Hochschule Konstanz
Fakultät Elektrotechnik
und Informationstechnik

IATF 16949: Ensuring Quality in the Automotive Industry

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- History & Development
- 5 Core Tools of IATF 16949
- Benefits of IATF 16949 Certification (Example)
- Challenges of IATF 16949
- Conclusion

Introduction

- **Definition:** IATF 16949 (**I**nternational **A**utomotive **T**ask **F**orce 16949) is a global standard for Quality Management Systems in the automotive industry.

- **Purpose:** It is developed to improve quality, efficiency, and consistency in automotive production and supply chains.

- **Integration:** It built upon the ISO 9001 standards, adding automotive-specific requirements.

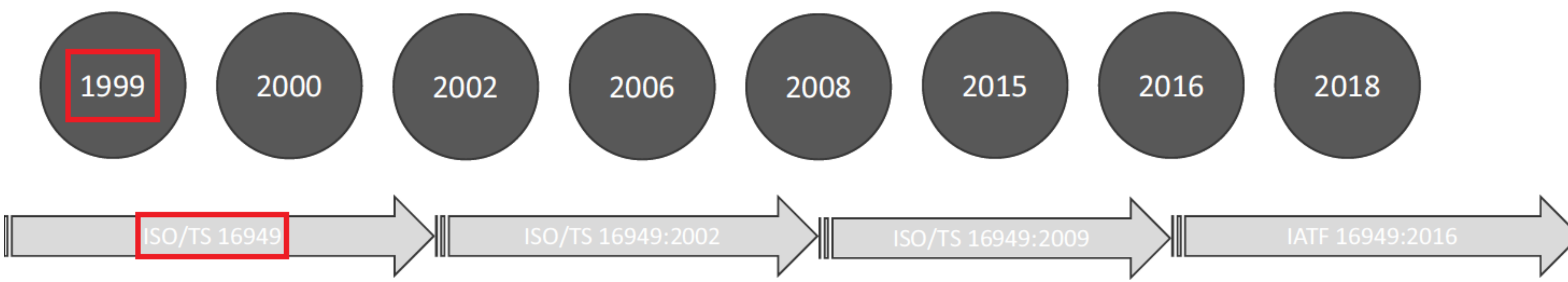
Source: IATF 2023

History & Development

First Release

- **Origins:** ISO/TS 16949 was first published in 1999, integrating various national standards within the global automotive supply chain, like QS-9000 (USA), VDA6.1 (Germany), EAQF (France), and AVSQ (Italy).

- **Collaboration:** International Automotive Task Force and ISO



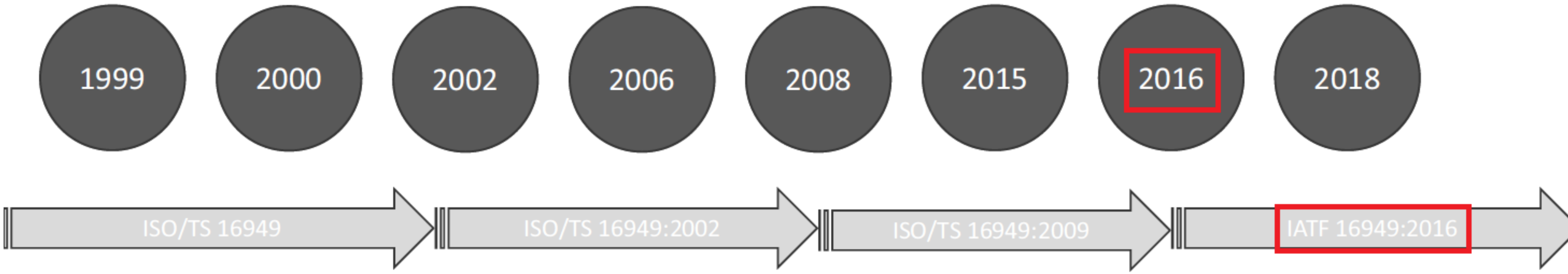
Source: Brückner/Bopp/Krauss 2019, S. 2

History & Development

Evolution

- **The Milestone:** A significant update came in 2016, transitioning from ISO/TS 16949 to IATF 16949.

