service quality.

This preliminary work is an important basis for drawing up the process-specific questionnaire.

In addition, auditors and the areas to be audited must collect information regarding "other applicable documents" which specify the framework conditions for a process audit, such as:

- Stipulations regard the organisation
- Responsibilities

Framework conditions of this kind are set out, for, example, in:

- Quality management manuals
- Procedural instructions
- VDA documents
- Standards
- Customer requirements

5.3 Process-specific audit questionnaire / detailed audit sequence plan

The auditor (the auditor team) uses the results of this preliminary work to draw up a process-specific list of questions / questionnaire. This is an extension of the general questionnaire (see Sections 6 and 11). Before the audit takes place, the comprehensive questionnaire must be given to the area to be audited and explained if necessary.

The first step in drawing up the detailed audit plan by the auditor (the auditor team) is to decide who the participants (auditors and for the area to be audited) are to be:

- The number of auditors and any specialists who need to be included

- Participants from the organisation / functional unit to be audited – e.g.:
  - Those responsible for the process
  - Specialists
  - Interface representatives

Following agreement between the auditors and the area to be audited, the final detailed audit plan is approved. It is useful to include an overview, including the organisation ' functional unit, the time and place and participants, with a reference to the questionnaire. Changes can be made on site. In particular, non-conformances or a lack of information on site can result in delays.

6 Carrying out the audit

6.1 Introductory meeting

An introductory meeting is to be held before the audit begins. Here, the first step is to introduce the participants in the audit. In the case of an external audit a presentation of the organisation may also be made. The reason for carrying out the audit and its purpose must be discussed again, so that all those involved have the same level of information and can identify better with the audit.

To ensure that the audit runs without any problems, any outstanding questions regarding the audit sequence (process limitation, questionnaire, evaluation system, etc.) and the peripheral conditions (responsibilities, on-site execution, availability of employees for questioning, etc.) must be clarified.

6.2 The audit sequence

The audit is carried out in accordance with the questionnaire which has previously been drawn up. In this, the questions can be worked through subject-by-subject or on an event-oriented basis. The types of questions (e.g., open questions why, when, who, how, etc.) and other interview techniques are part of the auditors training and are not dealt with further in this publication. It has been found to be advantageous to continue to ask open questions to dig deeper into matters.

The operators on site must be questioned so that they become involved in the audit. It is a good idea to record positive and negative findings in the course of the audit. If significant non-conformances are found, immediate actions must be taken with the persons responsible for the process.

The objective must be to eliminate all unclear matters on site; this will also prevent conflicts in the closing discussion meeting.

7 Evaluation

A quantitative evaluation in process audits makes it possible to compare audit results in association with the analysis of the audit report. Changes with regard to previous audits can be examined within the framework of continuous improvement.

Because of different evaluation limits and target requirements in individual organisations, it may be necessary to adapt the percentage classifications in the overall degree of achievement and the assessment identifications. In this respect a qualitative evaluation can also be used. Individual processes can also be weighted. Any other evaluation method (such as, for example, qualitative evaluation) must be agreed between supplier and customer and must be recorded in the audit report.

7.1 Individual evaluation of processes and their characteristics

Each process characteristic is evaluated against the relevant requirements and their achievement in the product creation process. For each characteristic the evaluation can award 0, 4, 6, 8 or 10 points, depending on the proven compliance with the requirements in question. Improvement actions with timings must be set for all evaluations under 10 points.

Points	Evaluation of achievement of individual requirements
10	Requirements achieved in full; no risks
8	Requirements generally achieved *
6	Requirements partially achieved and/or special risks
4	Requirements inadequately achieved and/or significant risks
0	Requirements not achieved

*) The term **generally** indicates that more than ca. 3/4 of all stipulations are shown to be effectively achieved and, at most, a slight risk exists

The level of achievement E_{XY} of a process is calculated by:

$$E_{XY}\,[\%] = \frac{\text{Total points achieved for the 6 process characteristics}}{60} \times 100\%$$

7.2 Overall evaluation of the audit result

The following five processes are each evaluated separately:

- Project management E_{PM}
- Product development E_{DE}
- Suppliers / incoming material E_{SM}
- Production E_{PG}
- Processes after shipment E_{CS}

Here, the processes of product development, production and processes after shipment are broken down into several process steps, with their individual evaluations being combined into a mean value for the processes in question, before the overall achievement level E_P can be calculated. Here it must be borne in mind that different process steps can apply to different product groups.

For example, the mean value of all process steps E_{PG} for the production process, for each product group, is:

$$E_{PG}\,[\%] = \frac{E_1 + E_2 + \ldots\ldots E_n}{\text{Number of process steps evaluated}} \quad [\%]$$

The overall achievement level E_P for the process audit is calculated as follows:

$$E_P\,[\%] = \frac{E_{PM} + [E_{DE}] + E_{SM} + [E_{PG}] + [E_{CS}]}{\text{Number of processes evaluated}} \quad [\%]$$

In addition to this process evaluation the process characteristics across all processes can be evaluated in summary and displayed separately. In this way conclusions can be drawn on the effectiveness of the QM system.

E_{U1} [%]	Achievement of objectives across all processes
E_{U2} [%]	Quality of the inputs
E_{U3} [%]	Appropriateness of controls and procedures/methods
E_{U4} [%]	Qualification and capacity of personnel
E_{U5} [%]	Suitability and capacity of material resources
E_{U6} [%]	Improvement in efficiency

7.3 Classification

Classification	Level of achievement E_G [%]	Description of the classification
A	**$E_P \geq 90$**	**Quality-capable**
B	**$80 \leq E_P < 90$**	**Conditionally quality-capable**
C	**$E_P < 80$**	**Not quality-capable**

Rules covering downgrading

The following rules covering downgrading must be applied and documented in the audit report:

Reasons for downgrading from A to B despite an overall achievement level $E_P \geq 90\%$

- At least one process has an achievement level under 80%.
- The overall mean value of one of the process characteristics 1 to 5 (excluding E_U6) has an achievement level under 80%.
- At least one process characteristic with a decisive influence on product and/or process quality is assessed as zero points.
- The organisation (2nd tier) does not have a valid ISO 9001 certificate.
- The organisation (1st tier) does not have a valid VDA 6.4 certificate extension.

Reasons for downgrading from A or B to C despite an overall achievement level $E_P \geq 80\%$

- At least one process has an achievement level under 70%.
- The overall mean value of one of the process characteristics 1 to 5 (excluding E_U6) has an achievement level under er 70%.
- At least one process characteristic with a particularly high risk with regard to product and/or process quality is assessed as zero points

8 Closing discussion meeting

The closing discussion meeting, involving specified participants, is a résumé of all the points (positive and negative) noted in the course of the audit.

The auditor explains the audit result and points out where non-conformances or the potential for improvements exist. The results are justified and any immediate actions required are set out in writing.

All the non-conformances pointed out by the auditor must be included in an action plan and activities must be allocated to them. The timing deadline for completing the action plan must be stipulated. Support (advice) from the auditor is possible, in the form of a joint specification of the future systematic procedures to be followed.

In the course of the closing discussion meeting the auditor can determine the need for a follow-up audit and can note this in writing in the final report.

In the case of external audits, the audit report (see Section 10) is signed by the auditor and the representative of the audited area (for internal audits, the audit report is signed as specified). In signing the report, the representative of the audited area confirms that the results recorded have been discussed with him/her. He/she is free to point out his/her own findings.

9 Corrective actions and checks on effectiveness

9.1 Corrective actions

If non-conformances are detected, an action plan must be drawn up within an agreed period.

Basically, a differentiation is made between

- technical/organisational actions (e.g., changes in operations in production/the supply of services, logistics, changes in design or software)

and

- administrative actions (e.g., instructions, revision of documents)

Technical/organisational actions in the field of capable and controlled processes have priority.

The action plan (see Section 13) contains all activities, with responsibilities and completion dates required in order to eliminate non-conformances in the process.

Actions can also be process audits in upstream or downstream areas outside the process which has been audited.

The action plan can also include a follow-up audit as part of the verification of actions which have been carried out.

Essentially, responsibility for drawing up the action plan lies with the area which has been audited, including essential actions in adjacent areas. Support by the auditor can be provided in an appropriate manner, if the auditor agrees. However, this support must not take the form of consultancy, in order to prevent any threat to the independence of the auditor in the event of a possible follow-up audit.

9.2 Checks on effectiveness

The effectiveness of the agreed actions must be monitored, for example by

- random sample checks
- product audit
- process audit (Tpart-processes)
- intermediate status / degree of completion

The person responsible for the process is also responsible for the execution of the actions and monitoring them in terms of their effectiveness. If effectiveness cannot be proven adequately, the action plan must be revised. A follow-up audit may also be required.

A follow-up audit can be carried out as a complete audit with a completely new evaluation, or as a part-audit which examines the processes actually affected.

10 Audit report and documentation

The documentation includes all the documents involved, from the audit preparations to the final audit report and the action plan. The type of documentation is laid down in the quality management system.

The audit report (see Section 13) contains the following details:

- Persons responsible for the process/audit participants
- Process description (limitation) – e.g., product group
- Reason for the audit
- Presentation of the result; grading with justification
- Date for completion of thr action plan
- Audit questions which could not be evaluated or which were taken up additionally
- Explanations of each process characteristic evaluated at less than 10 points, with reference to applicable documents (with examples if appropriate)
- If appropriate, degree of completion of actions from the previous audit.

It is important that only those points which were covered during the audit and/or in the closing discussion meeting are described in the audit report.

Each non-conformance must be clearly described by reference to the list of requirements – for example, by:

- A requirement which is not achieved
- Findings (e.g., type of defect and ist location)
- Description of the problem

Particularly positive findings should be mentioned in the audit report. The distribution of audit reports and any management information extracted from it (e.g., monthly or quarterly information on internal/ external process audits) must be regulated internally, including archiving. The audited organisation is free to forward the results of the audit to other parties.

All information which the auditor obtains must be treated as confidential.

11 List of requirements for the process audit

11.1 Application

The list of requirements set out here represents a basis for the auditor. He/she can take parts of it for his/her own special audit and select characteristics/questions from it or expand certain aspects. However, the structure shown should be preserved.

It is advisable to create appropriate data stores for the generally formulated characteristics in VDA 6.7.

In a process audit the effect on the product is of particular importance and examination from the product stand-point is the primary consideration.

