Methodology for Zero Defect Station by Advanced Product Quality Planning

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Abstract: This paper presents the methodologies applied for zero defect station in an Automobile industry. APQP can lead to the high quality products which meet customer desires and at the same time increase the operating income requirements for an organization. It is a structured step-by-step approach intended to achieve product and process design without affecting quality, performance, reliability, safety or environment. Advance product quality planning framework is a standardized set of quality requirements that enable to design a product which satisfies customer. The primary goal of the product quality planning is to facilitate the communication and collaboration between engineering activities. A Cross Functional Team (CFT), involving marketing, product design, procurement, manufacturing and distribution process. Advanced product quality planning ensures the Voice of the Customer (VOC) is clearly understood, translated into requirements, technical specifications and special characteristics. The product or process benefits are designed in through prevention. Advanced product quality planning supports the early identification of change, both intentional and incidental. These changes can result in exciting new innovation supporting customer delight. When not managed well they translate to failure and customer dissatisfaction. The focus of APQP is utilization of tools and methods for mitigating the risks associated with change in the new product or process for transaxle shop. Advance product quality planning is acts as catalysts for product processes by adding a focus on potential areas for failure or deburring the performance of the product. This methodology sticks to the ground and provides systematic solution to achieve perceived quality of product. APQP successfully create an impact on product quality with zero defect manufacturing (ZDM) with accepted quality level defined by the company.

Keywords: **Advanced Product Quality Planning, Performance, Quality, Cross Functional Team, Voice of Customer, Zero Defect Manufacturing.**

I. INTRODUCTION

This paper is related to the overall information about the advanced product quality planning methodology applied for zero defect station. Automotive industries are facing fierce competition in the market because of various factors like technology, standardization, quality, etc. This drives companies to work hard on systems of the company to improve and increase both quality and productivity continuously. One of the ways to increase productivity is to decrease the cost of poor quality. Lesser the poor quality components more will be the scope for increase in productivity keeping other functional aspects of management is rest assured. The ability to predict and prevent product failures is essential for managing the manufacturing process with the help of advanced product quality planning. Once failure symptoms are detected, timely maintenance needs to be performed with the support of required spare parts. However, the defect infancy rate is not resolved and a defect generation still continues, this increases the mean time to repair in the manufacturing process. In order to improve line Direct Run Rate (DRR), Direct Run Loss (DRL), uptime, preventive maintenance along with the availability of components plays a vital role. Procuring all related child parts for transaxle is a tedious job in terms of follow up and inventory cost. Critical to quality component matrix plays a solution for the above problem and keep the required components with zero defects at station level along to decrease the mean time to take repair. [1]

APQP can be applied for various ways to achieve process/product changes.

1. Identify the opportunity for improvement.
2. Contingency planning.
3. Anticipating problems.
4. Better product quality.
5. Do it first time right.
6. On time outputs.
7. Better communication.
8. Continual improvement.
9. Ensuring customer satisfaction.
10. Means for product checking and tracking.
11. Reduction in lead time by up-front planning.

Below are the reasons for conducting APQP exercises.

1. To promote early identification of required changes.
2. To avoid late changes.
3. To provide a quality products on time with lowest cost.
4. To facilitate communication with everyone involved in the team.
5. Developing easily understandable format by supplier & customer.

These are some fundamental activities considered while defining advanced product quality planning.

1. Organize the team.
2. Define the Scope.
3. Team to team collaboration.
4. Personnel training.

5. Customer and supplier involvement.

II. APQP PROCESS REVIEW

The advanced product quality planning (APQP) is a methodology used for new product development and existing product for development. It is a systematic approach to understand the customer requirements and ensure that all requirements are meet. It is a total integration of quality tools with management functions for product. APQP is consisting of one pre-planning stage and five concurrent phases and same as that of Plan-Do-Study-Act (PDSA) cycle. PDSA was made famous by W. Edwards Deming. Identifying early risk in product and process development is more desirable than finding late failure. The APQP phases are defined below.

1. Planning.
2. Product design and development.
3. Process design and development.
4. Process and product validation.
5. Feedback assessment and corrective action.