- **Update:** This change emphasized a more dynamic approach to risk management, process improvement, and customer satisfaction.



Source: Brückner/Bopp/Krauss 2019, S. 2

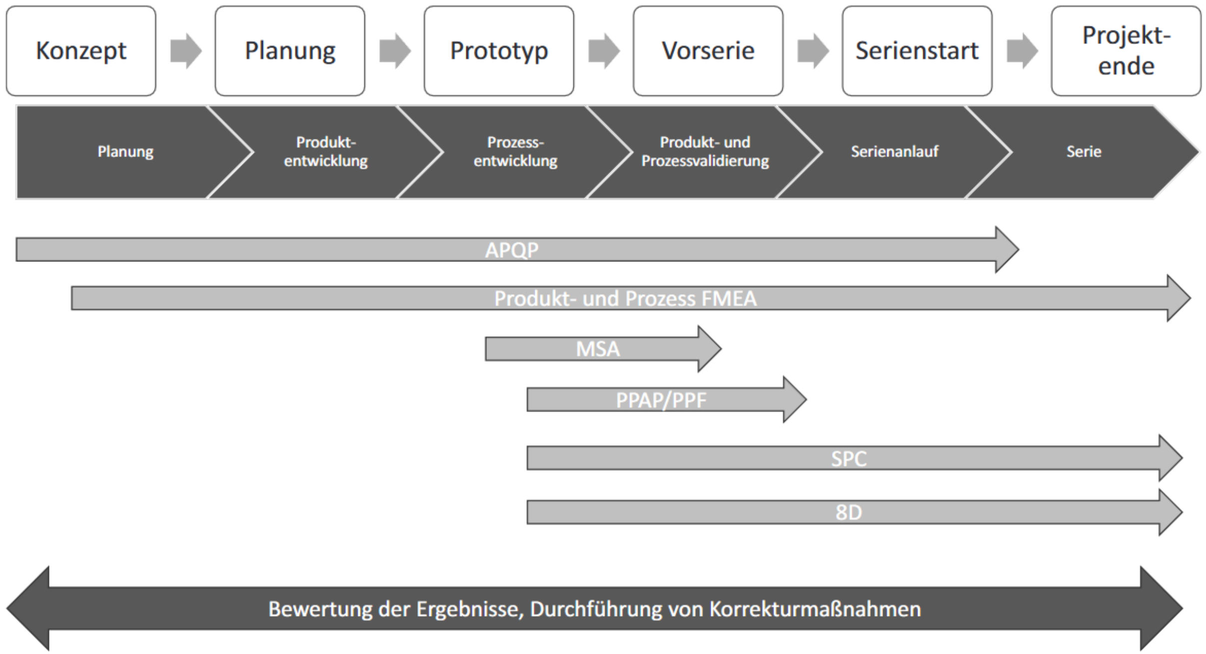
5 Core Tools

Introduction

- Set of techniques and methodologies
- Collectively they provide a framework to manage and improve processes
- Aim at ensuring high-quality Products, reliability and customer satisfaction

