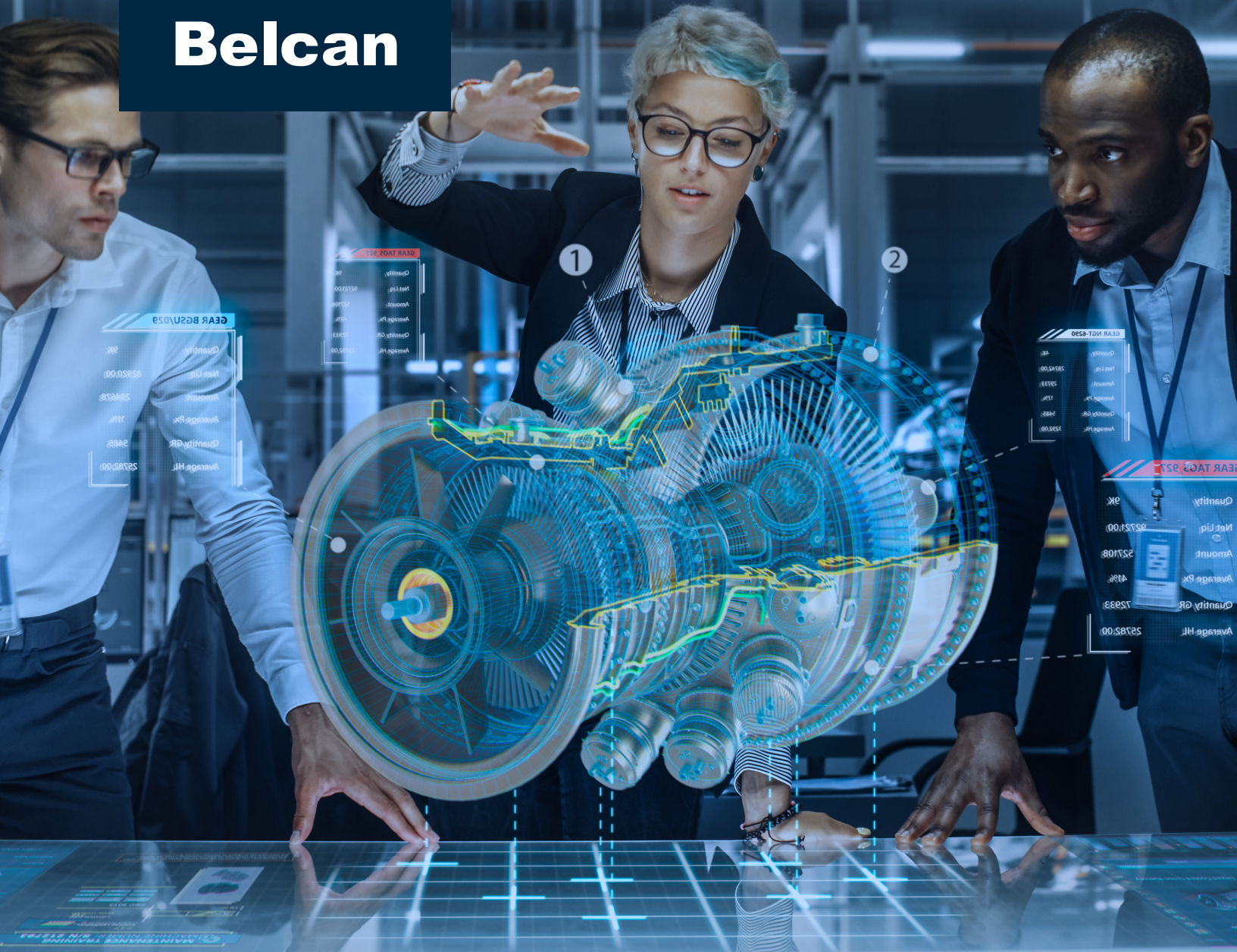


Belcan



January 2023

Aerospace APQP – Ready for Takeoff in 2023?

