

# Contributions concerning the possibility of implementing the APQP concept in the aerospace industry

*Alina Bianca Pop*<sup>1</sup>, *Mihail Aurel Țițu*<sup>2\*</sup>, *Constantin Oprean*<sup>3</sup>, *Costel Ceocea*<sup>4</sup>, *Andrei Victor Sandu*<sup>5</sup> and *Ștefan Țițu*<sup>6</sup>

<sup>1</sup> SC TechnoCAD SA, 72, Vasile Alecsandri Street, code 430351, Baia Mare, Romania

<sup>2</sup> “Lucian Blaga” University of Sibiu, 10, Victoriei Street, code 550024, Sibiu, România

<sup>3</sup> “Lucian Blaga” University of Sibiu, 10, Victoriei Street, code 550024, Sibiu, România

<sup>4</sup> SIF MOLDOVA Bacău, 94C, Pictor Aman Street, code 600164, Bacău, Romania

<sup>5</sup> “Gheorghe Asachi” Technical University of Iasi, Romanian Inventors Forum, 59A, Mangeron Street, code 700050, Iasi, Romania

<sup>6</sup> The Oncology Institute “Prof. Dr. Ion Chiricuță”, 34-36, Republicii Street, Cluj Napoca, România

**Abstract.** To ensure customer satisfaction, the products made by aviation, space and defense organizations need to be continuously improved from the point of view of safety, security, reliability and maintainability. The improvement goal is to be at the customers’ requirements and legislations level, if not even to overcome it. The occurring problem with the final products is the challenge to ensure their quality in a shorter time. In this research the importance of implementing the APQP concept in the aeronautical industry is highlighted. To achieve this purpose, the methodologies needed to ensure that the product development processes of the aviation, space and defense industry are fully integrated processes ranging from concept and design to planning, manufacturing and production, aiming the product good use, a quality service and finally getting a positive customer feedback. The final goal of this concept implementing is the Production Part Approval Process (PPAP), which is actually the main result of APQP confirming that the manufacturing process has demonstrated the potential to achieve products that consistently fulfil absolutely all the expressed and not expressed customer requirements.

## 1 Introduction

"The design methodology is requiring that designers have to learn how to use what they already know, have to learn how they can realize what they do not know, and they have to learn how to learn what they need to know." [1] For designing, to understand and master product quality planning, the Advanced Product Quality Planning concept (APQP) is often employed. The APQP concept belongs to standardized quality management in automotive industry (QS 9000 demands) [1]. This concept consists of a structured method which define and establish the necessary measures to ensure that a product meets the customer

---

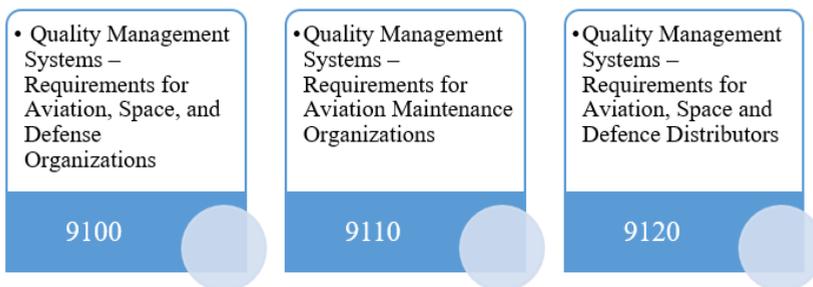
\* Corresponding author: [mihail.titu@ulbsibiu.ro](mailto:mihail.titu@ulbsibiu.ro)

requirements. The methods like APQP are required if it is desired to facilitate the information flow across the whole organization, through projects, and from a project to another project, and at the same time reducing the number of documents [2]. Brewer highlight that the APQP power is better to estimate during the planning of the project by rapidly integrating all necessary development information, rather than redesigning and reprocessing the new product during manufacture [3]. Lynn states that, in addition to a firm able to control the ability of executing the project phases, they can and must also consider project documentation, recovery, revision and clarity of the vision [4]. APQP is designed to ensure that both planning and reviewing project information are done according with the quality standards and project objectives. As a part of ISO standards [5], the APQP manual is describing the minimum results for each phase of the project. These notes, “(organizations) must demonstrate that they are meeting the intent of the (APQP) methods or techniques described in the manuals, even if they are not using them as stated.” [6] Advanced Product Quality Planning represents the procedures and techniques framework that is used to develop the industry products, particularly in the automotive industry. APQP is a structured method which is focused to define and establish the steps of a product development system for General Motors, Ford, Chrysler and their suppliers [7].