5 Core Tools

Overview



Source: Brückner/Bopp/Krauss 2019, S.3

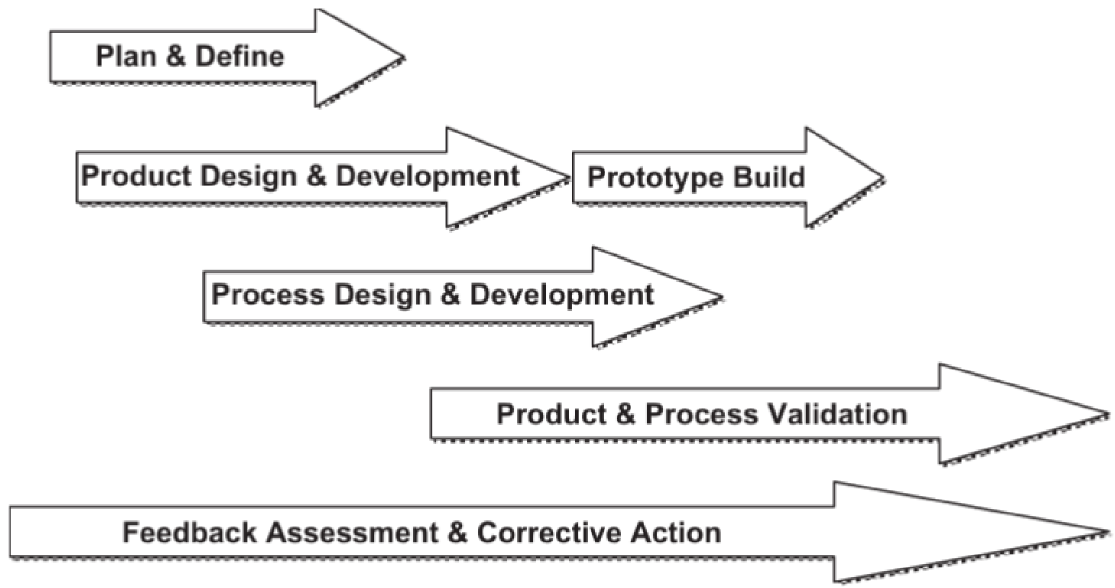
Advanced Product Quality Planning (APQP)

Aims of APQP:

- Minimize, reduce or eliminate late changes
- Reduce/eliminate quality issues
- Reduce/eliminate risk and warranty
- Increase customer satisfaction
- Reduce/eliminate waste

APQP

Model for implementation



Source: Brückner/Bopp/Krauss 2019, S. XXVI

FMEA:

Failure Mode and Effects Analysis

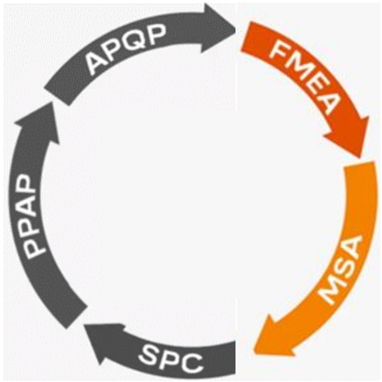
Main purpose:

Prevention of errors rather than post-detection and correction

- Analytical method in reliability engineering
- Identification and assessment of potential product failures in the design phase

FMEA:

Failure Mode and Effects Analysis



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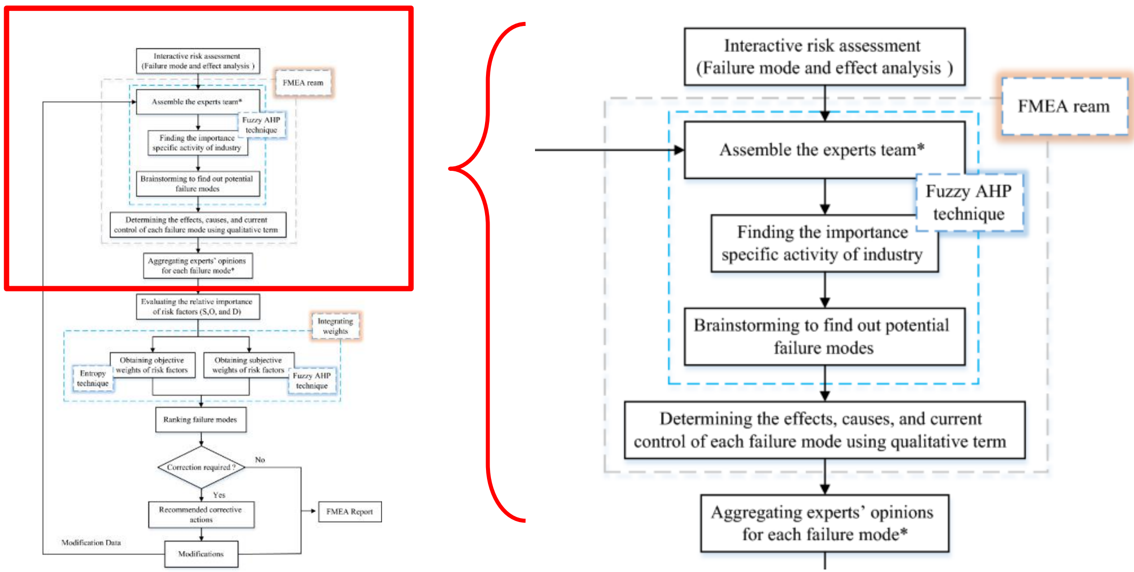