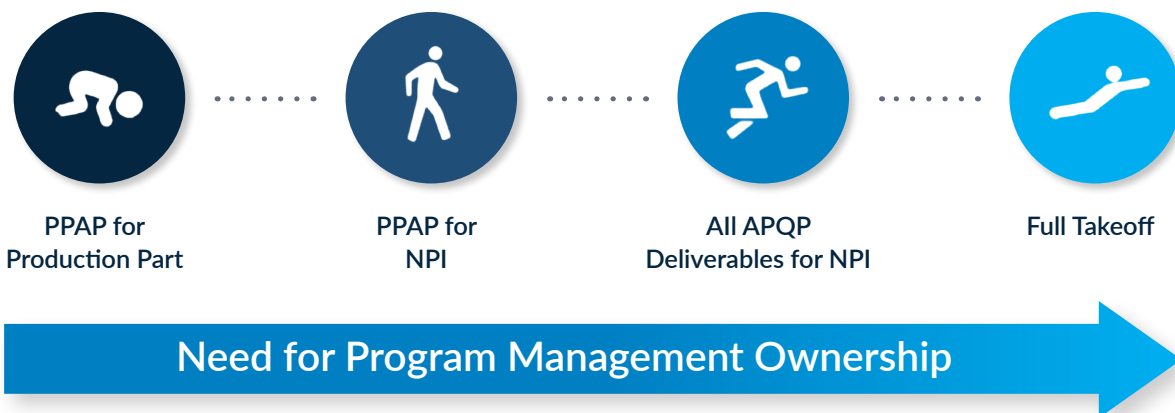
EXECUTIVE SUMMARY

Many aerospace organizations first took notice of Advanced Product Quality Planning (APQP) – a best practice framework for new product introduction (NPI) – in November 2016 with the release of AS9145 (the aerospace standard for APQP). Since then, aerospace organizations looking to adopt APQP have struggled due to the high complexity involved, budget constraints, and/or ownership issues. The global, multi-year impact from COVID-19 has also greatly hindered adoption.

Heading into 2023, aerospace APQP adoption is seeing some tailwinds. With the impact from COVID-19 waning, companies are starting to turn attention and investments back to pre-COVID initiatives like APQP. Also, leading aerospace engine organizations from the Aero Engines Strategy Group (AESG) are driving increased interest in APQP via a mandate that SAE AS13100 – a standard that encompasses AS9145 – be adopted by the aerospace engines supply chain by December 31, 2022.

APQP is typically considered “owned” by the quality function. However, if aerospace APQP adoption is to greatly escalate in 2023, the program management function within the adopting organization, not quality, needs to assume more ownership and act as the driving force. Organizations can accelerate this necessary shift by taking three actions: 1) enacting an intense APQP awareness campaign with targeted training for program management, 2) creating dedicated APQP Project Manager roles that are accountable for driving timely submission of APQP deliverables over the life of the program (including, but not limited to, PPAP elements), and 3) establishing a program management “infrastructure” aligned to AS9145.

2023 is indeed emerging as a significant year for aerospace APQP, but will it truly take off? The answer to this question remains to be seen; it may depend on how effectively aerospace organizations are able to shift adoption ownership to the program management function.



Typical APQP Adoption Journey

Aerospace APQP – What Is It?

APQP is a best practice framework for NPI that emphasizes investing more time, effort, and resources in the early stages of a program to significantly improve performance over the entire program life cycle (see **Figure 1**). In addition to reducing cost over the life of the program, successful adoption of APQP also reduces time to market, supports on-time delivery, and increases customer satisfaction.