APQP supports a product development and product quality plan to fulfil the needs of the internal and external customers. The APQP includes one pre-planning stage and five concurrent, collaborative sections. This process consists of a continuous cycle and is often described by the Plan, Do, Check, and Act Cycle (PDCA). Each section is based on a logical sequence of analytical techniques and tools that are used to risk and weakness discovering. The APQP team members are cross functional, they are able to identify each risk, and to take some actions in order to reduce or better, to eliminate the potential failure [7].

Advanced Product Quality Planning is a procedure mainly utilized in the automotive industry [8] but the quality planning process within the APQP can be applicable in all industries [9, 10]. In order to significantly improve the quality, delivery and safety and cost reduction, the Aviation, Space and Defense industry has set up the International Aerospace Quality Group (IAQG) including America, Asia/Pacific and Europe. The International Aerospace Quality Group (IAQG) recognizes that the aerospace industry is very different from other industries and therefore has developed a manual to guide companies working in the industry which is based upon the quality planning principles as Deming pioneered from the 1950s and the automotive industry during the later decades of the 20th Century.

Ford & Chrysler, in June 1994, collaboratively wrote and published the first Advanced Product Quality Planning (APQP) manual for the automotive industry. The International Aerospace Quality Group (IAQG) developed Quality Standards to provide supporting information for organizations that apply the 9100 standards, and to provide guidance for organizations that choose to progress beyond its requirements. The 9100 standard is one of the three quality management system standards developed by the IAQG - Figure 1.



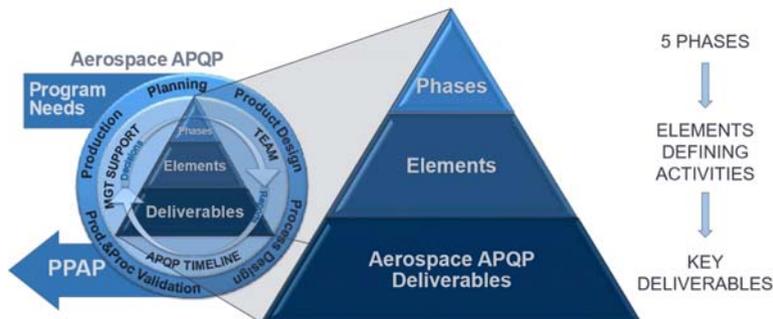
**Fig. 1.** The quality management system standards developed by the IAQG.

The IAQG standards outlined in the Figure 2 can provide assistance to organizations when they are establishing or seeking to improve their quality management systems, their processes or their activities.



**Fig. 2.** The IAQG standards.

The APQP purpose is to assure that new products satisfy customer requirements and wants. This includes product needs as well as project timing and delivery. A successful APQP project will always start with a detailed plan based on key customer dates. A project management approach that continually reinforces identification and mitigation of risks, monitors status of tasks and deliverables, and escalates issues to management as necessary is used to implement the plan. Another success factor of APQP is the establishment of a cross functional team to ensure alignment of timing, understanding of deliverables, and avoidance of miscommunications. [11]. The APQP concept practically is applying the PDCA cycle to the project management process [7]. Deming's Plan, Do, Check and Act (PDCA) represent a four-step management method that is used in businesses in the case of the processes and products control and continuous improvement. The PDCA cycle enables a company to ensure that its processes are proper resourced and managed, and that the improvement opportunities are determined and acted on.



