APQP- A Management Tool

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ABSTRACT

Advance Product Quality Planning (APQP) is emerging as a stimulus exercise to rejuvenate the manufacturing procedure of a product in an industry. It is not an ambiguity over the other quality management program like TQM (Total quality management), Six Sigma, TPM (Total productive management) as it clearly emphasize on the process improvement rather than the quality improvement. The successful implementation of the APQP covers every lacuna that can arise during production. In today's competent environment it has become very important for industries to heed upon the productivity simultaneously with quality. APQP complies with a system which consists of planning the quality of a product in advance and then developing it in a strategic manner. In this paper, the authors discuss various concurrent phases of APQP in the development of a product which shows how the goals of APQP in industries can be achieved and surpassed through the complimentary usage of this approach.

KEYWORDS - APQP, TPM, TQM, NPD

1. INTRODUCTION

APQP is a new product development (NPD) technique. Many authors argue for improved integrated product and process development (IPPD) methodologies. Olson et al. (2001), discussed the pattern of cooperation required between the functional groups of R&D, marketing and operations during various project phases. These authors found that a high level of cooperation between the functional groups was a critical factor that was related to project success for high levels of innovation. This finding is supported by Ancona and Caldwell (1990) and Anderson (1998), who noted that when technologies are challenging and time to market becomes even more important, deeper and more intensive cross functional integration is required. This paper presents APQP as a management tool for improving the performance of the industry by producing high quality products with high productivity. APQP is described as a philosophy, methodology and breakthrough strategy for developing the products in an organization. The purpose of APQP is to produce a product quality plan which will support development of a product or service that will satisfy the customer (Wang, 2009). APQP is a process developed in the late 1980s by a commission of experts gathered from the big three US automobile manufacturers: Ford, GM and Chrysler (Driva, 1997). This commission invested five years to analyze the automotive development and production status in the US, Europe and especially in Japan. At that time, the success of the Japanese automotive companies was starting to be remarkable in the US market. APQP was formulated to ensure that product quality is maintained and customer requirements are met (Carbone, 2005). APQP also helps in standardizing procedures and reporting formats across new product projects. The methods and tools of APQP make good business sense. The quality standards have been widely adopted and used in many industries.

2. PHASES OF APQP

Organizations structure the APQP process according to their needs, but past history within an organization also impacts on the existing product development methodology. However, methods such as APQP are required in order to facilitate the flow of information across the organization, within projects, and from project to project, while at the same time reducing paperwork Ghalayini and Noble (1996). Griffin and Page (1996) points out that the power of APQP is better estimating during project planning by integrating all of

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the required development information early, rather than redesigning and reworking the new product during manufacturing. APQP is intended to ensure that both the planning and the reviews of the project information are done in accordance with quality standards and the project objectives (Bobrek and Sokovic, 2005). APQP consists of five phases (Figure 1). In this section, it is explained how the APQP methodology is integrated as a development methodology within an organization for developing a new product. The goal of APQP is to facilitate communication between all persons and activities involved in a program and ensure that all required steps are completed on time, with a high quality-of-event, at acceptable cost and quality levels.

2.1. PHASE I (PLAN & DEFINE PROGRAM)

Determining the customer needs and expectations is the first and the most important step of any APQP project because understanding of customer expectations forms the backbone of the project and makes the job easier during development. The team for an APQP project is a multidisciplinary team. Effective APQP requires the involvement of more than just one department. The team includes representative from engineering, manufacturing, material control, quality control, sales, field service, supplier and customer as appropriate. During the selection of the project team leader who is responsible for overseeing the APQP project, it is always advantageous to rotate the team leader during the APQP cycle. Feasibility study of the proposed project is made by reviewing the design and manufacturing requirements, and their availability in the organization. Cost, timing and constraints are also given consideration during feasibility review. Based on the type of the product, its complexity and customer expectations, a time plan is prepared which consists of the list of tasks, assignments and other events. To facilitate status reporting, each event is provided with a 'start' and a 'completion' date.