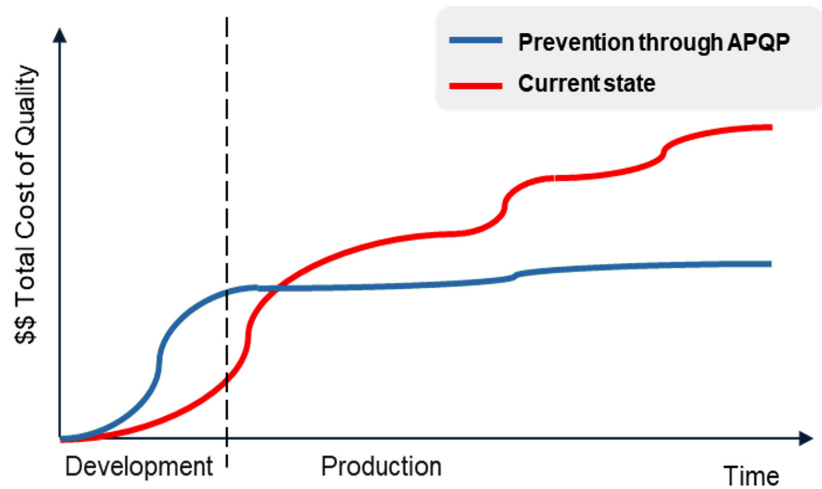


Figure 1: Investing More Upfront to Reduce Overall Cost

While APQP is a relatively new concept for aerospace, it has a decades-long track record of success in the automotive industry. Positive outcomes from that sector inspired the November 2016 publication of the AS9145 aerospace standard, which defines the aviation, space, and defense process requirements for APQP. AS9145 is a highly-structured framework that consists of five phases. **Figure 2** provides a conceptual illustration of the five phases, as well as how AS9145 and APQP fit into a typical product development process.

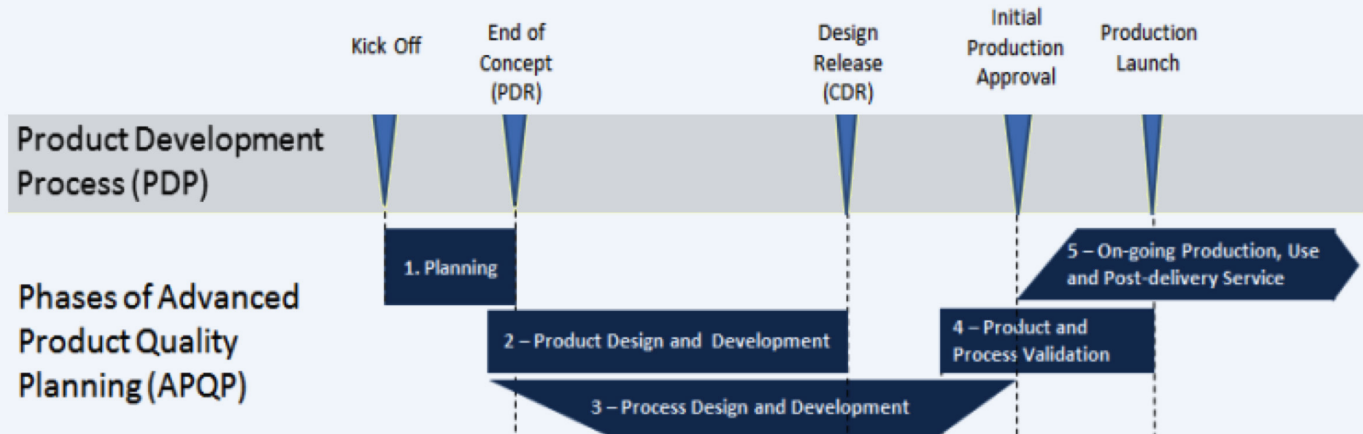


Figure 2: Product Development Process and APQP (Conceptual Illustration)

Source: SAE International AS9145 Standard

APQP's five phases encompass 50 deliverables, summarized by phase in **Figure 3**. A company adopting aerospace APQP will, for example, have developed a preliminary Bill of Materials (BOM), preliminary process flow diagram for making the product, and preliminary sourcing plan by the end of Phase 1, or the Preliminary Design Review (PDR). Historically, many aerospace organizations have failed to consider how a part will be made until later in the product life cycle, which can result in costly producibility issues.