**Fig. 3.** The Aerospace APQP Principles [11].

The APQP principles can be schematically represented by Figure 3. As this Figure shows the APQP principles can be defined in terms of 5 Phases, Elements that are activities defining and key Deliverables.

In this scientific paper the importance of implementing the APQP concept in the aeronautical industry will be highlighted. The methodologies needed to ensure that the product development processes of the aviation, space and defense industry are fully integrated processes ranging from concept and design to planning, manufacturing and production, aiming the product good use, a quality service and finally getting a positive feedback from the customer, are presented. The final goal of this concept implementing, is the Production Part Approval Process (PPAP), which is actually the main result of APQP confirming that the manufacturing process has demonstrated the potential to achieve products that consistently fulfil absolutely all the expressed and not expressed customer requirements.

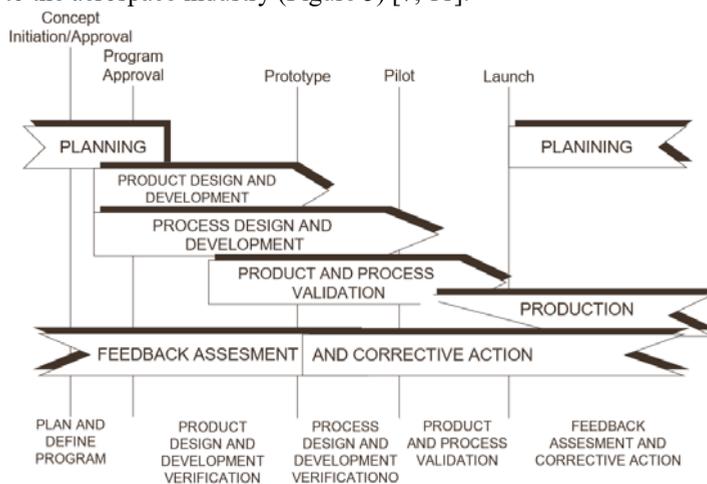
## 2 The APQP phases defined in the automotive industry vs. the aerospace industry

The aerospace and automotive industries are two major manufacturing industries. They have evolved drastically over the last 30 years in terms of product performance, focusing on high technology and significantly reducing market time. Both sectors are based on rigorous quality requirements, advanced materials, electronic and integrated systems, mechanical components, motors, structures.

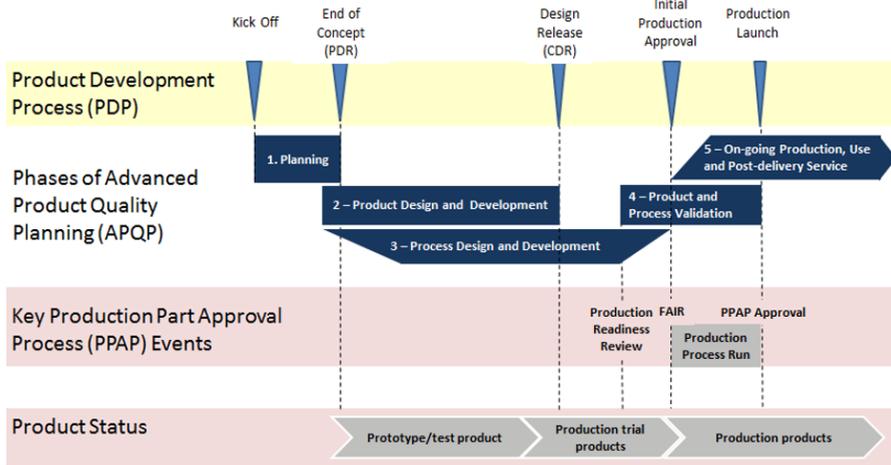
The aerospace industry has a strong requirement for certification and requirement compliance, with implications for development costs and technological solutions. The automotive industry requires less formal processes, although the focus is on compliance.

The automotive industry tends to be hit faster by economic recessions than the aerospace industry, due to its shorter product development and life-cycle. With regard to the military and defense sector, things are slightly different, in the sense the political factors and the global stability are not always linked to the global economy parameters.

