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Advanced Product Quality Planning

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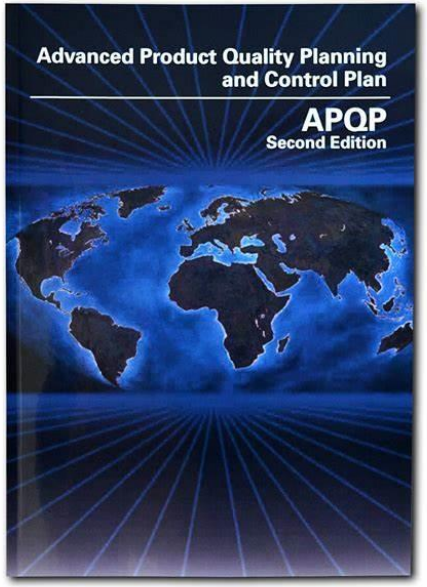
MxV Rail is a subsidiary of the Association of American Railroads (formerly TTCI)

What is Advanced Product Quality Planning or APQP?

- Advanced Product Quality Planning, APQP, exists to ensure suppliers and manufacturers produce products that meet or exceed customer expectations. It is considered a structured approach to the design and development of new products and manufacturing processes.



- Evaluates the output to determine if customers are satisfied & support continual improvement.

- The Advanced Product Quality Planning process consists of five phases and six major activities along with ongoing feedback assessment and corrective action.

Its Origin

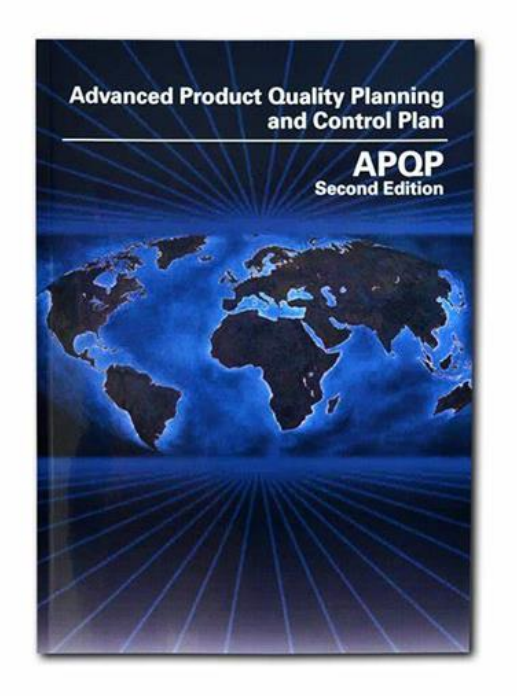
- Although the concepts and processes for APQP has existed for decades, the first APQP standard was published in 1980, by the Ford Motor Company.
- With lessons learned from Ford AQP, the North American Automotive OEM's collectively created the APQP process in 1994 and then later updated in 2008.

- Other high-reliability centric industries have since adopted a similar approach such as the:
  - The Aerospace Industry's AS9145 – APQP and PPAP Guideline.
  - Key Manufacturers in the Medical Device Industry Sector.

Reasons for Implementation

- Directing resources by defining the vital few items from the trivial many.
- Promotes the early identification of change (pre-release) and avoids costly late changes (post release).
- On-time quality product at lowest cost.
- Multiple options for mitigating the risk when found earlier.
- Higher capability of verification and validation of a change.
- Improved collaboration between Design of the Product and Process
- Improved Design for Manufacturing and Assembly (DFM/A)
- Lower cost solutions selected earlier in the process
- Legacy capture and reuse, advancement of Tribal Knowledge and standard work creation and utilization.