Book | June 2018 | *Improving failure mode and effect analysis*
Source: https://link.springer.com/article/10.1007/s12008-018-0496-2

FMEA:

Failure Mode and Effects Analysis

Process FMEA (P-FMEA):

- The potential failure modes within manufacturing or operational processes
- Focuses on identifying and mitigating risks associated with the process steps

Software FMEA (SW-FMEA):

- Potential failures in software systems
- Manly in industries where software plays a critical role

Types

System FMEA (S-FMEA):

- Failures at the system level
- For complex systems with multiple components and interactions

Functional FMEA (F-FMEA):

- Failures in specific functions of a product or system
- Each function meets its intended purpose without failure

Book | June 2018 | *Improving failure mode and effect analysis*
Source: https://link.springer.com/article/10.1007/s12008-018-0496-2

MSA:

Measurement System Analysis

Main purpose:

Reliability of crucial input and main output data in the manufacturing process

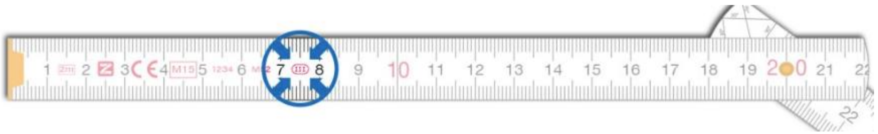
- Comprises methods to evaluate the uncertainty of a measurement process under operating conditions

- Understanding variations attributed to people, machines, materials, methods, or the environment

MSA:

Measurement System Analysis

Example:



ACCUARCY CLASS	A (MM)	B (MM/M)	C (MM)
I	0,1	0,1	0,1
II	0,3	0,2	0,2
III	0,6	0,4	0,3

Source: https://www.zollstock-direkt.de/2017/10/07/info-genauigkeitsklassen-fuer-zollstoecke/

MSA:

Measurement System Analysis

1. Study Design:

- Define the scope and objectives of the MSA
- Identify the specific measurement tools and processes to be analyzed
- Set protocol for data collection

2. Precision and Accuracy Assessment:

- Conduct tests to evaluate measurement
- Apply statistical methods to quantify variations and pinpoint sources of error
- Ensure measurements align

3. Repeatability and Reproducibility:

- Perform experiments with multiple operators
- Use statistical tools to distinguish measurement variability
- Calculate repeatability and reproducibility

4. Linearity and Bias Evaluation:

- Test across the full measurement range
- Analyze data to identify systematic errors
- Adjust tools or processes

5. Implementation in Manufacturing:

- Monitor ongoing system performance
- Set regular calibration schedules

Statistical Process Control
(SPC)

- **Analyzing** Measurements of a Process regarding its stability

- **Main Focus:** Variance

  A process is defined stable, if the center of variance in a representative measurement is constant and the spread is in a constant range

SPC

Causes of Variation

- **Common causes:**
  - Cannot be prevented entirely
  - Constant variance => stable
  - e. g. usual traffic
- **Special causes:**
  - Unpredictable variance -> unstable
  - e. g. traffic accident