The list of requirements is broken down into:

1: Project management
2: Product development
3: Sourcing
4: Production
4.1: Process preparations
4.2 Manufacturing
5: Processes after shipment
5.1: Work-site
5.2: Service

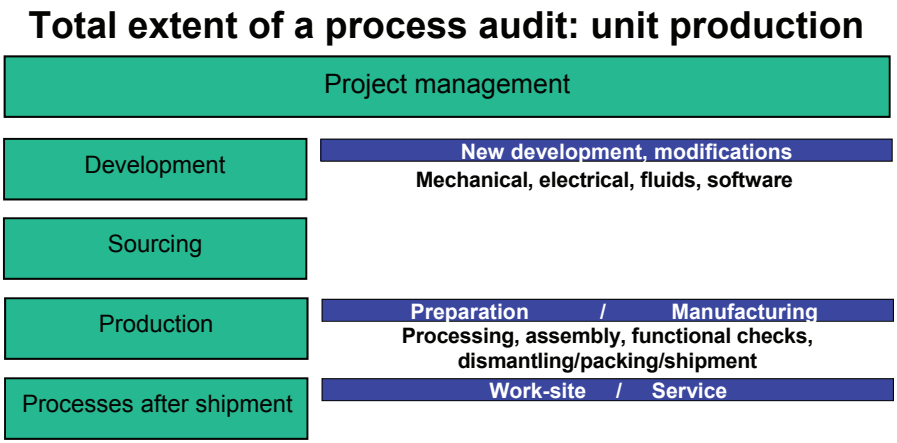


Fig. 4: Standard breakdown into processes

11.2 Structure

The list of requirements is broken down into:

- an introduction to each process
- the 6 process characteristics with requirements and explanations

The explanations provide information on aspects of particular significance, depending on the product/process. The relevant points in each instance must be assessed.

When evaluating the different process steps in the processes of development, production and processes after shipment, each process step must be given a separate title.

11.3 Process characteristics

Based on the process model (the turtle) developed by the IATF, each process and process step is examined from six stand-points. These are:

- Output / result / achievement of the objective
- Input / requirements
- Control / procedure / methods / execution
- Personnel resources
- Material resources
- Effectiveness

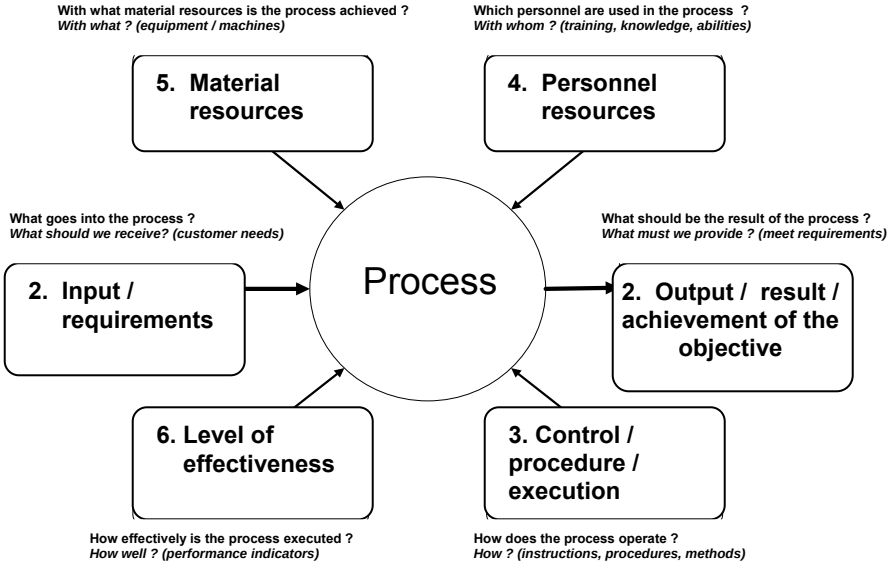


Fig. 5: The six characteristics in process evaluation

In general, the requirements and the risks are the crucial factors to be considered in the process evaluation.

All activities are based on the 4 steps in the planning cycle for product quality (plan, do, check, act).

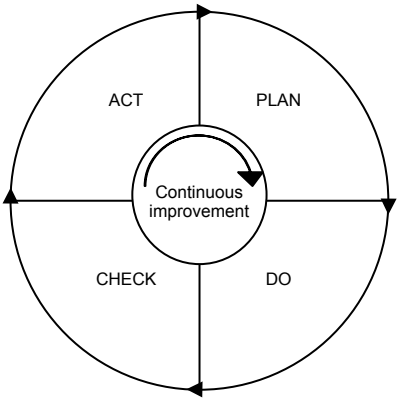


Fig. 6: The planning cycle according to Deming

Compliance with specified process sequences and target requirements must be monitored within the framework of an audit and the potential for improvement must be pointed out. Non-conformances and requirements associated with changes often result in altered target requirements.

Note: VDA publications 1, 2, 3, 4, 5 and 6 also apply and must be observed.

11.4 Requirements / explanations

Process 1: Project management

Customer-oriented operations in all internal and external processes are the key to the satisfaction of the external customer in terms of product quality, timing deadlines, prices and service. The management of the organisation must set the conditions for this in all processes. An important aspect in this regard is the minimizing of the project risk.

Comprehensive project management, from the acceptance of the contract to the final delivery of the product to the customer, including service, is crucial to the successful execution of a contract or project

Project management is a leadership instrument with the objective of executing the individual contract successfully. This requires the planning, control and decision-making processes to be defined, coordinated and managed in a direct form and on a cross-functional basis.

Inter-disciplinary cooperation, the controlled flow of information and responsible operation in all phases of the project are essential in achieving all the requirements involved in executing a contract and creating a product.

Project management accompanies all activities, from the initial enquiry, via receipt of the contract, to final acceptance by the customer (where appropriate, including the work-site and/or service). For complex contracts, products and sequences it is sensible to break operations down into part-projects.

1.1 Output / result / achievement of the objective

1.2 Input / requirements

1.3 Control / procedures / methods / execution

1.4 Personnel resources

1.5 Material resources

1.6 Effectiveness

1.1 Output / result / achievement of the objective

In creating the product to be manufactured it must be ensured that all internal and external requirements relating to the contract / project are met, in order to guarantee a high level of customer satisfaction and the achievement of internal objectives.

To ensure customer satisfaction, the supplier's first task is to fulfil the contract. In particular, this requires checks on:

- achievement of timing deadlines
- delivery quality
- customer service
- aligned test procedures and equipment

Proof that the requirements have been met is provided by checking the individual project phases (in accordance with the specified milestones) including acceptance checks by the customer.

1.2 Input / requirements

For project management the inputs consist of the external and internal requirements and stipulations relating to the product which is to be supplied.

It must be ensured that all essential stipulations can be met, both in the quotation phase and in the contract / execution phase (e.g., by checking against a check-list).

External and customer requirements

The customer's requirements are made up of contract-related and other, general demands:

- Requirements specification with availability, cycle times, deadlines
- Communication, data exchange, interfaces
- Customer's regulations regarding production facilities
- Standards, legislation, regulations

Internal requirements

Internal objectives must be laid down systematically for each project/ contract. The internal objectives can be divided into those which complement the customer's requirements and those relating to the sequence of the process. Consideration must be given, for example, to:

- Rules regarding the project organisation (requirements for issuing project reports / assessments (see Section 3)
- Stipulations regarding supplier management (e.g., the award strategy, make-or-buy)
- Project planning requirements (e.g., use of standard milestone plans)
- Calculation guidelines (e.g., carrying over quotation estimates into contract calculations)
- Financial target requirements
- Requirements regarding the project management process (e.g., execution times, personnel requirements)

1.3 Control / procedures / methods / execution

In project management, stipulations are required regarding process sequences and the control of interfaces to ensure the coordination of all those involved.

The size of the project team must be appropriate to the extent of the project. Depending on the scope and complexity of the project the supplier must decide whether additional, part-project managers are required. These must report to the main project manager. If work-sites are involved, a work-site manager must be appointed, to be present on site. In all cases the responsibilities within the project organisation must be laid down.

To achieve the project objective, the execution of a project must be controlled, using specified procedures. In the following text, consideration is given to:

- feasibility
- execution of the process
- corrections and corrective actions

Feasibility

Before the quotation is issued and both before and after accepting the contract, the external and internal requirements must be checked in inter-disciplinary cooperation for feasibility and possible risks. The requirements in the contract must be compared with those in the quotation and any necessary action must be taken.

Among other matters, consideration must be given to requirements regarding:

- development (design / method)
- quality
- process facilities (machinery/plant), capacity
- special characteristics
- life, availability, reliability, ease of maintenance
- the company's objectives
- regulations
- environmenta compatibility
- deadlines / time-frames
- capacity studies

Execution of the process

It is expected that project management will ensure customer service from the receipt of the contract, through to the commissioning and, if appropriate, the operation of the goods supplied. This means that a contact person (for the customer) must be available for all the customer's tasks and organisational areas. Where appropriate, reports must be supplied regularly and the customer's standard forms must be used. Furthermore, any outstanding points and lack of clarity in the project must be tackled actively and resolved without delay.

Items to be considered include:

- Protocols / notes on customer contactsn
- Determining customers' desires and generating associated actions
- Knowledge of the product application and product problems
- Improvement proposals
- Information if requirements are not achieved
- Information if work is sub-contracted
- Reports on the production status
- Expert advice; exchange of experience
- Accessibility; communication (e.g., languages)
- Regular meetings (video-conferening if appropriate)

- Agree on information and any actions to be taken (e.g., non-conforming requirements, drawings, regulations)
- Internet access to the customer

The project manager is responsible for planning and implementing the tasks in the project, as well as settling all internal and eternal technical questions. Items to be considered include:

- Project objectives / project plan with QM plan (project plan with milestones and quality-asurance activities)
- Planning of performance, timing deadlines, capacities, costs (where appropriate, making parts for customers)
- Controlling and monitoring all operations, including agreement on technical, timing and cost matters, as well as synchronisation with the customer's milestones
- Project cost controlling
- Use of employees and outside operators
- Consideration of risks (critical path)
- Technical risk consideration (e.g., risk analysis, FMEA)
- Organisation risk consideration (e.g., sub-contracting)
- Financial risk consideration

Effective monitoring of projects is based on comparisons between specified and actual results and is constantly up-dated, so that project managers can react flexibly to non-conformances or changes requested by the customer.

New requirements and/or corrections can affect execution, costs or timings (see VDA Band 4.3). Items to be considered include:

- Reports (e.g., of regular meetings)
- Change management
- Modifications to the project plan / QM plan (e.g., milestones, timings, resources)
- Documentation of the project history (time-sequences, decisions)

Planning for emergencies must be carried out to cover unplanned events in order to secure the project, through to securing production at the customer's premises. This must be based on a risk analysis, which will include:

- Loss of personnel
- Loss of supplier(s)
- Computer system failure
- Power failurel
- Machine failures
- Material damage; defective components
- Fire, storms, floods

Corrections and corrective actions

Defects and non-conformance with requirements and their peripheral conditions must be logged, corrections must be undertaken without delay and the relevant areas must be informed. The actions taken must be documented.