1 - Planning	4 - Product and process validation
Product Design Requirements	Product from production process run(s)
Project Targets - safety, quality, manufacturability, service life, reliability, durability, maintainability, schedule, and cost	MSA
Preliminary listing of Critical Items (Cis) and Key Characteristics (KCs)	Initial process capability studies
Preliminary BOM	Control plan
Preliminary process flow diagram	Capacity verification
SOW review	Product validation results
Preliminary sourcing plan	First Article Inspection Report (FAIR)
Project Plan	PPAP file and approval form
	Customer specific requirements
2 - Product design and development	5 - On-Going production, use, and post-delivery service
Design risk analysis	Quality indices [e.g., CpK, Parts Per Million (PPM), rejection rates]
Design records and BOM addressing the findings of the design risk analysis	Key Performance Indicators (KPIs) reflecting product quality and reliability
DFMA, tolerance, stack-up analysis, etc.	Evidence that project targets have been met
Special requirements, including product KCs and Cis listings	On-time Delivery (OTD) and capacity KPIs
Preliminary risk analysis of sourcing plan	OTD and capacity improvement plan
Packaging specification	MRO KPIs and plan(s) to reach the established targets
Design review report	Project closure recommendations
Development product build plan	Continuous improvement actions
Design verification and validation plans, and associated results	Lessons learned
Feasibility assessment	Updated design risk analysis, PFMEA, and controls plans
3 - Process design and development	
Process flow diagram	
Floor plan layout	
Production preparation plan	
Operator staffing and training plan (Human Resources)	
PFMEA	
Process KCs	
Control plan	
Preliminary capacity assessment	
Work station documentation	
Measurement Systems Analysis (MSA) Plan	
Supply Chain Risk Management Plan	
Material handling, packaging, labelling, and part marking approvals	
Production Readiness Review (PRR) results	

 = PPAP Package Element

Figure 3: The 50 APQP Deliverables (Including PAP Elements) by Phase

Source: SAE International AS9145 Standard

A typical output of APQP is a Production Part Approval Process (PPAP) package, which consists of several “elements” including a Process Flow Diagram, Process Failure Model and Effects Analysis (PFMEA), Control Plan, and others noted in **Figure 4**. To realize the full benefit of APQP, PPAP elements should be developed during the APQP phases indicated in **Figure 3**.

In summary, aerospace APQP is a highly structured, best practice framework for NPI that drives discipline in the development process to ensure the **right deliverables** are completed at the **right times**, by the **right people**, within budget.

Typical PPAP Package Elements

- Design Risk Analysis (e.g., DFMEA)
- Process Flow Diagram
- Process Failure Mode and Effects Analysis (PFMEA)
- Control Plan
- Measurement System Analysis (MSA)
- Initial Process Capability Studies
- Packaging, Preservation, and Labeling Approvals
- First Article Inspection Report (FAIR)
- Customer PPAP Requirements
- PPAP Approval Form (or equivalent)

Figure 4: Typical PPAP Package ‘Elements’

Aerospace APQP – Tailwinds Heading Into 2023

Moving into 2023, aerospace APQP adoption has proceeded unevenly, with mixed results. Belcan experience shows that challenges related to complexity, ownership, budget, and flow down to suppliers are major headwinds. Global, industry-wide events like COVID and the grounding of the Boeing 737 MAX also contributed to slow adoption over the last several years by diverting industry resources and focus elsewhere.

Although aerospace APQP adoption has been sluggish until now, several tailwinds exiting 2022 suggest that 2023 might see a significant uptick across the industry. As the impact of COVID continues to wane, more aerospace companies are turning attention and investment back to pre-COVID strategic initiatives like APQP/PPAP – both in terms of internal adoption and flow down to suppliers. With some industry experts predicting global air traffic will return to pre-Covid levels as soon as 2023, things seem to be returning back to normal.

Leading aerospace engine original equipment manufacturers (OEMs) from the Aerospace Engine Supplier Quality (AESQ) Strategy Group, such as GE Aviation, Pratt & Whitney, Honeywell, Rolls-Royce, and others noted in **Figure 5**, are also driving increased APQP activity heading into 2023 with a mandate that the engine supply base adopt SAE AS13100 (inclusive of APQP) by December 31, 2022. Per the AESQ, SAE AS13100 *“has been created to harmonize and simplify supplier quality requirements that are in addition to the requirements of AS/EN/SJAC9100 Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations and AS/EN/SJAC9145 Advanced Product Quality Planning and Production Part Approval Process.”*



Figure 5: AESQ Strategy Group Members

Given the criticality and influence of these engine OEMs, the rollout of SAE AS13100 will no doubt lead to an uptick in APQP adoption activity as aerospace engine suppliers look to remain compliant and competitive.

