

# Adapting Quality Planning Tools to Evolving Products and Manufacturing Processes: The Case of FMEA

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The dynamic changes in products and production processes regarding quality requirements necessitate the concurrent evolution of applied quality management methods and tools, particularly in quality planning. These methods and tools must keep pace with changes in requirements and their fulfilment because potential non-conformities can lead to inefficiencies in processes, resulting in economic losses and, consequently, affecting the competitiveness of enterprises. The increasing complexity of products and processes and the associated interactions between individual product components and process operations demand improving methods and tools to maintain effective risk identification impacting quality. This need is especially evident in the automotive industry, where effective quality management methods and tools are essential. One of the key quality planning methods is Failure Mode and Effects Analysis (FMEA). This article examines the necessity of evolving quality planning methods and tools, focusing on the example of FMEA evolution in response to challenges associated with changing products and process developments [1].

The FMEA method, a key quality planning method, has undergone significant changes since its inception to meet the evolving expectations arising from its application in various fields. Initially used in the military, and later in the aerospace and nuclear industries, FMEA was adopted by the automotive industry in the 1970s. Changes in quality management methods, such as FMEA, are crucial considering the evolution of products, technologies, and production processes. The first versions of FMEA manuals focused on preventing defects in manufacturing. As technology advanced and customer expectations grew, it became necessary to address a broader spectrum of potential risks and failure impacts. A milestone was the integration of guidelines from AIAG (Automotive Industry Action Group) and VDA (Verband der Automobilindustrie) regarding FMEA. This harmonization aimed to standardize risk analysis procedures at an international level, contributing to better interoperability and understanding among collaborating companies within supply chains [2,3].

Continuous improvement of quality planning methods and tools aimed at adapting to changing conditions (new products, new manufacturing processes) is essential for maintaining high standards of quality, safety, and customer satisfaction in organizations that utilize them [4].

1. Doshi, Jigar, and Darshak Desai. "Application of failure mode & effect analysis (FMEA) for continuous quality improvement- multiple case studies in automobile SMEs." *International Journal for Quality Research* 11.2 (2017): 345.
2. Wu, Zhongyi, Weidong Liu, and Wenbin Nie. "Literature review and prospect of the development and application of FMEA in manufacturing industry." *The International Journal of Advanced Manufacturing Technology* 112 (2021): 1409-1436.
3. Automotive Industry Action Group Association. *Failure Mode and Effects Analysis, FMEA Handbook. Reference Manual 1st Edition*. AIAG & VDA 2019
4. Rudolf, Łukasz, and Marek Roszak. "Efficiency of the product-development process as a factor determining the effectiveness of implementation for subsequent project phases acc APQP." *Materials and Technology* 58.3 (2024): 429-431.