The inputs to first phase of APQP are voice of customer, market research, historical warranty and quality requirement, past experiences, product/process benchmark data, product reliability studies and other customer inputs. Based on these inputs, the outputs of this phase are design goals, reliability and quality goals, bill of material, list of special product characteristics. In an APQP project it is essential to do all work with the customer (final user) in mind. The inputs and outputs applicable to every particular project may vary.

2.2. Phase II (Product Design & Development)

The APQP team considers all design factors to ensure that the final product satisfies "voice of the customer". Some times the required product designs/drawings are provided by the customer itself but yet supplier has to check the feasibility of those designs/drawings according to existing equipments and the manufacturing process to be used. The designs of other necessary equipment like jigs and fixtures, inspection gauges and other necessary equipments are also prepared. After the planning and development of design/drawings, the team conducts a Design Failure Mode and Effect Analysis (DFMEA) study which indicates various modes in which a design can fail and the effects of failures on the final assembly.

The inputs to this phase are the outputs of the first phase i.e. plan and define program. The outputs of this phase are the DFMEA, design reviews, engineering drawings, material specifications etc.

2.3. PHASE III (PROCESS DESIGN & DEVELOPMENT)

Designing of manufacturing process consist of sequencing of various operations required in the manufacturing of the required product (Hart, 1993). After finalizing the sequence of manufacturing process a Process Flow Diagram (PFD) is prepared and then a Process Failure Mode and Effect Analysis (PFMEA) is carried out which checks the feasibility of the planned and designed process. A shop floor layout for the process is prepared keeping in mind the existing layout of the shop floor. The inspection equipment for all operation stages are designed and developed. The inspection equipments are corresponding to the dimension/ shape which is being produced at that stage. A proper Measurement System Analysis (MSA) which includes the gauge R & R (Repeatability & Reproducibility) is conducted. The purpose of gauge R & R study is to ensure that the measurement system is statistically sound. Gauge R & R study determine how much of the process variation is due to the measurement system variation. Simultaneously the working of the existing as well as the new equipments is checked by conducting various trials. A proper process capability study is carried out by conducting trials on manufacturing equipments which tells about the variations in the process. All the observations like the process descriptions, key product characteristics, inspection equipment and checking aids, process capability index, frequency of inspection, process audit

method and frequency are enclosed in a single chart. This chart is known as control plan which is one of the very important outputs of the APQP project. This control plan is displayed on every work station for the convenience of the worker and engineers.

The inputs to this phase are the outputs of the second phase i.e. product design and development. The output of this phase are process drawings, PFD, shop floor layout, PFMEA, control plan, process work instructions, MSA, process capability plan and packaging standards.

2.4. PHASE IV (PRODUCT & PROCESS VALIDATION)

During this phase the manufacturing process is validated by means of an evaluation trial run. The trial run is named as Production Part Approval Process (PPAP). It consists of continuous production of about 300 nos. of parts on the same equipments and by the same operators who will produce the parts during upcoming production period. The number of parts can vary depending upon the type and volume of the parts. The APQP team verifies that the control plan and process flow chart are being followed and the product meet the customer requirements. These 300 parts are sent to the customer for approval along with the documents listed as follows:

- Design records(Drawings)
- Engineering change note
- DFMEA
- PFMEA
- PFD
- Control plan
- MSA
- Material test reports
- Appearance approval report
- Checking aids
- Part submission warrant etc.

The input to this phase is the output of the third phase and the outputs are the PPAP parts and documents.

2.5. PHASE V (FEEDBACK, ASSESSMENT & CORRECTIVE ACTION)

During this phase the optimal solution for reducing variations or mean is determined and confirmed. The objectives of this phase are:

- To confirm the key process variation.
- Test for improvement in centering.
- Use of brainstorming and action workout.
- Process optimization and confirmation experiments.
- To enhance delivery and service performance.

This phase helps to identify and quantify the key process variables and their influence on Critical to Quality (CTQ) factors. The step may involve the use of a variety of statistical methods and tools to determine high priority attrition variables and need to develop and/or redesign functions that impart product performance and success.

All the described phases of APQP are the simultaneous phases as shown in (Figure1). These phase need not to be started after completion of the previous phase. However the ending of the subsequent phase depends upon the ending of the previous phase.