Aids in this regard include:

- Problem sheets; product folders
- The logging of extra work involved with problems/changes
- Know-how store (collected experience)
- Information to the area causing the problem

Appropriate corrective actions must be taken to prevent a recurrence of the problem – e.g., by changes to drawings, specifications, internal standards, etc.

1.4 Personnel resources

Sufficient personnel with the necessary abilities, knowledge and expertise must be available for project management.

Qualification

Employees and managers must be suited to carrying out the allotted tasks. Their qualification must be maintained. This can be demonstrated via training, instruction or experience.

Factors to be considered include:

- Management attitude, project leadership, teamwork
- Planning & control tools (e.g., MS Project)
- Quality techniques (e.g., project risk analysis, FMEAs, 8D Method)
- Foreign languages (areas of use, customer, suppliers)
- Evaluation methods (e.g., comparisons between specification against actual results, statistics, metrics)

Personnel must actively accept their responsibility for equipment and their surroundings.

This will be seen, for example, in terms of:

- Tidiness and cleanliness
- Dealing with material resources
- Maintaing and archiving the project documents

Motivation

The employees' motivation and readiness to perform must be encouraged by targeted information.

Items to be considered include:

- Quality information (specified and actual results)
- Improvement proposals
- Voluntary special action (training courses, quality circles)
- Company metrics
- Contribution to improved quality
- Self-assessment

Capacity

The personnel capacity required to manufacture the product must be planned and available.

Items to be considered include:

- Loadings
- Projects running in parallel
- Additional tasks
- Lack of personnel (holidays, absence)
- Suitable deputies
- Qualification matrix

1.5 Material resources

The organisation must provide adequate levels of necessary technical resources, equipment and facilities for project management. These are broken down into:

- Adequate means for carrying out the work
- Adequate apacities

Means for carrying out the work

Adequate facilities are required for tracking the project, making reports and documentation. The customer's demands must be taken into account here and these include:

- Premises
- Hardware (e.g., communication systems, computers)
- Software (e.g., MS Project, FMEA data bank, PP system)

Capacities

The resources must be available to a sufficient extent at the planned time:

- Up-to-date and functionally capable hardware and software (e.g., continuous innovation to the latest state of technology – up-dates)
- Licences for the use of software
- Assured readiness for use (care, maintenance, replacement)
- Resources for data security and strategy for emergencies
- Sub-contracting (e.g., out-sourcing of services)

1.6 Effectiveness

The following areas are of particular importance when judging the efficiency / effectiveness of the project management:

- Effective, economic and adequate execution
- Continuous improvement
- Process audits

Effective and adequate execution

The effectiveness of project management is measured by the work and effort expended in order to achieve the objectives at each project phase and for the overall project.

This is measured by appropriate metrics at the various milestones and at the end of the project. Factors include:

Time

- Overall execution time
- Processing time
- Non-conformance with delivery times
- Time at the work-site

Resources

- Financial results
- Personnel requirements
- Material requirements

Quality

- Achievement of the project plan
- Number of changes caused by the supplier
- What was good and what was bad
- Number of interfaces
- Repeatability
- Proportion of standard components used

In order to assess the metrics, objectives and reference dimensions must be documented. These are derived from the customer's requirements and/or from previous experience.

Continuous improvement

The analysis of the effectiveness of project management leads to the identification of potential for improvement.

These must be put into effect on a cross-project basis with the aid of appropriate improvement programmes. This will involve the use of the following sources of information:

- Reports (e.g., reports at the conclusion of the project)
- Protocols of meetings (e.g., milestones, presentations, reviews)
- Improvements to operations, project duration, run-through times, correction loops
- Asking questions of customers; customer complaints
- Cost-changes (calculations as the project progresses)
- Experience, project knowledge, knowledge data bank
- Certification audits, system audits, process audits, product audits

Audits

An audit makes it possible to determine how efficient the process of project management is and where there is potential for improvement. The organisation audits the process of project management regularly and this includes checks on the extent to which improvement actions which have been taken are effective.

Other reasons for carrying out an audit include:

- Projects with significant risks
- Non-compliance with quality requirements (internal/external)

Audit reports must be forwarded to the persons with responsibility. Corrective and improvement actions must be monitored.

Process 2: Product development

As early as the quotation phase, development requirements for a new or modified product will exist as a result of the customer's requirements, national / international legislation and crucial in-house requirements. These must be established in concrete form following acceptance of the contract and incorporated in a product development plan and a quality management plan (QM plan). The QM plan should be an integral part of the product development plan.

The product development/QM plan must state all the essential tasks, as well as attainable targets and timings. Neither of the plans must contradict the project plan.

The requirements for a product are often more comprehensive than stated in the customer's requirements. Because of this, customer requirements and products of the organisation must be analysed in detail, in order to derive the necessary internal requirements. A continuous re-examination of all requirements may lead to the need for changes in the course of the planning phase.

2.1 Output / result / achievement of the objective

2.2 Input / requirements

2.3 Control / procedures / methods / execution

2.4 Personnel resources

2.5 Material resources

2.6 Effectiveness

2.1 Output / result / achievement of the objective

The product to be developed, with all its parts and components, must meet all internal and external requirements. This is demonstrated by positive results from internal and external checks, as well as the relevant requirements documents:

- Performance requirements specification
- Specifications, drawings, parts lists
- Results of trials with prototypes, components,...
- Product documentation

2.2 Input / requirements

Inputs to the product development process include external requirements (e.g., the contract, customer's specifications, etc.) and internal stipulations (e.g., the quotation, standards, factory standards, target requirements). These are summarized and listed in the performance specification drawn up by the supplier.

2.3 Control / procedures / methods / execution

The product development process is controlled via the product development plan (and, where appropriate, an independent QM plan). Intermediate checks are made at the various milestones (e.g., design, sourcing, manufacturing and delivery releases). Where necessary, corrections are made in order to achieve the development objective.

The organisation unit handling the product development must draw up the product development plan as part of the project plan. This department bears responsibility for all development activities, including those which are out-sourced.

All quality assurance activities regarding product development (including components and sub-assemblies) must be specified (in the product development plan or in the independent QM plan for the product development) and must be constantly up-dated.

All the points from the inputs (see 2.2) must be taken into account. Additional acceptance criteria may be a further matter.

The product development plan includes important matters such as:

- Methods
- Standardisation
- Design FMEA

Methods

Development to the latest state of technology and knowledge demands the use of appropriate methods and systems. These include:

- Finite element method (FEM)
- Design of experiments (DOE)
- Statistical methods (regression...)
- Simulation
- Computer-aided design (CAD, CAE, CAM)

Standardisation

In the interests of economy, the control of risks, rapid contract processing and also ease of maintenance, the organisation must standardise the structure and components of its products and design solutions.

Items to be considered include:

- internal / external standards
- experience from previous projects
- robust design, secure processes
- data from the usage phase

Design FMEA

Inter-disciplinary cooperation, including with customers and suppliers, must be applied in order to identify product risks, assess them and reduce them constantly by appropriate actions. The effectiveness of the actions is revealed by fresh assessments showing lower levels of risk. Essentially, the use of a System FMEA is useful (see VDA Band 4).

Items to be considered (where relevant) include:

- customer requirements / requirements specification / performance specification
- Data from the usage phase for similar products
- Function, safety, reliability, ease of maintenance
- Environmental aspects
- Results of tests and trials
- Product-specific action from the customer's and the organisation's Process FMEAs

Corrections and corrective actions

Defects and non-conformance with requirements and their peripheral conditions must be logged, corrections must be undertaken without delay and the relevant areas must be informed. The actions taken must be documented.

Aids in this regard include:

- Problem sheets; product folders
- The logging of extra work involved with problems/changes
- Know-how store (collected experience)
- Information to the area causing the problem

Appropriate corrective actions must be taken to prevent a recurrence of the problem – e.g., by changes to drawings, specifications, internal standards, etc.

2.4 Personnel resources

Sufficient personnel with the necessary abilities, knowledge and expertise must be available for the product development process.

Qualification

Employees and managers must be suited to carrying out the allotted tasks. Their qualification must be maintained. This can be demonstrated via training, instruction or experience.

Items to be considered include:

- Knowledge of CAD, CAM and CAE
- Product / specifications / special customer requirements
- Standards / legislation
- Design methods, simulation
- Manufacturing procedures, assembly, transport
- Foreign langaues
- Quality techniques (e.g., value analysis, FMEA, 8D Method)
- Leadership, project management, teamwork

Personnel must actively accept their responsibility for equipment and their surroundings.

This will be seen, for example, in terms of:

- Tidiness and cleanliness
- Dealing with material resources
- Maintaing and archiving the project documents

Motivation

The employees' motivation and readiness to perform must be encouraged by targeted information.

Items to be considered include:

- Quality information (specified and actual results)
- Improvement proposals
- Voluntary special action (training course, quality circles)
- Company metrics
- Contribution to improved quality
- Self-assessment

Capacity

The personnel capacity required to manufacture the product must be planned and available. Items to be considered include:

- Loadings
- Projects running in parallel
- Additional tasks
- Lack of personnel (holidays, absence)
- Suitable deputies
- Qualification matrix

2.5 Material resources

The organisation must demonstrably provide the necessary technical aids, equipment and facilities for the manufacturing process to the extent required and in the appropriate condition.

Consideration must be given to:

- premises
- work-places
- tidiness and cleanliness
- hardware (e.g., communications equipment, computers)
- software (e.g., MS Project, FMEA data bank, PP sSystem, CAD, CAM, CAE (CATIA, ProE,...)
- simulation (EM planner, ROBCAD, Autoform...)
- licences for the use of software
- ensuring readiness for use (care, maintenance, replacement)
- data storage resources
- test, inspection and laboratory facilities
- sub-contracting (including out-sourcing of services)

The associated evidence of qualification must be provided.

2.6 Effectiveness

The level of effectiveness of the product development must be evaluated with the appropriate metrics, such as:

Time

- Overall execution time
- Processing time
- Achievement of milestones

Resources

- Compliance with budget
- Personal requirements
- Material requirements

Quality

- The number of correction loops
- Compliance with specified timings
- Complaints from downstream processes
- Compliance with the performance specification
- Number of changes caused by the organisation
- Percentage of standard components used

In order to assess the metrics, objectives and reference dimensions must be documented. These are derived from the customer's requirements and/or from previous experience.

Improvement actions

The potential for improvements must be determined. Sources of information include process metrics, proposals for improvement by the work-force and management programmes. Improvement actions must be generated and implemented.