Where the Publication Can be Located and Purchased



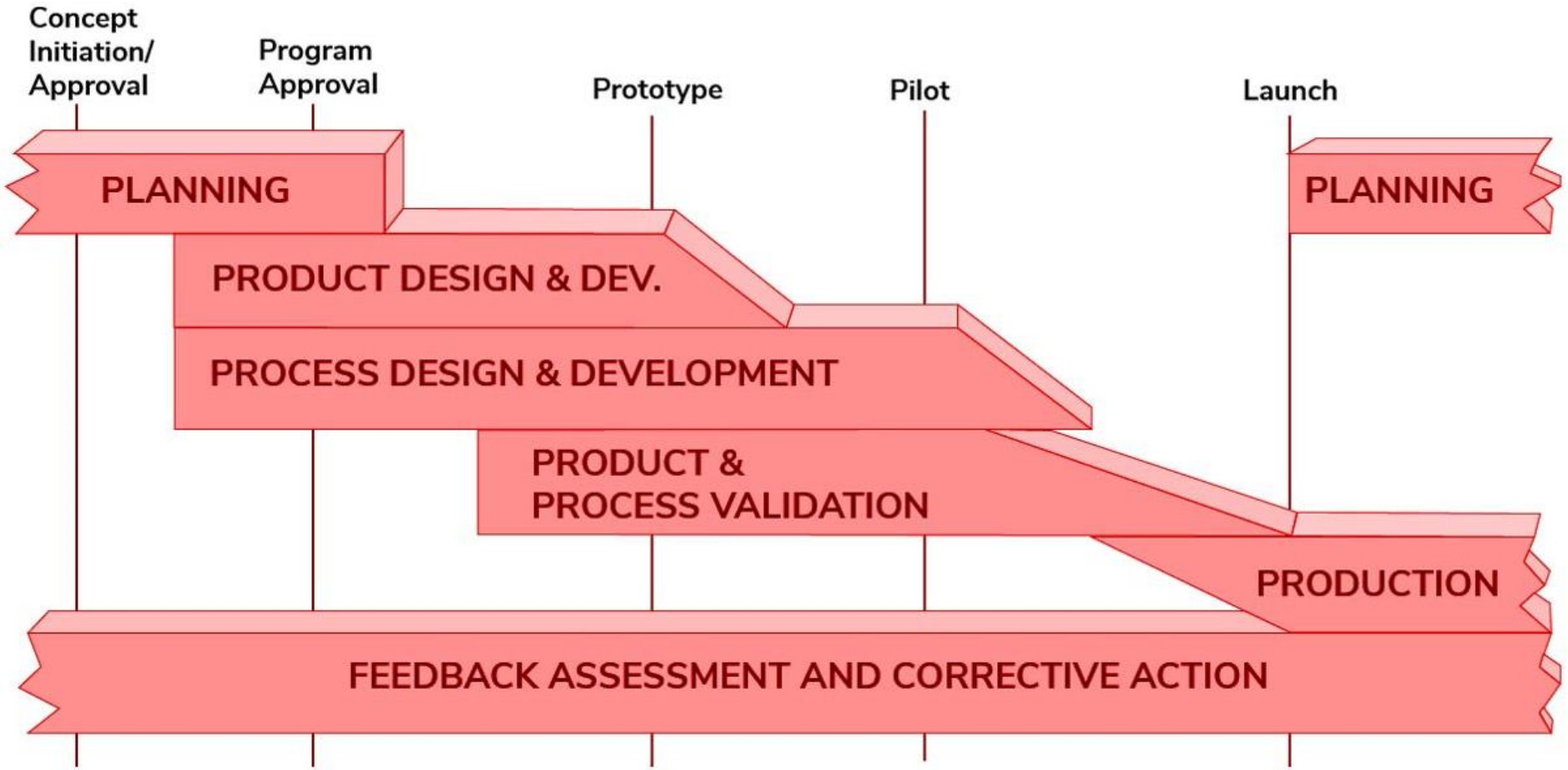
- The AAIG Website: https://www.aiag.org
- Product Code: APQP
- Publication Description: APQP and Control Plan provide a process to reduce the complexity of product quality planning for suppliers and customers, and allows organizations to easily communicate product quality planning requirements to suppliers.

- In addition to acquiring the publication, On-line and On-Site training opportunities exist that can culminate in AAIG APQP/PPAP Certification.

The APQP Process

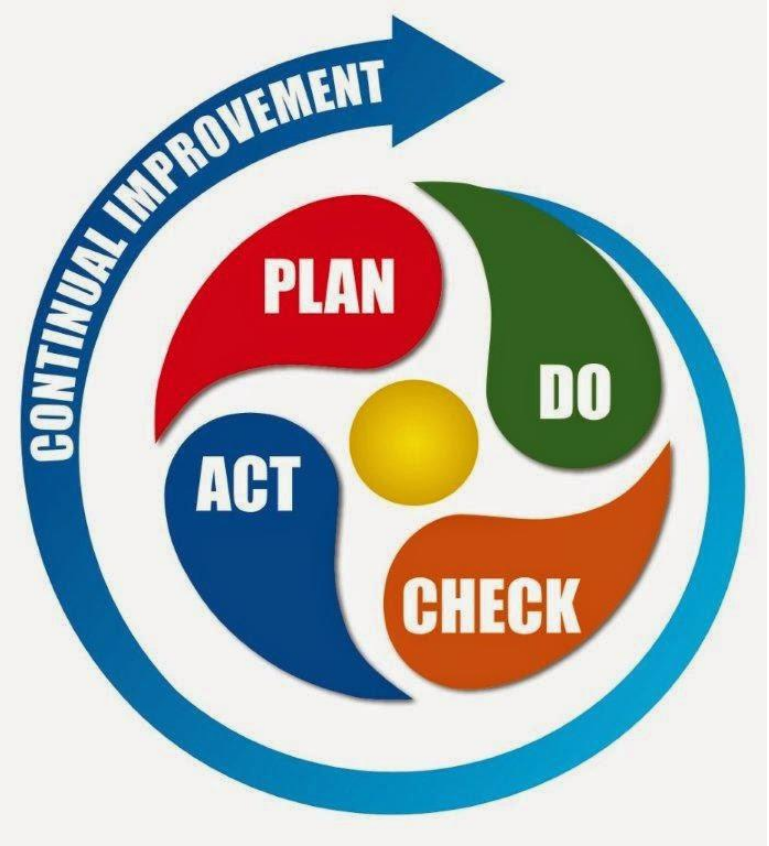
- With APQP, upfront planning and output review work together to support continuous improvement. Suppliers understand the requirements of all parties, and an approved product design reflects this.
- The process includes:
  - Prepare (Organize)
  - Plan and Define (Customer Requirements)
  - Product Design and Development (Features and Characteristics)
  - Process Design and Development (Manufacturing System and Control Plans)
  - Product and Process Validation (Validates Manufacturing Process)
  - Feedback, Assessment and Corrective Action (Evaluate Output)