Next, the APQP phases defined in the automotive industry (Figure 4) are compared to those defined to the aerospace industry (Figure 5) [7, 11].



**Fig. 4.** Product quality planning and APQP phases [7].



**Fig. 5.** Product development process and APQP phases [11].

By the Figures 4 and 5, it can be seen that each section has inputs, outputs and gateway reviews with management. The gateways are timed to coincide with key decisions impacting project Quality, Cost or Delivery. The APQP culminates in a sample submission as evidence that the product quality, as planned, was achieved. This activity is named Product Part Approval Process (PPAP). PPAP highlights the evidence or proof collected by APQP and it is validating with the first trial run results. The trial run cannot represent a prototype. This trial must to represent a production environment, with correct machines, tools, personnel, processes and conditions that can affect part quality.

Thus, in order to help suppliers to formulate a plan with the least negative impact on the functioning of the existing organization, the following steps are recommended:

- Training is needed because the organization needs to understand the philosophy, methodology and techniques described in the APQP manual to enable them to implement and use them effectively;
- The entire organization must also have a clear understanding of where the specific roles are in the overall activity;
- There must be no expertise in all the methods and techniques discussed in the APQP manual, but it should be understood if they would be beneficial to the organization. This also applies to other projects, such as the QS9000 deployment itself;
- To make the process visible and identify where the organization is already using multidisciplinary approaches;
- To identify what activities are currently being advanced quality planning activities;
- To identify what advanced quality planning activities the organization should do;
- To develop a plan.

### 3 Conclusions

The APQP use project management to drive on-time and on-quality delivery of the product by monitoring key project deliverables.

APQP employs a cross-functional approach in order to support commitment and effective communication, and also it establishes proactive and preventative mind set.

The Advanced Product Quality Planning concept helps to satisfy the customer with:

- Improved product quality by risks anticipation and mitigation;
- Defects elimination and process variation reduction;
- Shorter lead time by waste and rework reducing and better manage capacity;

-Lower costs.

The need of APQP standard in aerospace industry is given by the necessity of align and organize the huge number of requirements specific to aerospace in order to get the best product quality.

This approach is coming only now, after years, because, so far, aerospace is concerned mainly in making parts flight worthy with all controls need to succeed for what was design, in steady Automotive is concerned with extremely high levels of consistency with high volumes and extreme cost cutting pressures. Now, since the build rate for aircraft it is increasing, and cost reduction becomes more important, the APQP methods becomes more important.

From quality perspective is well know that:

- One of the main tools for achieving the high level of quality for Aerospace is the First Article Inspection.

- One of the main tools for achieving the high level of consistency (another word for quality) in Automotive is the PPAP.

PPAP really only works well with high volume, but those who have extensively used it seem to believe that it works for everything.

## References

1. J. Gharajedaghi, *Systems thinking - Managing Chaos and Complexity* (Butterworth Heinemann, Boston, Oxford, 1999)
2. E. Mitchell, *Quality*, **40**, 40 (2001)
3. J. C. Brewer, *Automotive Industries*, **182**, 34 (2002)
4. G. S. Lynn, R.R. Reilly, A.E. Akgun, *IEEE Transactions on Engineering Management*, **47**, 221 (2000)
5. R. A. Munro, *Quality*, **41**, (2002)
6. L. C. Thisse, *Quality Progress*, **31**, 73 (1998)
7. Chrysler Corporation, Ford Motor Company and General Motors Corporation, *Advanced Product Quality Planning (APQP) and Control Plan* (Reference Manual, 1995)
8. Ford/GM/Chrysler, *Advanced Product Quality Planning and Control Plan*, (Essex: Carwin Continuous, 1995)
9. M. Borbek, M. Sokovic, *J. of Mat. Proc. Tech.*, 718 (2005)
10. M. Morris, Retrieved 7 7, 2013, (*Advanced Product Quality Planning: static.squarespace.com*, 2012)
11. *Advanced Product Quality Planning (APQP) Production Part Approval Process (PPAP), Guidance Material for International Aerospace Standard 9145, IAQG, SCM Section 7.2.3 APQP* (2017)