Audits

The product development process must be audited regularly in order to identify potential for improvements. Improvement actions which have been carried out must be checked for effectiveness.

Other reasons for carrying out an audit include:

- New projects / processes / products
- Non-compliance with quality requirements (internal/external)
- Evidence of compliance with quality requirements
- Significant changes to peripheral conditions

Process 3: Sourcing

The customer's need for shorter delivery times makes special activities necessary in the individual processes. These include the use of standard materials and components and the continuous reduction of through-times. This makes a problem-free organisational system essential, since defects and any delivery deficiencies can rarely be balanced by falling back on alternative parts or materials. Problems with quantities or logistics result directly to breaks in production if minimum or no intermediate stocks are held.

The organisation therefore has the responsibility and the obligation to work with its suppliers of products, materials and services, to ensure the security of the associated processes and procedures, together with the process capability of all customer-relevant significant characteristics. In-house process and product audits are essential in this regard. The effectiveness of specified quality assurance actions to achieve continuous improvement must be demonstrated.

3.1 Output / result / achievement of the objective

3.2 Input / requirements

3.3 Control / procedures / methods / execution

3.4 Personnel resources

3.5 Material resources

3.6 Effectiveness

3.1 Output / result / achievement of the objective

The organisation must receive products and services to the agreed quality and must monitor the quality performance and capability of its suppliers.

Agreed quality

Acceptance checks and an official release must be issued for all deliveries (including services) made by a supplier, before new or modified products (including new processes) can be introduced.

These checks must cover all out-sourced goods and services – e.g., materials, parts, components, models, tools for one or more operations, design activities and software.

Items to be considered include:

- Informing the customer of sub-contracting
- Acceptance checks / releases for:
  - design, simulation, methods plan
  - build samples, trials, transport (e.g., hauliers)
  - external process operations/work; laboratory checks
  - acceptance of complete plant components/tools
  - software for control and evaluation purposes
- Evaluation of reliability
- Evidence of capability of significant characteristics (if relevant)
- Compliance with safety data sheets, EU standards
- Adequate checking & inspection facilities (internal/external laboratory and measurement equipment),
- Gauges and fixtures provided by the customer
- Drawings/order requirements/specifications/material test certificates
- QA agreements
- Agreement on test/inspection procedures, sequences & frequencies
- Evaluation of main areas of defects

Quality performance and capability

The quality capability of a supplier must be checked at reasonable intervals. The quality performance must be evaluated continuously. Both results must be kept up-to-date in records (supplier listing).

3.2 Input / requirements

At the time the contract is issued, all requirements relating to the products (and/or services) to be supplied must be known and taken into account, including all peripheral conditions.

These are covered, for example, by the following:

- Quality requirements
- Legislation, standards, specifications
- Tining plans
- Drawings
- Material specifications
- Test/inspection procedures

3.3 Control / procedures / methods / execution

The organisation department responsible for sourcing has the task of determining the need for products, materials and services which need to be obtained and making sure they are available at the right time, to the correct quality. This is done in cooperation with the other functional departments in the organisation. The basis for this is provided by the technical documents (drawings, parts lists, …) and the milestones (timing dates) in the project plan. This basic task expands to cover detailed requirements regarding ordering procedures, material purchasing, logistics and quality. These must be controlled and specified, depending on the organisation structure, to guarantee problem-free operations.

Approval / release for suppliers and products

Products and services must be obtained only from suppliers whose performance capability has been checked and approved.

Approval / release can be issued on the basis of:

- an evaluation of quality capability – for example, from audit results or certificates
- a quality assessment of the production facilities employed or checked references (e.g., performance evaluation by customers)
- supplier meetings; regular service
- an evaluation of quality performance (quality, costs, service)

Acceptance checks and an official release must be issued for all bought-in products (including services) before new or modified products (including new processes) can be introduced.

These checks must cover all bought-in goods and services – e.g., materials, parts, components, models, tools, out-sourced operations, design activities, software, etc..

In addition, items to be considered include:

- Informing the customer of sub-contracting
- Acceptance checks / releases for:
  - design, simulation, methods plan
  - build samples, trials, transport (e.g., hauliers)
  - external process operations/work; laboratory checks
  - acceptance of complete plant components/tools
  - software for control and evaluation purposes
- Evaluation of reliability
- Evidence of capability of significant characteristics (if relevant)
- Compliance with safety data sheets, EU standards
- Adequate checking & inspection facilities (internal/external laboratory and measurement equipment),
- Gauges and fixtures provided by the customer
- Drawings/order requirements/specifications/material test certificates
- QA agreements
- Agreement on test/inspection procedures, sequences & frequencies

Order quantities, stock-levels and storage

The order quantities for incoming parts and materials (related to demand) must be determined in the earliest planning stage and adapted if changes occur. Stores capacity, storage conditions and stores systems must be planned for the project-related quantities calculated in this way.

Items to be considered include:

- customer requirements
- KANBAN/Just in time
- strategy for emergencies to cover incoming material bottlenecks
- FIFO (first in first out)
- stores administration system
- cleanliness and tidiness
- packiung
- climatic conditions
- protection against damage, contamination, corrosion
- identification (for traceability, inspection status/work sequence/usage status)
- protection against mixing
- quarantine stores (to be set up and used)

Corrections and correction actions

Defects and non-conformance with requirements and their peripheral conditions must be logged, corrections must be undertaken without delay and the relevant areas must be informed. The actions taken must be documented.

Aids in this regard include:

- Problem sheets; product folders
- The logging of extra work involved with problems/changes
- Know-how store (collected experience)
- Information to the area causing the problem
- Reject reports

A recurrence of the problem must be prevented by an analysis of the cause of the failure by the department responsible, followed by appropriate corrective actions – for example:

- changes to drawings, specifications, internal standards and procedures
- process improvements by the supplier

If non-comformances apply to a supplier, qualification actions must be agreed and monitored.

Products provided by the customer

The procedures agreed with the customer regarding products provided by the customer must be complied with. Requirements relating to such products must be taken from the quality agreements and applied in a responsible manner. Products provided by the customer can include:

- services
- tools; test/inspection equipment
- packing; transport containers
- (upstream) products

The following must be considered when handling such products:

- Control, verification, storage, transport, maintaining the quality and characteristics of the products (use-by dates)
- Flow of information in the cae of deficits or losses
- Quality records (quality situation; quality history)

3.4 Personnel resources

Sufficient personnel with the necessary abilities, knowledge and expertise must be available for the sourcing process.

Qualification

Employees and managers must be suited to carrying out the allotted tasks. Their qualification must be maintained. This can be demonstrated via training, instruction or experience.

Items to be considered include:

- Methods for selecting, evaluating and qualifying suppliers
- Logistics planning, stores management
- Product / specifications / special customer requirements
- Standards / national regulations
- Process operations
- Planning and control tools (e.g., MS Project)
- Evaluation methods (e.g., comparisons between specification against actual results, statistics, metrics)
- Foreign languages (areas of use, customer, suppliers)

Personnel must actively accept their responsibility for equipment and their surroundings.

This will be seen, for example, in terms of:

- Tidiness and cleanliness
- Dealing with material resources
- Maintaing and archiving the project documents

Motivation

The employees' motivation and readiness to perform must be encouraged by targeted information.

Items to be considered include:

- Quality information (specified and actual results)
- Improvement proposals
- Voluntary special action (training course, quality circles)
- Company metrics
- Contribution to improved quality
- Self-assessment

Capacity

The personnel capacity required to manufacture the product must be planned and available.

Items to be considered include:

- Loadings
- Projects running in parallel
- Additional tasks
- Lack of personnel (holidays, absence)
- Suitable deputies
- Qualification matrix
- Agreement with suppliers

3.5 Material resources

The organisation must demonstrably provide the necessary technical aids, equipment and facilities for the manufacturing process to the extent required and in the appropriate condition.

Consideration must be given to:

- Premises, including stores
- Equipment for taking materials into stores
- work-places
- tidiness and cleanliness
- hardware (e.g., communications equipment, computers)
- software (e.g., MS Project, PP system)
- licences for the use of software
- ensuring readiness for use (care, maintenance, replacement)
- data storage resources
- sub-contracting (including bought-in items and out-sourcing services)

3.6 Effectiveness

The following methods are used in particular to evaluate and improve economic and appropriate sourcing:

- Determining process metrics
- Improvement actions
- Process audits

Determining process metrics

The effectiveness of the sourcing process is evaluated, using appropriate metrics, such as:

Time

- Overall execution time
- Processing time
- Compliance with order timings

Resources

- Compliance with budget
- Personal requirements
- Material requirements

Quality

- The supplier's quality performance
- The supplier's quality capability
- Ordees handled wrongly
- Timely deliveries
- Stock levels; stock turnover frequency

In order to assess the metrics, objectives and reference dimensions must be documented. These are derived from the customer's requirements and/or from previous experience.

Improvement actions

The potential for improvement must be obtained from the process metrics. Information gained and problem areas must be allocated to the departments responsible, including suppliers. These must then generate and implement improvement actions.

Audits

The sourcing process must be audited regularly in order to identify potential for improvement. Improvement actions which have been implemented must be checked for effectiveness.

Other reasons for carrying out an audit include:

- New projects / processes / products
- Non-compliance with quality requirements (internal/external)
- Evidence of compliance with quality requirements
- Significant changes to peripheral conditions

Process audits at suppliers' premises should also be used to identify further potential for improvement.

Process 4: Production

Quality performance is determined by man, machine, material, method, management and the environment. The responsibility which operators bear must be characterized by their independent ability to detect problems and defects in the product and process., Actions to achieve improvements must be initiated and implemented on their own responsibility.

In the individual process steps in the manufacture of a product, the technical and personnel resources, procedures and sequences which have been planned must be monitored, maintained and continuously improved, taking account of economic aspects. In this process, points of particular emphasis are the qualification of operators, the suitability and improvement of process and test/inspection equipment, as well as the appropriate storage and transport of the parts, components and assemblies to be produced.

The basis for all activities is the customer's requirements for each product and these may change as the contract carries on to its conclusion. All changes must be taken into account at the earliest possible stage and flow into the individual processes.

The customer's demand for **zero defects** and the constant striving for improvements must run as a guiding thread through all the various process steps. The management of the organisation must provide the necessary conditions for this.

Good customer-supplier relationships must be established and demonstrated at the seams of the internal processes. A high level of independent responsibility must therefore be transferred to teamwork and the personnel in the various process operations.

The customer must be informed of any sub-contracting of complete (part) products such as tools, test/inspection equipment and machines, or changes in the manufacture of the products. The customer can then decide to what extent additional qualification actions or new approvals/releases are necessary (see also VDA Band 2).