Product Quality Planning Cycle



APQP Incorporates the Deming Cycle, or PDCA

- **Plan** – Technology and Concept Development
- **Do** – Prototype | Product | Process and Prototype Development
- **Check** – Product Verification and Validation Process
- **Act** – Continuous Improvement



Core Tools Used APQP

- There are numerous tools and techniques described within the APQP Publication. Each tool has potential value when applied in the correct timing. Tools that have the greatest impact on product and process success are called the Core Tools. The Core Tools are:
  - Failure Mode and Effects Analysis (FMEA)
  - Measurement Systems Analysis (MSA)
  - Statistical Process Control (SPC)
  - Production Part Approval Process (PPAP)

Failure Mode and Effects Analysis (FMEA)

- Failure Mode and Effects Analysis (FMEA) is a structured approach to discovering potential failures that may exist within the design of a product or process.
- Failure modes are the ways in which a process can fail. Effects are the ways that these failures can lead to waste, defects or harmful outcomes for the customer. Failure Mode and Effects Analysis identifies ,prioritizes, and limits these failure modes.
- Developed in the 1950s, FMEA was one of the earliest structured reliability improvement methods. Today it is still a highly effective method of lowering the possibility of failure.

Measurement Systems Analysis (MSA)

- MSA is defined as an experimental and mathematical method of determining the amount of variation that exists within a measurement process.
- Variation in the measurement process can directly contribute to our overall process variability.
- MSA is used to certify the measurement system for use by evaluating the system’s accuracy, precision and stability.

What is a Measurement System?

- A measurement system has been described as a system of related measures that enables the quantification of particular characteristics.
- It also includes a collection of gages, fixtures, software and personnel required to validate a particular unit of measure or make an assessment of a feature or characteristic being measured.
- The sources of variation in a measurement process can include the following:
  - Process – test method, specification
  - Personnel – the operators, their skill level, training, etc.
  - Tools / Equipment – gages, fixtures, test equipment used and their associated calibration systems
  - Items to be measured – the part or material samples measured, the sampling plan, etc.
  - Environmental factors – temperature, humidity, etc.

Statistical Process Control (SPC)

- SPC is method of measuring and controlling quality by monitoring the manufacturing process. Quality data is collected in the form of product or process measurements or readings from various machines or instrumentation.
- Data collected is then used to evaluate, monitor and control a process. SPC is an effective method to drive continuous improvement.
- By monitoring and controlling a process, we can assure that it operates at its fullest potential.

Production Part Approval Process (PPAP)

- PPAP defines the approval process for new or revised parts, or parts produced from new or significantly revised production methods.
- There are five generally accepted PPAP submission levels:
  - Level 1 – Part Submission Warrant (PSW) only submitted to the customer
  - Level 2 – PSW with product samples and limited supporting data
  - Level 3 – PSW with product samples and complete supporting data
  - Level 4 – PSW and other requirements as defined by the customer
  - Level 5 – PSW with product samples and complete supporting data available for review at the supplier's manufacturing location
- The PPAP process consists of 18 elements that may be required for approval of production level parts. Not all of the elements are required for every submission.

18 Elements of PPAP

1) Design Documentation
2) Engineering Change Documentation
3) Customer Engineering Approval
4) Design Failure Mode and Effects Analysis
5) Process Flow Diagram
6) Process Failure Mode and Effects Analysis
7) Control Plan
8) Measurement System Analysis Studies
9) Dimensional Results
10) Records of Material / Performance Tests
11) Initial Process Studies
12) Qualified Laboratory Documentation
13) Appearance Approval Report
14) Sample Production Parts
15) Master Sample
16) Checking Aids
17) Customer Specific Requirements
18) Part Submission Warrant

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Thank you