SPC

Main steps

1. **Detect & remove** Special causes of Variation to reach a stable process

2. **Reduce** common causes to improve *capability of the process

*__capability__:

– Describes how well a process performs (term only used for stable processes)

SPC

Statistical Tools

- X-bar, R-charts
- Capability (Cpk, Ppk)
- Run charts
- Cause & Effect Analysis
- Affinity
- Histogram
- Pareto
- Scatter Diagram
- Radar
- Force field Analysis

SPC

X-bar, R-chart example

Given a dataset with m samples X={x_1,…,x_n}:

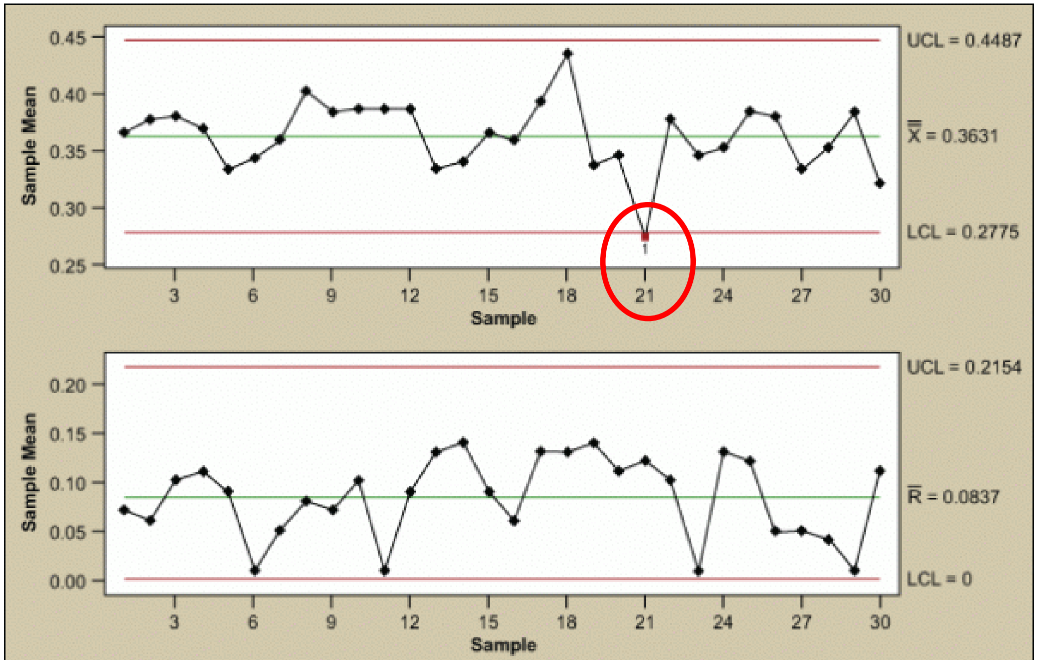
– **Calculate…**

	Centerline	Upper Limit	Lower Limit
X-bar	$\bar{\bar{X}} = \frac{1}{m}\sum \bar{X}$	$UCL = \bar{\bar{X}} + A_2\bar{R}$	$LCL = \bar{\bar{X}} - A_2\bar{R}$
R chart	$\bar{R} = \frac{1}{m}\sum \max(X) - \min(X)$	$UCL = D_4\bar{R}$	$LCL = D_3\bar{R}$

– Where A_2, D_3 & D_4 are constants of a control chart table for different sample sizes n

SPC

X-bar, R-chart example



Source: https://www.researchgate.net/figure/Fig-13-Example-of-X-bar-and-Range-X-bar-R-Chart_fig4_339738274

- *UCL & LCL define the range for constant variance
- **X-Bar:** avg(sample)
- **R-chart:** range(sample)
- Unstable behaviour in sample 21

*U-/LCL = „Upper-/Lower Control Limit“

Production Part Approval Process (PPAP)

- **Goal:** Ensuring understanding & compliance of requirements within a new / modified production process