4.1 Process preparations (for each process step)

As early as the quotation stage, preparations must be made and implemented for the manufacture of a product on the basis of the customer's requirements. Once the contract has been accepted, these preparations are then put into concrete form and established in a production process development plan (production plan). As a general rule this will also include the stipulations of the quality management plan (QM plan). The technical and personnel resources available must be taken into account and any extra capacity must be planned in advance.

In establishing all the tasks, targets and timing dates in concrete form, all interface areas must be included with the inter-disciplinary cooperation of all areas. All tasks and responsibilities must be clearly laid down.

When preparing manufacturing processes or innovations to these, changes in the customer's requirements or national regulations may require changes to be made and these may necessitate a fresh examination of the existing planning launch-pads.

A high level of requirements regarding qualification and performance is placed on all personnel involved in the project/contract. Their considered contribution to the preparation of the production process is essential in order to meet the customer's requirements by manufacturing to a high quality level.

4.1.1 Output / result / achievement of the objective

4.1.2 Input / requirements

4.1.3 Control / procedures / methods / execution

4.1.4 Personnel resources

4.1.5 Material resources

4.1.6 Effectiveness

4.1.1 Output / result / achievement of the objective

The result of the preparations for the production process is the production control plan, together with the planning of personnel and technical resources (quality and capacity).

Production control pan (production plan with QM plan)

The production control plan lays down all the manufacturing and checking activities (QM plan) through to the completion of the production facilities and, where applicable, the work-site. The target requirements must be derived from the requirements relating to the product and included in the various process steps. As a general principle, process parameters and test/inspection characteristics must be provided with tolerances.

The production control plan must cover the process operations for the manufacture of all parts, components, sub-assemblies and assemblies contained in the end-product. The production control plan is a living document and must be renewed/revised if new or modified products or processes occur. Items to consider include:

- The customer's requirements / acceptance criteria
- Setting and monitoring of objectives
- Capacities, machine & assembly operations, through-times
- The need for processing tools and personnel
- Timing deadlines; releases
- Security concept for changes (launch problems, etc.)
- Logistics/delivery concept
- The extent of checks/test/inspection and their timings – e.g., internal final inspection/pre-checking by the customer/acceptance at the customer's premises
- Provision/costs of equipment, checking facilities, measurement technology

Personnel and technical requirements

The personnel and technical capacities required must be determined and considered at the quotation phase. These data must be confirmed following receipt of the contract. If requirements have changed, the data may need to be up-dated. Essential facilities and qualified personnel must be planned and provided.

Other items to be considered include:

- Production/checking equipment, tools, auxiliary tools, laboratory facilities
- Simulation points, NC programming points in the productionarea
- Buildings; premises
- Transport equipment, con tainers, stores
- Interfaces; comprehensive data availability
- Availability of incoming materials & bought-in parts
- Machine/assembly occupancy
- Down-times
- Through-times, work analyses/time studies (MTM, Refa)

4.1.2 Input / requirements

All requirements relating to the product to be manufactured (production facilities) must be known and must be included in the planning.

Among other factors, these arise from:

- Customer requriements
- National requirements
- Internal and external standards
- The supplier's performance specification
- Logistics requirements
- Delivery conditions
- Waste disposal; environmental protection

4.1.3 Control / procedures / methods / execution

Process preparations have the task of generating the production control plan from the performance specification, parts lists and other requirements, together with technical and personnel requirements. These activities are controlled by the production process development plan (a detailed section within the project plan). The extent and detailing depend on the complexity of the production process. In the simplest case the production process development plan is the same as the relevant section of the project plan.

In all cases, a risk analysis is an important part of process preparations.

Depending on the division of tasks in the organisation, NC programs and simulations are part of the production process preparation. NC programs must be clearly identified (e.g., with the change level of the part to be processed).

Risk analysis

Process risks must be identified with inter-disciplinary cooperation (including the customer and suppliers) and must be reduced, using appropriate action. The effectiveness of the action must be demonstrated.

The Process FMEA is used to analyse the technical process risks. This includes consideration of the following:

- All production operations, including those of suppliers
- Customer requirements; function
- Significant parameters/characteristics
- Traceability; environmental aspects
- Transport (internal/external)
- Process-specific actions from the Design FMEA

In addition, the organisational risks (unplanned events such as power failures, etc…) must be evaluated and appropriate action must be planned.

Corrections and corrective actions

Defects must be eliminated immediately and the departments responsible must be informed. Any recurrence must be prevented by appropriate action. It is essential to carry out a systematic analysis of defects by:

- Pareto analysis
- Cause & effect diagrams
- 8D method

4.1.4 Personnel resources

Adequate numbers of personnel with the necssary qualifications and experience must be available for the production process preparations.

Qualification

Requirements relating to the personnel to be employed must be determined. Appropriately qualified personnel must be made available and must maintain their qualification. The qualification can be demonstrated by training, instructions or experience from previous projects.

Items to be considered include .:

- Logistics planning, stores management
- Product/specifications/special customer requirements
- Standards; legislation
- Processing and assembly procedures
- Data processing (CAD; CAM, PPS, NC programs, MS-Project)
- Knowledge of the project
- Knowledge of the flow of information (internal, external)
- Quality techniques (FMEA, analysis methods)
- Time studies (Refa)

Personnel must actively accept their responsibility for working equipment and the working environment.

Capacities

Personnel with suitable qualifications must be available to meet the needs of process preparations. Items to be considered include:

- loadings
- Projects running in parallel
- Additional tasks
- Lack of personnel (holidays, absence)
- Suitable deputies
- Agreement with suppliers

4.1.5 Material resources

The company must provide appropriate levels of technical facilities, equipment and fixtures required for the process preparations, including capacity and any necessary licences.

Items to be considered include:

- Hardware (e.g., communication facilities, computers)
- Software (project planning system, FMEA data bank, …)
- Check-lists
- Premises, including stores if relevant
- Secure availability (care, maintenance, replacement)

4.1.6 Effectiveness

The following factors are of particular importance when evaluating and improving the economic and effective execution of the process preparations:

- Determination of process metrics
- Improvement actions
- Innovations in the process
- Process audits

Determining process metrics

The effectiveness of process preparations is constantly evaluated at the milestones (if these are included) and finally judged with appropriate metrics, such as:

Time

- Through-times
- Processing times

Resources

- Compliance with budget
- Personnel employed

Quality

- Number of correction loops
- Compliance with specified timing deadlines
- Complaints from downstream processes
- Efficiency of the production control plan

In order to assess the metrics, reference dimensions and targets must be specified, derived from the customer's requirements and/or experience from previous projects.

Improvement actions

The potential for improvements must be obtained from the process metrics. Items and problem areas detected must be allocated to the departments responsible and these departments must generate and implement improvement actions.

Innovation

The manufacturing processes are developed further by innovation. Inter-disciplinary cooperation and benchmarking are used to determine requirements relating to the processes. QFD and DoE are typical methods here. Previous experience and forward-looking expectations such as standardisation must be included in the examination. New production procedures in the manufacturing process must be appropriate to market demands and customer expectations. The manufacturing process must be competitive.

Items to be considered include:

- Customer requirements; market demands
- Company objectives
- Simultaneous engineering
- Robust design/secure process
- Significant characteristics; legal requirements
- Benchmarking, research projects
- Production process development plan

Audits

Audits make it possible to judge the efficiency of the production process preparations and what potential for improvement exists. The process must be audited regularly. This must include checks to determine to what extent improvement actions which have been implemented are effectives.

Other reasons for carrying out an audit include:

- New projects / processes / products
- Non-compliance with quality requirements (internal/external)
- Evidence of compliance with quality requirements
- Significant changes to peripheral conditions

4.2 Manufacturing (each process step)

Selecting employees with qualifications appropriate to the work to be carried out, maintaining their qualifications and training them for other activities are management tasks. Evidence must be provided of the qualification of employees for the tasks which they undertake in terms of product and process.

Employees must be aware of the customer's requirements and quality objectives. Within limits clearly defined by management, the tasks with which they are entrusted must enable them to recognize their own responsibility for quality.

Adequately qualified personnel must be employed for all processes. Deputies for individual processes must be arranged – here again, qualified personnel must be available.

It must be possible to achieve the quality requirements for the product with the production facilities employed. The specified suitability of the process must be achieved and maintained.

The continuing suitability of machines, etc. must be checked following conversion, repair and replacement. Work and test/inspection areas must be suitably equipped. For each new contract/project, each individual process must be checked and release before starting. Quality and process data must be recorded to enable continuous improvements to be generated.

Production operations must be aligned with each other. It must be possible to identify the manufacturing and inspection status of the parts at all times.

Storage and transport facilities throughout the entire process chain must be appropriate for the parts/components/assemblies in question. They must not be able to cause damage in any way.

During long periods out of use, tools, production and test/inspection equipment must be adequately conserved and stored so that they are not damaged.

4.2.1 Output / result / achievement of the objective

4.2.2 Input / requirements

4.2.3 Control / procedures / methods / execution

4.2.4 Personnel resources

4.2.5 Material resources

4.2.6 Effectiveness

4.2.1 Output / result / achievement of the objective

The manufactured product (parts, components, end-product) must meet all internal and external requirements at the specified times. Evidence that the requirements have been met is provided by test / inspection.

4.2.2 Input / requirements

On the one hand, the inputs for the manufacturing process are the results of the product development and the production process preparations; on the other they arise from the bought-in materials and services.

4.2.3 Control / procedures / methods / execution

Control of the manufacturing process is carried out with reference to the following main points of emphasis:

- Execution and control
- Release and monitoring
- Corrections and corrective actions

Executing the process

The process is executed in all respects in accordance with the production control plan, including all the specified intermediate and final checks and inspection.

Production and test/inspection documents must be available at the work-stations. They must contain details regarding:

- Process parameters (e.g., pressures, temperatures, tikmes, rev. speeds)
- Machines, tools, clamps and other aids
- NC programs
- Test/inspection characteristics, equipment and methods
- Setting plans

The flow of materials and parts must be secured against mixing or incorrect identification. Points to be observed, where applicable, are

- Parts identification
- Identification of the production, inspection and application status
- Batch identification and use-by date
- Workingdocuments with parts / production master date

Depending on the product risk, traceability must be assured over the entire process chain, from supplier to the end-customer.

Releasing and monitoring the process

Before production begins, a release must be issued for the overall process, its work operations and the production facilities. The release must be carried out by authorized employees in accordance with specified rules and with demonstrable results. The release operations must include:

- Machine suitability checks / machine approval
- NC programs; production control plan
- Tools (e.g., tool settings; manual assembly devices), jigs, transport facilities)
- Measurement and test/inspection equipment
- Process breaks (e.g., for reepairs, maintenance and changes)

Compliance with quality requirements must be monitored during production. Appropriate responsibilities must be specified.