3. CONCLUSION

APQP tools and methodology have evolved utilizing various domains associated with product development and process improvement. The evolution of APQP parallels the evolution of quality methods. It provides a comprehensive and flexible system for maximizing business success. It is like sowing good quality seeds for better tomorrow. It has been considered as a revolutionary approach to product and process improvement. The implementation of the APQP will clear every snag & paucity and make the manufacturing process streamlined. This paper illustrates the key ingredients of APQP methodology. Use of this approach will make production effective and more productive with less effort and less rejection. Companies that wish to accelerate development of their own management program can utilize the evolutionary phases explained in this paper to understand their current level of evolution and to implement focused actions that can quickly move them past their competition. The author also proposes the APQP system as a management tool for enhancing the performance of an industry (Figure 2). Integrating this management tool with the proper performance measure can initiate new knowledge which will contribute to the improvement of an industry. The further study of APQP performance measurement in conjunction with the different quality tools is recommended.

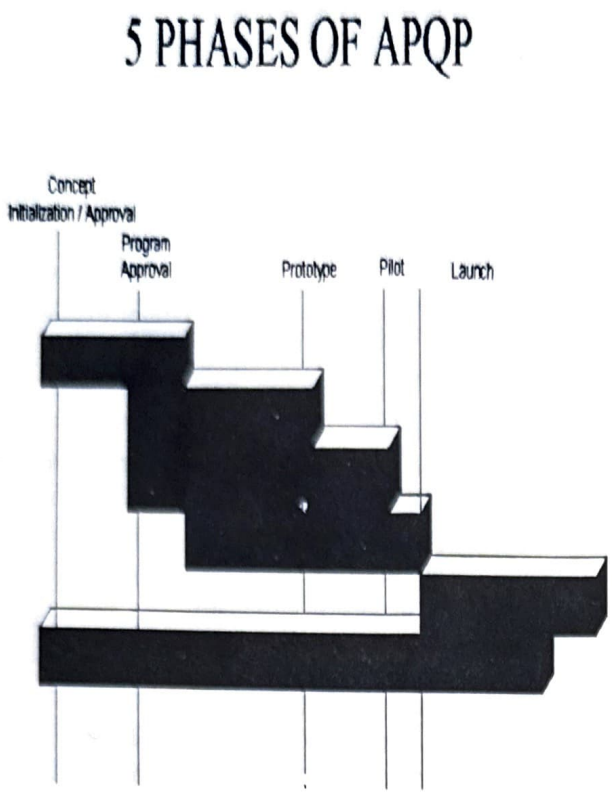

Figure 1 - Five Phases of APQP

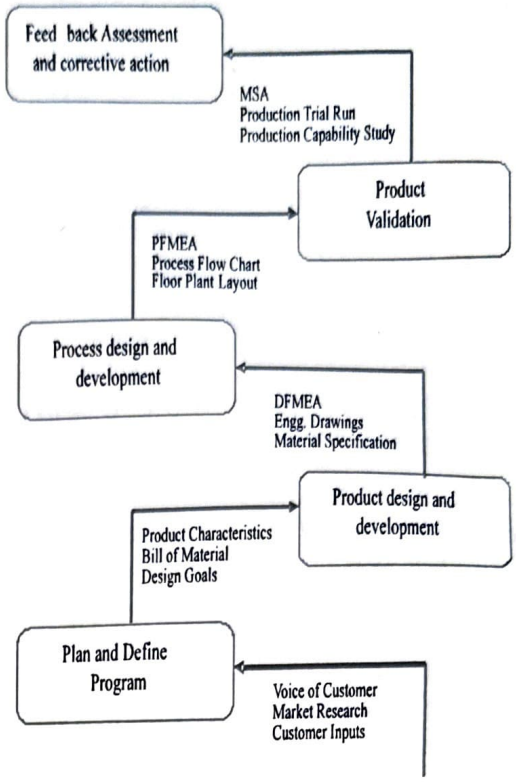

Figure 2-APQP Process Flow

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