International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048
Volume 9, Issue 8, pp 9-11, August-2025
https://doi.org/10.47001/IRJIET/2025.908002

New Product Design and Development Process Steps, Measurements, and Control Plans in the Automotive Industry

Sakthivel Rasu

Design Engineer, Stanadyne LLC, USA. E-mail: Sakthivelrasu85@gmail.com

***Abstract* - In the Automotive industry, there are continuous challenges to deliver products that meet in-market demand, align with customer expectations, and remain cost-effective in a competitive market. To navigate these situations with a well-organized structure to establish the flow of the New Product Development (NPD). This paper helps navigate each stage of product development, which ultimately converts technical data into a successful product launch. Additionally, various analysis tools such as DFMEA/PFMEA, APQP, validation & control plans help control failure data, which minimizes product warranty costs.**

By following best practices, fostering teamwork across different functions, and adhering to industry standards, this paper demonstrates how the NPD process enhances technical quality, complies with regulations, and boosts customer satisfaction and market success in the rapidly evolving automotive industry.

Keywords: New Product Development, Manufacturing, Mechanical Design, Product Design.

I. Introduction

New Product Development (NPD) in the automotive sector is a complex, collaborative, cross-functional process across the team that includes concept generation, detailed engineering design, prototype development, strict testing, validation, and final product launch. This paper presents the approaches to new product development across various stages, from initial market study to Final production launch, with best practices for each stage of the process.

II. New Product Development Process Methods

2.1 Program introduction and Market study

In New Product Development, market study plays a significant role in the development stage. This stage ensures that we study market demand, customer voice, sales feedback, competitor products, Technology development, benchmarking, and current product improvements.

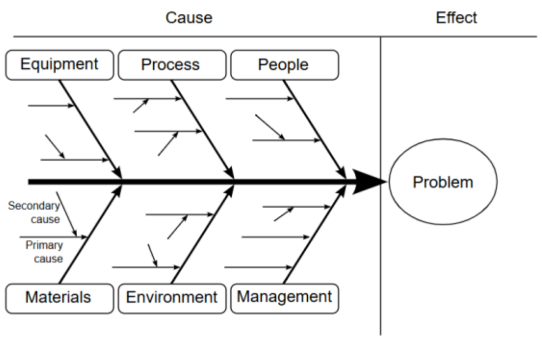
This to develop the business case and convert the data into technical requirements for product development.

2.2 Current product data

The Current Product Data phase is a beginning stage in the New Product Development (NPD) process. It leverages historical data from design, manufacturing, and field performance data to guide new product design decisions and performance. During the New product launch, this step ensures collecting and analyzing data from warranty claims, field service reports, current supplier capacity, failure rates, component deviations, and manufacturing feasibility. Root cause analysis, such as the Fishbone diagram, 5 Whys, Fault Tree Analysis, and 7 Steps Analysis, is used to identify the critical failure mode of the components.

Previous Design Failure Mode and Effects Analysis (DFMEA) and Process FMEA (PFMEA) are revisited to validate whether known high-risk failure modes have been mitigated or require further design modification.

By prioritizing the carryover of proven components, we not only reuse designs but also achieve significant cost savings and reduce development risks. This reuse strategy, which aligns with Design for Manufacturability (DFM) and Design for Assembly (DFA) principles, is a testament to the impact of our work. The current product reports, such as DFMEA & PFMEA, as well as Expert feedback and lessons learned from other similar products, significantly help to develop the concept and the prototype development phase.



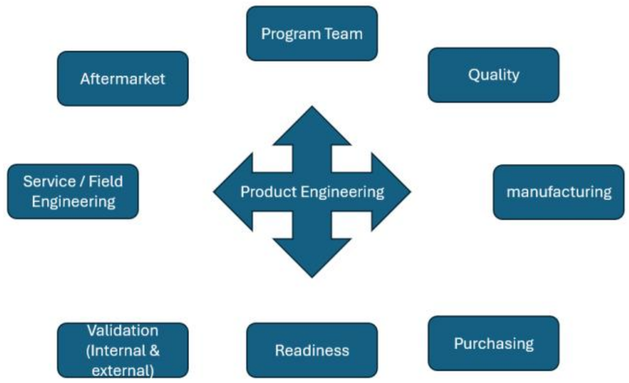
Fishbone Analysis

ISSN (online): 2581-3048
Volume 9, Issue 8, pp 9-11, August-2025
https://doi.org/10.47001/IRJIET/2025.908002

2.3 Cross-functional study

The Cross-Functional Study phase is essential in the New Product Development (NPD) process, ensuring seamless collaboration between different engineering and business domains. Automotive product development requires input from mechanical design, manufacturing, quality, electronics, and supply chain teams, supplier performance, purchasing team, after-market, validation study, service callout on warranty, customer feedback, field failure, current product failure, and mating components.

The primary objective of this phase is to leverage cross-functional expertise to evaluate design feasibility, manufacturability, assembly, serviceability, and cost implications at an early stage of the development cycle. This is achieved through systematic reviews of cross-functional DFMEA and PFMEA, combined with FEA analyses and other validated functional data, enabling effective risk identification and mitigation before progressing to prototype development.