Monitoring must include checks on the following:

- Process control (e.g., NC program corrections; rework)
- Checks/inspection; quarantining; releases
- Data logging (test/inspection results; production data)
- Storage, handling, identification

Corrections and corrective actions

Defects and their peripheral conditions must be logged. Corrections must be implemented immediately and the departments responsible must be informed. The actions taken must be documented.

Aids in this regard include:

- Problem sheets; product folders
- The logging of extra work involved with problems/changes
- Know-how store (collected experience)
- Information to the area causing the problem

Appropriate corrective actions must be taken to prevent a recurrence of the problem – e.g., by changes to:

- drawings, specifications, internal standards
- production control plans
- NC programs, machine setting data

4.2.4 Personnel resources

Adequate personnel with the necessary abilities and experience must be available for the manufacturing process.

Qualification

Employees and managers must be suited to carrying out the allotted tasks. Their qualification must be maintained. This can be demonstrated via training, instruction or experience.

Factors to be considered include:

- manufacturing procedures; process requirements
- product specifications
- health & safety at work; environmental aspects
- evidence of suitability (e.g., welding certificate, eye tests, driving licence for internal transport vehicles)
- experience in dealing with defects

Personnel must actively accept their responsibility for production equipment and the production environment.

This can be detected, for example, by:

- tidiness and cleanliness
- the handling of materials and material resources (TPM)
- provision and storage of parts; transport equipment
- the handling of test/inspection and measurement equipment

Motivation

The employees' motivation and readiness to perform must be encouraged by targeted information.

Items to be considered include:

- Quality information (specified and actual results)
- Improvement proposals
- Voluntary special action (training courses, quality circles)
- Company metrics
- Contribution to improved quality
- Self-assessment

Capacity

The personnel capacity required to manufacture the product must be planned and available.

Items to be considered include:

- Loadings
- Projects running in parallel
- Additional tasks
- Lack of personnel (holidays, absence)
- Suitable deputies
- Qualification matrix

4.2.5 Material resources

The organisation must demonstrably provide the necessary technical aids, equipment and facilities for the manufacturing process to the extent required and in the appropriate condition.

Consideration must be given to:

- production facilities (machines, tools, jigs & fixtures, other aids)
- work-places
- test/inspection stations and equipment
- transport equipment
- premises, storage areas, environmental conditions
- overhaul and maintenance equipment
- ensuring readiness for use (care, maintenance, replacement)
- tidiness and cleanliness

The associated proof of qualification must be available.

4.2.6 Effectiveness

The following factors are particularly important when assessing and improving the economic and effective execution of the manufacturing process:

- determining the process metrics
- Improvement actions
- Process audits

Determining the process metrics

The effectiveness of the production process must be evaluated, using the appropriate metrics, such as:

Time

- Through-times
- Processing times
- Down-times

Resources

- Compliance with budget
- Use of personnel
- Use of materials

Quality

- The number of correction loops
- Compliance with specified timings
- Scrap, rework
- Complaints from downstream processes

In order to assess the metrics, objectives and reference dimensions must be documented. These are derived from the production control plan, general internal objectives and from previous experience.

Improvement actions

The potential for improvements must be determined. Sources of information include process metrics, proposals for improvement by the work-force and management programmes. Improvement actions must be generated and implemented.

Audits

Manufacturing processes and products must be audited regularly in order to identify the potential for improvements. Improvement actions which have been carried out must be checked for effectiveness.

Other reasons for carrying out an audit include:

- New projects / processes / products
- Non-compliance with quality requirements (internal/external)
- Evidence of compliance with quality requirements
- Significant changes to peripheral conditions

Process 5: Processes after shipment (structure, commissioning, warranty, service)

The commissioning process covers the disassembly (if necessary) of the product, its packing and its transport. On arrival at the customer's premises it is re-assembled (if necessary), installed and put into operation, so that the customer can carry out acceptance checks and finally accept the product.

Depending on the type, size and complexity of the production equipment, various procedures are required at the maker's premises following manufacture and initial testing. Many kinds of production equipment (e.g., standard test/inspection equipment) can be given initial checks and inspection and then delivered to the customer and put into operation. Other products need to be run in and adjusted as necessary before they can be delivered (e.g., forming tools).

With large, complex production equipment (plant, production lines, etc.) there is the extra complication that they do not exist as fully assembled systems; they have been constructed only as pilot systems or as part-components before being partly or fully disassembled again before being delivered to the customer, where they are re-assembled (or fully assembled for the first time). This may require changes to be made.

The customer has the right to expect products free from defects, which meet all his requirements (zero defects) for the entire life of the product (production equipment). This includes service for the production equipment after it has been accepted (at the customer's premises and, if appropriate, by the customer) so that any deviations from the customer's requirements can be detected at an early stage. Appropriate improvement actions can then be carried out for the current and any future projects in order to regain / maintain customer satisfaction and permit further development of the customer's own products.

This refers in particular to the characteristics of availability, reliability, ease of maintenance and maintenance costs. The customer service function is key in measuring customer satisfaction and is therefore a means of measuring active supplier involvement.

The customer service function must be manned with qualified personnel and be able to introduce improvements at all levels and in all areas of the company.

The company must ensure that there is a prompt reaction to quality problems and that parts are available in accordance with the customer's quality requirements.

For this reason, customer service extends over the entire life of the product, starting from the initial request for quotation.

5.1 Work site

The "work site" at the customer's premises (where the product is assembled, installed and put into operation) is the final link in the supply chain. This is where the actual final assembly and final checks/inspection of the production equipment are usually carried out. Information and facilities must be ready and available in order to carry out the on-site work in accordance with the contract.

Framework planning for these operations is carried out as part of project management (see Section 4.1). The personnel at the work site, the procedures and equipment and the operating conditions must enable the work to be completed in accordance with the contract (including a risk analysis of the work site). Communications between the parties involved (customer, supplier, internal departments in the organisation) must be ensured.

Selecting employees with qualifications appropriate to the work to be carried out, maintaining their qualifications and training them for other activities are management tasks. Evidence must be provided of the qualification of employees for the tasks which they undertake in terms of product and process.

Employees must be aware of the customer's requirements and quality objectives. Within limits clearly defined by management, the tasks with which they are entrusted must enable them to recognize their own responsibility for quality.

Capacity studies must ensure that adequately qualified personnel are employed for all processes. Deputies for individual processes must be arranged – here again, qualified personnel must be available.

It must be possible to achieve the quality requirements for the product with the production facilities employed. The specified process capability must be achieved and maintained.

When starting production following changes, conversion work or having made replacements, special precautions must be taken. Work-stations and test/inspection areas must be properly equipped for the product and releases must be obtained for product and process before the start of production. Quality and process data from previous production must be known and all specified improvement actions must be implemented.

Production operations must be aligned with each other. It must be possible to identify the manufacturing and inspection status of the parts at all times.

Storage and transport facilities throughout the entire process chain must be agreed with the customer for the products in question. They must not be able to cause damage in any way.

During long periods out of use, tools, production and test/inspection equipment must be adequately conserved and stored so that they are not damaged.

5.1.1 Output / result / achievement of the objective

5.1.2 Input / requirements

5.1.3 Control / procedures / methods / execution

5.1.4 Personnel resources

5.1.5 Material resources

5.1.6 Effectiveness

5.1.1 Output / result / achievement of the objective

When fully installed at the work site, the production equipment must comply with all internal and external requirements at the specified timing deadline. Proof that the requirements have been met is provided by the acceptance checks carried out by the customer.

5.1.2 Input / requirements

The inputs for final assembly at the work site consist of the product's components and any bought-in services, together with the associated instructions (production control plan ...) and specifications. Information must be available regarding the location point, the connections to be made and transport to the site.

5.1.3 Control / procedures / methods / execution

The work site and final assembly process must be fully prepared at the right time and carried out in a controlled manner, taking account of national and customer-specific regulations. The following items must be considered:

- Setting up the work site (working space, communication arrangements, supply and disposal systems, questions relating to customs, tax and insurance) and acceptance checks
- Organising transport and storage (transport equipment and routes, lifting gear, suitable storage areas)
- Quality of assembly aids
- Installation and setting in operation
- Controlling supplier activities on site
- Checks and regular progress reports
- Carrying out changes / modifications
- Instructing operating personnel
- Agreed qualifications (e.g., functional evidence, proof of capability)
- Transfer of the equipment, ready for operation (including documentation, programs, machine data,...)
- Records of the changes carried out during final assembly and commissioning
- Performance test as agreed
- Closing the work site (removal of personnel, materials, equipment)

A person responsible for the work site must be appointed and his/her tasks must be specified.

Risks at the work site must be dealt with as part of the risk analysis for the complete project (see Section 1.3).

Communications between the parties involved (customer, supplier, internal departments in the organisation) must be ensured.

General management

The organisation of the project, responsibility for product development and spreading the individual components of the product across the suppliers, as well as their inter-action, are the responsibility of the general management. (to be evaluated under Sections 1.3 and 2.3).

It is here, in Section 5.1.3, where the preparation for all production activities at the work site is evaluated. In the same way as the stipulations in Section 4.1.3, the process preparations must include the creation of the production control plan, based on the performance specification, parts lists and other requirements, as well as planning the technical and personnel requirements.

These activities are controlled by the production process development plan (a detailed section within the project plan). The extent and detailing depend on the complexity of the assembly process. In the simplest case the production process development plan is the same as the relevant section of the project plan. The results of risk analyses covering the assembly process must have been taken into consideration.

Correction and corrective actions

Defects and non-conformance with requirements and their peripheral conditions must be logged, corrections must be undertaken without delay and the relevant areas must be informed. The actions taken must be documented.

Aids in this regard include:

- Problem sheets; product folders
- The logging of extra work involved with problems/changes
- Know-how store (collected experience)
- Information to the area causing the problem
- List of outstanding points
- Work site reports

Following analysis of the causes of the problem, appropriate corrective actions must be taken to prevent a recurrence, by changes to:

- drawings, specifications, internal standards
- production control plans
- product control software (SPS, robot programs, ...)
- product machine data

Changes

Changes by the customer (change requests) must be authorized by the customer before they are carried out. The effects of changes must be determined and evaluated. The implementation of changes must be specified (and agreed with the customer, if appropriate).

This will include the following:

- Release of changes (technology, timing, costs, risks)
- Acceptance of the changes when completed
- Up-dating of data (e.g., component issue levels, software, design documents, operator instructions)

5.1.4 Personnel resources

Sufficient personnel with the necessary abilities, knowledge and expertise must be available for the work site.