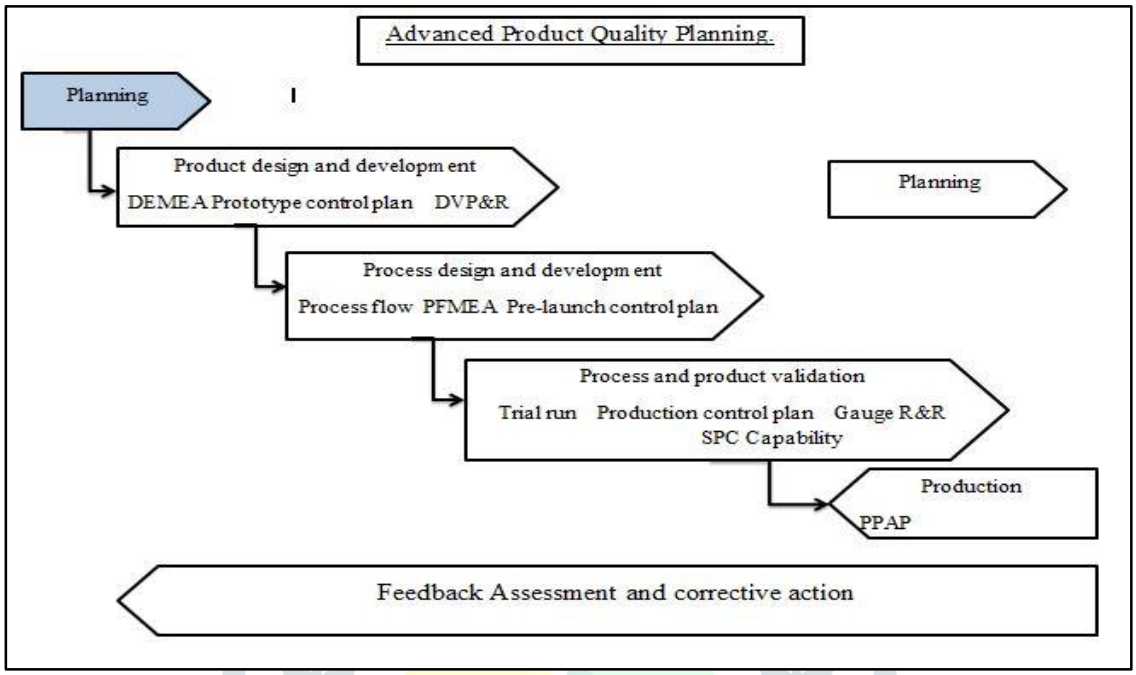

Fig.1 Process flow diagram of advanced process quality planning.

III. APQP APPROACH

Advanced Product Quality Planning (APQP) is a structured method for defining and executing the actions necessary to ensure a product satisfies the customer. APQP is program and supplier-led and is required of all system, subsystem and component manufacturing locations. APQP process is applied to both internal and external suppliers in an organization for achieving world class quality products with minimum cost of poor quality. For zero defect station, APQP approach applied from zero defect station with ASK principle of TQM and structured brainstorming is carried out in concurrent phases of APQP process. Zero defect continuous improvement programme training session is conducted within plant and feedback collected from them is used while implementing APQP process implemented at transaxle shop for Zero defect station.[2]

Advanced product quality planning methodology explained with these six steps.

1. Pre-planning.
2. Plan and define.
3. Product design and development.
4. Process design and development.
5. Product and process validation.
6. Feedback assessment and corrective action.

Pre-planning: In these step all the information pertaining about manufacturing of transaxle is carried out from the information available at transaxle shop floor. The various processes starts from the raw material to the final finished products and its qualitative testing are critically studied and analyzed. Assembly line of transaxle is studied at each individual station and each operation is seen find its significance with their functionality where assembly line of TA-7800 is composed into four main areas such as soft shop, heat treatment shop, hard shop, assembly line.

Plan and define: APQP processes mainly starts with plan and define. In this step, identification of critical to quality (CTQ) station is initiating course of action is taken as inputs. Besides these are following input parameters considered for process are listed below:

i. Voices of customer.
ii. Product/process benchmark data.
iii. Product/process assumptions.
iv. Targets for product quality life, reliability, durability, Maintainability, timing and cost.
v. Customer inputs such as special characteristics, identification, traceability and packaging. [3]

With the inputs taken at plan and define step coverts the voices of customer are converted into the technical requirements through quality function deployment (QFD) approach for selection of CTQ station. For Identification of critical to quality station in the transaxle shop QFD analysis is done on the basis of CTQ process requirements within shop data.

After QFD analysis, the measurement needs to perform at CTQ station to know about the contribution of defect source individually as well as in combination. The selected CTQ stations are critically observed during this phase and the selection of CTQ station depends upon the resolution requirements for first shot OK transaxle. [4]

Product design and development: Product design and development is the second phase of the advanced product quality planning methodology. To develop design features and characteristics into the final near form product quality planning team should consider all design factors in the planning process to ensure the final product will satisfy the voices of the customer.