2.4 Concept Design and Analysis

This phase is a critical stage in the new product development process. After collecting cross-functional inputs, technical requirements, and overall program specifications, an initial concept design is created. The design then undergoes comprehensive system-level analyses for validation, including Design for Assembly (DFA), Design for Manufacturability (DFM), cross-functional assembly clearance reviews, cost evaluation, procurement feasibility studies, and supplier assessments for prototype parts.

Key activities include developing a 3D CAD model using various CAD software, preparing detailed engineering drawings for manufacturing, performing Finite Element Analysis (FEA), and performing an initial cost study with a prototype supplier to ensure the concept meets both technical and commercial targets.

2.5 Concept design, physical Part validation

In the Prototype Development phase, the first stage of physical part validation, the component is tested against various functional requirements, such as high-speed tests, drop tests, chemical resistance tests, environmental cycling, and high-stress or fatigue tests. This phase also evaluates the soft tooling supplier's capability, which is critical since, in some cases, the same supplier may transition into the production supplier.

The primary objective of this stage is to determine whether the physical prototype meets all functional and cross-functional requirements defined during the design phase. All functional critical parameters, as well as cross-functional requirements identified in the Design Failure Mode and Effects Analysis (DFMEA), are validated during this process. Testing is often conducted over extended durations (e.g., 2,000 hours of endurance testing) to ensure reliability, durability, and long-term performance.

This phase not only confirms the technical feasibility of the physical component but also conducts a detailed study of supplier readiness, supplier manufacturability capability, and potential design refinements before proceeding to pre-production and full-scale manufacturing.

2.6 Development of Production Supplier

After validating the prototype physical model in various validation processes, document all the results in the DFMEA tool. It is helpful to evaluate the design and selection of the hard-tooling supplier (production supplier) when developing the component. At this stage, the final selected supplier undergoes detailed technical feasibility with engineering and cross-functional teams to understand the requirements and final outputs. After this process, engineering will initiate the tooling for production parts and order the PPAP/Limited production parts. These parts are crucial for quality checks of the component and actual field tests on limited machines, ensuring the highest quality of the product. This stage will build confidence in the component/product among both customers and OEMs.

The PFMEA document serves as a crucial tool in the validation and approval processes. Once all processes are finalized and no further changes are permitted, the supplier, quality, and engineering teams will sign off on this document, confirming the product's readiness for production.

2.7 Production Release

The production release is the final stage in the New Product development. During this stage, all validation results,

ISSN (online): 2581-3048
Volume 9, Issue 8, pp 9-11, August-2025
https://doi.org/10.47001/IRJIET/2025.908002

APQP, DFMEA, PFMEA, purchasing orders, quality, aftermarket, and other supporting documents are properly documented. The transformation from engineering to manufacturing is an effective shift that underscores the importance of each team member in preparing the final product for end customers.

Following the successful transitions, full-scale production will commence. The quality team will continue to monitor the physical parts and conduct audits at supplier sites, a key part of our quality control process, to ensure product quality.

III. Control Plans and Risk Mitigations

At this stage, Quality and Engineering will continue to monitor the product from the Supplier to the assembly line, addressing any deviations or requests from the Supplier and maintaining a live document of the DFMEA based on service/dealer feedback. Likewise, PFMEA is maintained as a live document to control the process flow in the assembly line.

The purchasing team will monitor supply chain activity to ensure component readiness in the assembly line, tracking supplier capacity and any other global factors that may impact the supply chain. Purchasing and Quality will conduct periodic discussions with the Supplier to ensure the readiness of the component.

IV. Conclusion

The new product development (NPD) stages in the automotive industry require a proper cross-functional approach to ensure technical requirements and validation, cost effectiveness, product readiness, on-time market launch, and customer satisfaction.

Various design and process tools, such as DFMEA, PFMEA, APQP, Root cause analysis, Cost management, and Risk assessment, are used to identify potential failures and modes of new product development.

Furthermore, working with internal and external suppliers for product validation at various design stages (Prototype, pre-production, and production) ensures the product design and supplier capability from a manufacturing standpoint. Maintaining the live document of DFMEA and PFMEA throughout the product lifecycle helps to continue monitoring product failures and the corrective action plan.

In conclusion, adopting NPD methods supports and guides the team in following industry standards to meet technical requirements, launch the product promptly into the market, ensure customer satisfaction, achieve cost savings, and minimize warranty claims.

REFERENCES

[1] Cross, Nigel. Engineering design methods: strategies for product design. *John Wiley & Sons*, 2021.
[2] Aguiar, Marina Fernandes, and Daniel Jugend. "Circular product design maturity matrix: A guideline to evaluate new product development in light of the circular economy transition." *Journal of Cleaner Production* 365 (2022): 132732.
[3] Naiju, C. D. "DFMA for product designers: A review." *Materials Today: Proceedings* 46 (2021): 7473-7478.
[4] Tuli, Prashant, and Ravi Shankar. "Collaborative and lean new product development approach: a case study in the automotive product design." *International Journal of Production Research* 53, no. 8 (2015): 2457-2471.
[5] Homburg, Christian, Martin Schwemmle, and Christina Kuehnl. "New product design: Concept, measurement, and consequences." *Journal of marketing* 79, no. 3 (2015): 41-56.

Citation of this Article:

Sakthivel Rasu. (2025). New Product Design and Development Process Steps, Measurements, and Control Plans in the Automotive Industry. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(8), 9-11. Article DOI https://doi.org/10.47001/IRJIET/2025.908002

****