Qualification

Employees and managers must be suited to carrying out the allotted tasks. Their qualification must be maintained. This can be demonstrated via training, instruction or experience.

Factors to be considered include:

- knowledge of foreign languages (if relevant)
- assembly and commissioning procedures
- contents of contracts, product specifications, process stipulations
- health & safety at work; environmental aspects
- evidence of suitability (e.g., welding certificate, eye tests, driving licence for internal transport vehicles)
- experience in dealing with defects
- ability to work in a team; integration in unfamiliar surroundings
- ability to handle physical and physiological stress

Personnel must actively accept their responsibility in the work site environment. This can be detected, for example, by:

- tidiness and cleanliness
- the handling of material resources
- handling, storage, transport
- the use of auxiliary aids and test/inspection and measurement equipment

Motivation

The employees' motivation and readiness to perform must be encouraged by targeted information.

Items to be considered include:

- Quality information (specified and actual results)
- Customer complaints / rejects
- Contribution to quality improvement
- Involvement in the organisation's internal information flow
- Feedback on performance

Capacity

The personnel capacity required for the work site must be planned and available.

Items to be considered include:

- Additional capacity for "trouble-shooting“
- Coordination work (supplier service, ...)
- Capacity loss (holiays, absences)
- Suitable deputies; qualification matrix
-

5.1.5 Material resources

The organisation must demonstrably provide the necessary technical aids, equipment and facilities for the work site, to the extent required and in the appropriate condition.

Consideration must be given to:

- production facilities (machines, tools, jigs & fixtures, other aids)
- test/inspection equipment
- assured readiness for use (care, maintenance, replacement)
- transport facilities
- premises, storage areas, environmental conditions
- tidiness and cleanliness

Associated evidence of qualification must be provided.

5.1.6 Effectiveness

The following factors are particularly important when assessing and improving the economic and effective execution of all activities at the work site:

- Determining the process metrics
- Improvement actions
- Process audits

Determining the process metrics

The effectiveness of processes at the work site must be evaluated, using the appropriate metrics, such as:

<u>Time</u>

- Time spent on the work site
- Extra work involved
- Down-times

Resources

- Compliance with budget
- Use of personnel
- Use of materials

Quality

- The number of correction loops
- Compliance with specified timings
- Customer complaints

In order to assess the metrics, objectives and reference dimensions must be documented. These are derived from the project plan/ production control plan, general internal objectives and from previous experience.

Improvement actions

The potential for improvements must be determined. Sources of information include process metrics, proposals for improvement by the work-force and management programmes. Improvement actions must be generated and implemented.

Audits

Work sites must be audited regularly in order to identify the potential for improvements. Improvement actions which have been carried out must be checked for effectiveness.

5.2 Service

The customer has the right to expect products free from defects, which meet all his requirements, beginning with the warranty. This includes service after the products have been delivered by the supplier so that any deviations from the customer's requirements and expectations can be detected at an early stage. Appropriate corrective actions can then be carried out in order to regain / maintain customer satisfaction.

The customer service function is therefore key in the measurement of customer satisfaction. It must be manned with qualified personnel and be able to introduce improvements at all levels and in all areas of the company

If there is a service agreement with the customer, the organisation must ensure the effectiveness of all its customer service centres, including the training of personnel and the technical facilities.

The supply of spares and replacement parts must meet the customer's quality requirements. A speedy reaction is required to any quality problems.

No matter what work is involved in the organisation, the term "customer service" as it is used here refers to any kind of service (warranty, care and maintenance, repair, …) after the customer has accepted a product.

5.2.1 Output / result / achievement of the objective

5.2.2 Input / requirements

5.2.3 Control / procedures / methods / execution

5.2.4 Personnel resources

5.2.5 Material resources

5.2.6 Effectiveness

5.2.1 Output / result / achievement of the objective

The provision of a service can involve:

- the supply of spares or replacement parts
- repair, maintenance
- on-site service
- advice

The result of service processes should be evaluated from two aspects:

- Customer service and the supply of spares/replacement parts
- Customer satisfaction

Customer service and the supply of spares/replacement parts

Compliance with customers' requirements in terms of service and the supply of spares and replacement parts must be assessed by evaluation of the following aspects:

- Reports / notes regarding customer contacts
- Product introduction and problems with the product
- Use of spares and replacement parts
- Reaction times
- Special action

Customer satisfaction

The customer's satisfaction with the service must be evaluated regularly.

Points to consider include:

- reports / notes regarding customer contacts
- questionnaires sent to customers, supplier assessments by customers
- accessibility
- availability
- ease of maintenance; reliability

5.2.2 Input / requirements

Requirements relating to service consist of internal, national and customer requirements (contractual regulations).

5.2.3 Control / procedures / methods / execution

Customer service and records of associated data must be maintained for the entire period in which a service is offered.

The supply of spares / replacement parts and satisfactory operation must be ensured for the guarantee period and also thereafter, if contractually agreed.

Experienced contact personnel for the various departments in the organisation must be available to the customer.

In this, two points in particular must be considered:

- Preparation
- Execution

Preparation

As part of the preparation, the work involved in all service operations must be laid down. All relevant regulations and stipulations to be observed must be listed in instructions and / or check-lists. The internal areas and activities involved must be coordinated, as well as their links to the customer.

Points to be observed include:

- Determine the requirements relating to materials and personnel
- Plan the use of personnel (qualification and capacity)
- Stocks of spares / replacement parts
- Supplier contracts
- Responsibilities, authority, tasks
- Packing & transport regulations
- References to other instructions, standards, regulations, legislation
- Records of service operations
- The customer's contact personnel
- Plans for emergencies to maintain production by the customer

It must be possible to evaluate performance. All information must be made available to the departments and areas involved.

Execution

Service operations must be carried out to the specified procedure. Each service situation must be recorded and evaluated.

Sources for this include:

- machine log-books (change records)
- questions to maintenance personnel and operators
- existing data (remote diagnosis, previous service actions)
- the product status as discovered
- new information on the use of the product
- problem sheets
- illustrations of defects

The result of the diagnosis and the service solution must be recorded in a service report.

Corrections and corrective actions

Service errors and repeated customer complaints must be logged, including any resultant extra work and any peripheral conditions. Corrections must be made without delay and the departments responsible must be informed. The actions taken must be recorded.

If specified service regulations cannot be followed, the service department management must be informed, so that appropriate corrections can be made. The same applies if there is no appropriate service regulation.

At the same time, the service specialist must provide at least a temporary solution (immediate action) on site, with the agreement of the operator where relevant.

Appropriate corrective actions must be taken to prevent a recurrence of the problem – e.g., by changes / additions to:

- specifications, service regulations
- software
- hardware

5.2.4 Personnel resources

Sufficient personnel with the necessary abilities, knowledge and expertise must be available for service operations.

Qualification

Employees and managers must be suited to carrying out the allotted tasks. Their qualification must be maintained. This can be demonstrated via training, instruction or experience.

Points to be considered include:

- foreign languages
- knowledge of the product and specifications
- operation and application
- health & safety at work, environmental aspects
- evidence of suitability
- failure analysis methods
- service instructions

Personnel must actively accept their responsibility for equipment and tools in the organisation and also on the customer's premises.

Capacities

The personnel capacity for the service of products and services must be planned and in place.

Items to be considered include:

- availability. accessibility
- qualification matrix
- additional tasks

5.2.5 Material resources

The organisation must demonstrably provide the necessary technical aids, equipment and facilities for the service process to the extent required and in the appropriate condition.

Consideration must be given to:

- equipment (hardware, software, tools, test/inspection devices and other aids)
- assured readiness for use (care, maintenance, replacement)
- communication facilities, information data banks
- tidiness and cleanliness

The associated evidence of suitability must be provided.

5.2.6 Effectiveness

The following main points are used in order to evaluate and improve the economic and effective execution of the service processes:

- Determination of process metrics
- Improvement actions
- Process audits

Determining the process metrics

The effectiveness of the service process must be evaluated using appropriate metrics, such as:

Time

- Reaction time
- Process time
- Down-times

Resources

- Compliance with budget
- Use of personnel
- Use of materials

Quality

- Customer satisfaction
- Compliance with timing deadlines
- Customer complaints
- Number of correction loops

In order to assess the metrics, objectives and reference dimensions must be documented. These are derived from service contracts, general internal targets and from previous experience.

Improvement actions

The potential for improvement must be determined. Sources of information include process metrics, improvement proposals by employees and management programmes. Improvement actions must be generated and implemented.

Audits

Service processes must be audited regularly in order to identify the potential for improvements. Improvement actions which have been implemented must be checked for effectiveness.

12 Reference matrix VDA 6.7 – VDA 6.4

Process	Output	Input	Methods	Personnel resources	Material resources	Effectiveness
Project management	7.0.2 Project control 7.1.1 Project planning 7.1.2 Quality planning 7.3.6 Development validation 8.2 Monitoring & measurement	4.2.3 Controlling documents 4.2.4 Controlling records 5.4.1 Quality objectives 5.5.1 Responsibility & authority 7.0.4 Controlling changes 7.2.1 Determining requirements for the product 7.2.4 Drawing up quotations 7.4 Sourcing (only for general organisations)	4.2.3 Control of documents 4.2.4 Control of records 5.2 Customer orientation 7.0.2 Project control 7.0.4 Controlling changes 7.1.1 Project planning 7.1.2 Quality planning 7.2 Customer- related processes 8.1.1 Specifying relevant methods	5.1 e) Management dedication 5.1.1 c) Business plan 5.6.3 c) Evaluation results 6.1 Providing resources 6.2 Personnel resources 7 Project creation (project team) 7.0.1 Project organisation	5.1 e) Management dedication 5.1.1 c) Business plan 5.6.3 c) Evaluation results 6.1 Providing resources 6.3 Infrastructure 6.4 Working environment	5.1.3 Efficiency of processes 5.4.1 (a) + (c) Quality objectives 7.5.1.7 Feedback from the field 8.2.1 Customer satisfaction 8.2.2 Internal audits 8.2.3 Monitoring & measurement of processes 8.2.5 Financial analysis 8.4 Data analysis 8.5 Improvement