Product design is originally created at research and development center and its prototype development starts within the plant with α (alpha), β (beta) batch before coming to the actual production batch in the form of 1-5-25. Design factor should be considered even if the responsibility is owned by the customer and shared. In the product design and development phase these all points must be included to ensure the sound quality of the product.

i. Engineering drawing.
ii. Design Failure Mode and Effect analysis. (DFMEA)
iii. Design for Manufacturing and Assembly.
iv. Engineering specification/material specification.
v. Special product/process Characteristics.
vi. Prototype building.
vii. Prototype control plan.
viii. Targets for the productivity, process capability and cost.
ix. New equipment's, tooling and facilities requirements.
x. Gauge testing equipment's requirements.
xi. Team feasibility commitments.

Product design and development phase points 1 to 5 are included for specific Product design and from points, 6 to 11 are considered under development or in advance quality department.

Process design and development: This phase is mainly dealt with the major features of developing a manufacturing process and its related control plan to achieve quality products. The manufacturing system must assure those customer requirements, needs and expectations are met. The outputs from the product design and it is ensured with developments are taken as input for the process design and development. These are some points which included in this process design and development phase are listed below.

i. Pre-launch control plan
ii. Characteristics matrix.
iii. Process flow chart
iv. Floor plan layout
v. Process Failure Mode and Effect Analysis. (PFMEA)
vi. Data for quality, reliability, maintance and measurements.
vii. Method of rapid detection and feedback.
viii. Results of error proofing activities as CAPA report.
ix. Measurement System Analysis (MSA) plan.
x. Packaging standard.
xi. Packaging Specification.

The scope for the problem statement of the project includes some of the following points in order to achieve zero defect station. The process flow chart, process failure mode and effect analysis are the basic footsteps in the phase of process design and development. Afterwards, scrutiny for the gear noise, hard shifting and housing leakage is started over it. Method of rapid detection and feedback is an important to step which will stands with the root cause analysis. [5]

Process and product validation: Process and product validation is the fourth phase of the advanced product quality planning methodology. To develop zero defect products it is prime importance to validate the manufacturing process through an evaluation of a production trial run. During production trial run the product quality planning team should validate the control plan and process flow charts are being followed and products should meet customer requirements. There is also one concern that should be identified for the investigation and resolution prior to the regular production run.

Process and product validation should be assessed within the transaxle shop and it starts within the plant with α (alpha), β (beta) batch before coming to the actual production batch in the form of 1-5-25. Manufacturing issues factor should be considered even, its responsibility is owned by the corresponding authority and shared. The validation of the effectiveness of the manufacturing process begins with the production run. Quantity of the production run set by the customer usually but exceeded by the product quality planning team. In the process and product validation phase these all points must be included to ensure the zero defect of the product.

i. Preliminary process capability.
ii. Measurement system analysis (MSA) evaluation.
iii. Final feasibility.
iv. Process review.
v. Production validation testing.
vi. Production part approval.
vii. Packaging approval.
viii. First time capability.
ix. Quality planning sign-off.

In Process and product validation phase points 1 to 4 are included for specific CTQ station and from points, 5 to 9 are considered under development parts in the advance quality department. The scope for the problem statement of the project includes some of the following points in order to achieve zero defect station. The preliminary process capability, Measurement system analysis for

final product, Gauge repeatability and reproducibility (GRR) of CTQ dimension are the basic footsteps in the phase of process and product validation. Afterwards, scrutiny measures such as process capability, gauge calibration, Kappa study is done at CTQ station. [6]

Feedback assessment and corrective action: Feedback assessment and corrective action is the final phase of the advanced product quality planning methodology. Product quality planning does not end with process and product validation. In the individual component manufacturing stage, all outputs are evaluated where all assignable causes, common and special causes of variation are recorded as past trouble data base format for internal customer. All external customers are evaluated with potential supplier assessment (PSA) for product quality assurance.

IV.SUMMARY

In this paper, the methodology was set to implementation of zero defect station with the application of advanced product quality planning methodology. Advanced product quality planning is now currently used in the advanced supplier quality department for achieving zero defect products growing in the automobile industry also, APQP methodology is growing in the field of quality assurance process like purchase and supply chain functions for the preparation of zero defect product. APQP process makes a paradigm shift in end to end supplier engagement with strong commitment for world class supplier quality.

1. The parts and products obtained from the APQP methodology have more direct run rate and high product quality.
2. The products verified with APQP gate review at each stage for kick-off of tooling, risk priority review, early production review and final PPAP documents issued with level of acceptance from both side of the organization.
3. APQP methodology gives detailed insights about the function of design, manufacturing, purchase and supply chain department to strive for excellence.
4. APQP methodology helps to achieving and exceeding the global benchmark levels to manufacture and deliver the highest quality products to customer.

V.References

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