- **Origin / Usage:** automotive Industry / sectors with high quality standards

- **Output:** PPAP-Package => Documentation demonstrating the capability of the production process to meet the requirements

PPAP: Package
Submission Levels

- **5 levels** in depth of documentation and testing:
  1. Part Submission Warrant (PSW) only
  2. + Product Samples
  3. + limited supporting data
  4. + detailed supporting data
  5. + capability studies
- Approaches to **select the level**:
  - Complexity of the product
  - Criticality of application
  - Requirements
- **Note:** Level independent, a full APQP is required

PPAP: Package

Key Documents [level req.]

- Part Submission Warrant (PSW) [1+]
- Sample Production Parts [2+]
- Design Records [3+]
- Dimensional / Material / Performance Test results [3+]
- Process Flow Diagram (PFD) [3/4+]
- Control Plan [3/4+]
- Measurement System Analysis (MSA) [4+]
- Initial Process Studies [4+]
- Capability Studies [5]

PPAP

Approval

- **Customer approval:** Customer reviews submitted PPAP package and may inspect production process before granting approval for the supplier to proceed

- **Ongoing monitoring:** Supplier must continue monitoring and maintaining the process in compliance with agreed requirements

Benefits of IATF 16949 Certification - example

Introduction to BIWIN Technologies:

- **Overview:**
  - Leading company in memory chip R&D, packaging, and testing.
  - Recognized as a national high-tech enterprise with strategic investments.
- **Core Competencies:**
  - Integrated business model focused on the semiconductor memory industry.
  - Expertise in storage medium research, firmware development, and chip packaging.

Source: https://www.eetasia.com/biwin-packaging-and-testing-center-achieves-iatf-16949-recognition/

Benefits of IATF 16949 Certification - example

- **Certification Attained:** BIWIN Technologies achieved IATF 16949:2016 certification for automotive quality management in 2018.

- **Significance:**
  - Affirms standardized management, quality control, and technological prowess.
  - Symbolizes an intelligent management system with premium product delivery.

Source: https://www.eetasia.com/biwin-packaging-and-testing-center-achieves-iatf-16949-recognition/

Benefits of IATF 16949 Certification - example

- **Integrated Advantage:**
    - BIWIN tightly integrates its operations around the semiconductor memory industry chain, emphasizing research and development with packaging and testing.

- **Automotive Market Presence:**
    - Strategically expanding presence in the automotive storage market.
    - Meticulous control of each stage of the process according to automotive-grade requirements.

Source: https://www.eetasia.com/biwin-packaging-and-testing-center-achieves-iatf-16949-recognition/

Benefits of IATF 16949 Certification - example

- **Advanced Packaging and Testing:**
    - Excellence in design and simulation of packaging for automotive-grade storage products.
    - Established capabilities for high-temperature, ambient-temperature, and low-temperature testing of automotive-grade products.
- **Comprehensive Layout:**
    - Products widely applied in automotive information and entertainment systems, advanced driver assistance systems, intelligent cockpit systems, and more.
    - Future plans include active deployment of integrated R&D and testing, deepening cooperation with automotive manufacturers.

Source: https://www.eetasia.com/biwin-packaging-and-testing-center-achieves-iatf-16949-recognition/

Challenges of IATF 16949

- **Cost Implications**
  - Initial and ongoing costs for training, system changes, and audits can be substantial.
- **Complex Implementation**
  - Adapting existing processes to meet the standard's requirements can be time-consuming and complex.
- **Supplier Management**
  - Ensuring suppliers meet quality standards can strain resources and supplier relationships.

Conclusion

- **Improved Product Quality**
  - Rigorous adherence to IATF 16949 leads to a significant reduction in defects and errors in automotive production.
- **Enhanced Customer Satisfaction**
  - Consistent adherence leads to increased customer satisfaction.
- **Global Market Access**
  - Certification opens doors to global markets, enhancing competitiveness.

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Thank you!