Process	Output	Input	Methods	Personnel resources	Material resources	Effectiveness
Prduct development	7.3.2.2 Inputs for production process development 7.3.3.1 Results of product development 7.3.3.3 Significant characteristics 7.3.4 Development evaluation 7.3.5 Development verification	4.2.3 Controlling documents 4.2.4 Controlling records 5.4.1 Quality objectives 7.0.4 Controlling changes 7.1.1 Project planning 7.1.2 Quality planning 7.2.1 Determining requirements for the product 7.2.2 Evaluating requirements for the product 7.3.2.1 Inputs for product development 7.5.1.7 Feedback from the field	4.2.3 Controlling documents 4.2.4 Controlling records 5.2 Customer orientation 7.1.2 Quality planning 7.3.1.1 Product development planning 7.3.4.1 Development evaluation at milestones 7.3.4.2 Evaluating product safety 7.5.5.1 Handling products 8.1.1 Specifying relevant methods 8.5.1 Continuous improvement (product) 8.5.2 Corrective actions	5.6.3 (c) Evaluation results 6.1 Providing resources 6.2 Personnel resources 6.3 Infrastructure 6.4 Working environment 7.0.2 Controlling projects	5.6.3 c) Evaluation results 6.1 Providing resources 6.3 Infrastructure 6.4 Working environment 7.0.2 Controlling projects	5.1.3 Efficiency of processes 5.4.1 (a) + (c) Quality objectives 7.5.1.7 Feedback from the field 8.2.1 Customer satisfaction 8.2.2 Internal audits 8.2.3 Monitoring and measuring processes 8.2.5 Financial analysis 8.4 Data analysis 8.5 Improvement

Process	Output	Input	Methods	Personnel resources	Material resources	Effectiveness
Sourcing	7.4.2 Sourcing information 7.4.3 Verifying purchased parts/products	7.1.1 Project planning 7.1.2 Quality planning 7.2.1.1 Customer requirements 7.3.3.1 Results of product development 7.3.7 Controlling development changes 4.2.3 Controlling documents 4.2.4 Controlling records	4.2.3 Controlling documents 4.2.4 Controlling records 7.1.2 Quality planning (7.4.1 Sourcing planning) 8.1.1 Specifying relevant methods 8.3 Controlling defective products 8.4 Data analysis	5.6.3 c) Evaluation results 6.1 Providing resources 6.2 Personnel resources 7.0.2 Controlling projects	5.6.3 c) Evaluation results 6.1 Providing resources 6.3 Infrastructure 6.4 Working environment 7.0.2 Controlling projects	5.1.3 Efficiency of processes 5.4.1 (a) + (c) Quality objectives 7.5.1.7 Feedback from the field 8.2.1 Customer satisfaction 8.2.2 Internal audits 8.2.3 Monitoring and measuring processes 8.2.5 Financial analysis 8.4 Data analysis 8.5 Improvement

Process	Output	Input	Methods	Personnel resources	Material resources	Effectiveness
Production	7.5.1.1 Production control plan (7.5.1.5 Assembling and commissioning production equipment at the customer's premises) 7.5.2 Validating processes for production 8.2.1 Customer satisfaction 8.2.4 Monitoring and measuring the product	7.1.1 Project planning 7.1.2 Quality planning 7.3.3.1 Results of product development 7.3.3.2 Results of production process development 7.3.6.1 Product and production process release 7.3.7 Controlling development changes 7.4.1 Controlling development changes 7.4.1 Sourcing process 7.5.1.7 Feedback from the field	4.2.3 Controlling documents 4.2.4 Controlling records 7.1.2 Quality planning 7.3.1.1 Production process development planning 7.5 Production 7.6 Controlling monitoring and measurement equipment 8.1.1 Specifying relevant methods 8.3 Controlling defective products 8.4 Data analysis	5.6.3 c) Evaluation results 6.1 Providing resources 6.2 Personnel resources 7.0.2 Controlling projects	5.6.3 c) Evaluation results 6.1 Providing resources 6.3 Infrastructure 6.4 Working environment 7.0.2 Controlling projects	5.1.3 Efficiency of processes 5.4.1 (a) + (c) Quality objectives 7.5.1.7 Feedback from the field 8.2.1 Customer satisfaction 8.2.2 Internal audits 8.2.3 Monitoring and measuring processes 8.2.5 Financial analysis 8.4 Data analysis 8.5 Improvement

Process	Output	Input	Methods	Personnel resources	Material resources	Effectiveness
Processes after shipment **(A) Work site**	7.3.6 Development and validation = 7.5.2 Validating processes for production	7.5.1.1 Production control plan, production; packed product, other components supplied 7.3.1.1.2 Production process development plan	7.3.1.1 Production process development planning 7.1.2 Quality planning 7.5.1 Controlling production 7.5.1.1 Production control plan for the work site 7.5.1.5 Assembling and commissioning production equipment at the customer's premises, Process FMEA for work site 7.3.6 Development validation	5.6.3 c) Evaluation results 6.1 Providing resources 6.2 Personnel resources 7.0.2 Controlling projects 7.1.1.1 Work site planning	5.6.3 c) Evaluation results 6.1 Providing resources 6.3 Infrastructure 6.4 Working environment 7.0.2 Controlling projects 7.1.1.1 Work site planning	5.1.3 Efficiency of processes 5.4.1 (a) + (c) Quality objectives 7.5.1.7 Feedback from the field 8.2.1 Customer satisfaction 8.2.2 Internal audits 8.2.3 Monitoring and measuring processes 8.2.5 Financial analysis 8.4 Data analysis 8.5 Improvement

Process	Output	Input	Methods	Personnel resources	Material resources	Effectiveness
Processes after shipment **(B) Service**	5.6.2 h) Action in the usage phase 7.5.2 Validating processes for production 4.2.4 Controlling records	7.5.1.8 Service agreements with the customer; service stipulations 7.3.3.1 Results of the product development 7.3.4.2 Evaluating product safety 7.3.6 Development validation	7.5.1 Controlling the provision of services	5.6.3 c) Evaluation results 6.1 Providing resources 6.2 Personnel resources 7.0.2 Controlling projects 7.1.1.1 Work site planning	5.6.3 c) Evaluation results 6.1 Providing resources 6.3 Infrastructure 6.4 Working environment 7.0.2 Controlling projects 7.1.1.1 Work site planning	5.1.3 Efficiency of processes 5.4.1 (a) + (c) Quality objectives 7.5.1.7 Feedback from the field 8.2.1 Customer satisfaction 8.2.2 Internal audits 8.2.3 Monitoring and measuring processes 8.2.5 Financial analysis 8.4 Data analysis 8.5 Improvement

Process	Output	Input	Methods	Personnel resources	Material resources	Effectiveness
Processes after shipment **(A + B) Work site and service**	8.2.1 Customer satisfaction 8.2.4 Monitoring and measuring the product	7.4.3 Verifying purchased products 7.5.1.6 Capacity planning 7.5.1.7 Feedback from the field	4.2.3 Controlling documents 4.2.4 Controlling records 7.4.3 Verifying purchased products 6.3.2 Plannin for emergencies 7.5.1.6 Capacity planning (adapting) 8.1.1 Specifying relevant methods 8.2.4 Monitoring and measuring the product 8.3 Controlling defective products 8.5.2 Corrective actions	5.6.3 c) Evaluation results 6.1 Providing resources 6.2 Personnel resources 7.0.2 Controlling projects 7.1.1.1 Work site planning	5.6.3 c) Evaluation results 6.1 Providing resources 6.3 Infrastructure 6.4 Working environment 7.0.2 Controlling projects 7.1.1.1 Work site planning	5.1.3 Efficiency of processes 5.4.1 (a) + (c) Quality objectives 7.5.1.7 Feedback from the field 8.2.1 Customer satisfaction 8.2.2 Internal audits 8.2.3 Monitoring and measuring processes 8.2.5 Financial analysis 8.4 Data analysis 8.5 Improvement

13 Process audit forms

Manufacturer Ltd.	Process audit to VDA 6.7	Order: Date:

Supplier No..:
Company:
Address

Reason for order:

Client:

Certificates

Norm / Basis	Date	Carried out by	Valid until

Last audit results

Audit basis / Audi No.	Date	Carried out by	Valid until

Audit results

Product groups	Total achievement level E_P [%]	Grade

Reason for downgrade:

Grading scale:					
	A	= 90 - 100 %	Quality-capable	Downgrade possible (for reasons see above)
	B	= 80 - 89 %	Conditionally quality-capable	
	C	= 0 - 79 %	Not quality-capable	

Follow-up action:	Completion by:

Audit participants:

Name	Area	Function

Signatures:

Auditor: _____ Organisation. _____
Name Name/position

Auditor: _____ Organisation. _____
Name Name/position

Distribution:						

Manufacturer Ltd.	**Overview of results** **Process audit**	Order: Page: **2**

Product group

Min. requirements per evaluation element

Target ≥80 ≥90

Evaluation elements	Archieved [%]		60	70	80	90	100
Project management	E_{PM}						
Development	E_{DE}						
Mechanical							
Fluids							
Electrical							
Software							
Sourcing	E_{SM}						
Production	E_{PG}						
	E_1						
	E_2						
	E_3						
	E_4						
	E_5						
	E_6						
Processes after delivery	E_{CS}						

Process characteristics	Archieved [%]		60	70	80	90	100
Output	1						
Input	2						
Personnel resources	3						
Material resources	4						
Methods	5						
Effectiveness	6						

Audit participants

Audito

Manufacturer Ltd.	**Improvement programme**	Order : Page : **4 of**
Weaknesses / recommended actions	**Actions by the supplier**	Timing /status / responsible

Manufacturer Ltd.	**Process audit: single products** **Questions evaluated / achievement grades**	Order: **Attachments**

Machine group **Achievement [%]**

	.1	.2	.3	.4	.5	.6		
1 Project management								PM
2 Developmen								E_{DE}
2.1 Mechanical								
2.2 Fluids								
2.3 Electrical								
2.4 Software								
3 Sourcing								E_{SM}
4 Production							PV	PH E_{PG}
Process step 1:	**Desc:**							
Process preparations								
Manufacturing								E_1
Process step 2:	**Desc:**							
Process preparations								
Manufacturing								E_2
Process step 3:	**Desc:**							
Process preparations								
Manufacturing								E_3
Process step 4:	**Desc:**							
Process preparations								
Manufacturing								E_4
Process stage 5:	**Desc:**							
Process preparations								
Manufacturing								E_5
Process step 6:	**Desc:**							
Process preparations								
Manufacturing								E_6
5 Processes after delivery								E_{CS}
5.1 Work site								
5.2 Service								

Overall average Process characteristics 1- 6	1	2	3	4	5	6

Achievement **E_{PG} [%]** Element 4 by product groups (mean values of associated process steps)

Achievement **E_P** By product groups from elements 1 to 5

Product groups						
Process steps						
E_{PG}						
E_P [%]						

$$E_P\,[\%] = \frac{E_{PM} + E_{DE} + E_{SM} + E_{PG} + E_{CS}}{\text{Qty of processes evaluated}}\ [\%]$$

Note: "nb" = question not evaluated

Quality Management in the Automotive Industry

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