¹ <https://www.fitchratings.com/research/corporate-finance/global-aerospace-defense-outlook-2023-industry-continues-to-recover-supply-chain-is-key-risk-30-11-2022>

² <https://aesq.sae-itc.com/as13100-resources>

2023 Critical Success Factor – Program Management Ownership

The notion that the quality function “owns” APQP deployment is a common misconception among organizations attempting to implement APQP. A key contributing factor is that aerospace organizations – as a part of a “crawl, walk, run” strategy – routinely equate APQP adoption with completion of a PPAP package. In the early stages of adoption, completion of PPAP elements is not usually aligned to the phases described earlier, and in many cases initial APQP adoption efforts are limited to PPAP packages for existing production parts, as shown in **Figure 6**. Since the quality function owns or contributes to many of the PPAP elements (e.g., Control Plan, Measurement Systems Analysis, First Article Inspection Report, etc.), quality is typically viewed as the primary functional owner of APQP overall. Advancing from adequately completing PPAP packages to executing APQP as an NPI process requires greater ownership by the program management function.



Figure 6: Typical APQP Adoption Journey

Action 1 – Foster APQP Awareness Through a Training Campaign

The first action organizations can take to shift more ownership of APQP adoption to program management is to implement an APQP awareness and training campaign. The IAQG Supply Chain Management Handbook – which has a wealth of publicly available APQP and PPAP templates, tools, and training – is an excellent place to start.

For program management, the focus should be on developing APQP generalists, or “APQP Champions,” who can drive the end-to-end APQP process and the holistic set of APQP deliverables across the five phases (**Figure 3**). Program management should also be familiar with PPAP and able to contribute in cross-functional working sessions, but the deep PPAP expertise is better left to other functions like engineering, quality, production, and procurement. See **Figure 7** for a sample awareness / training strategy.

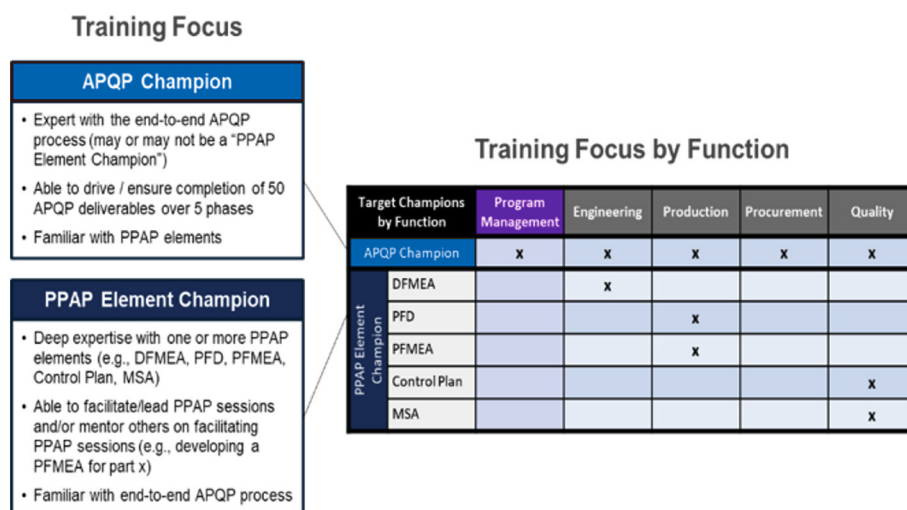


Figure 7: Sample APQP Awareness / Training Strategy

Action 2 – Create a Dedicated APQP Project Manager Role Within Program Management

Organizations with scale should look to establish a dedicated APQP Project Manager role aligned to the program management function to drive internal adoption (see **Figure 8**). A key responsibility of the APQP Project Manager is to establish an APQP project plan that identifies which APQP deliverables are applicable (see **Figure 3**), when are they due, and which function is the owner. Over the life of the program, the APQP Project Manager should perform three key functions:

- 1) Monitoring and ensuring timely completion of deliverables across organizational functions.
- 2) Providing APQP coaching and mentoring to functional stakeholders where needed.
- 3) Harvesting artifacts and lessons learned throughout the program and providing communication for future programs.

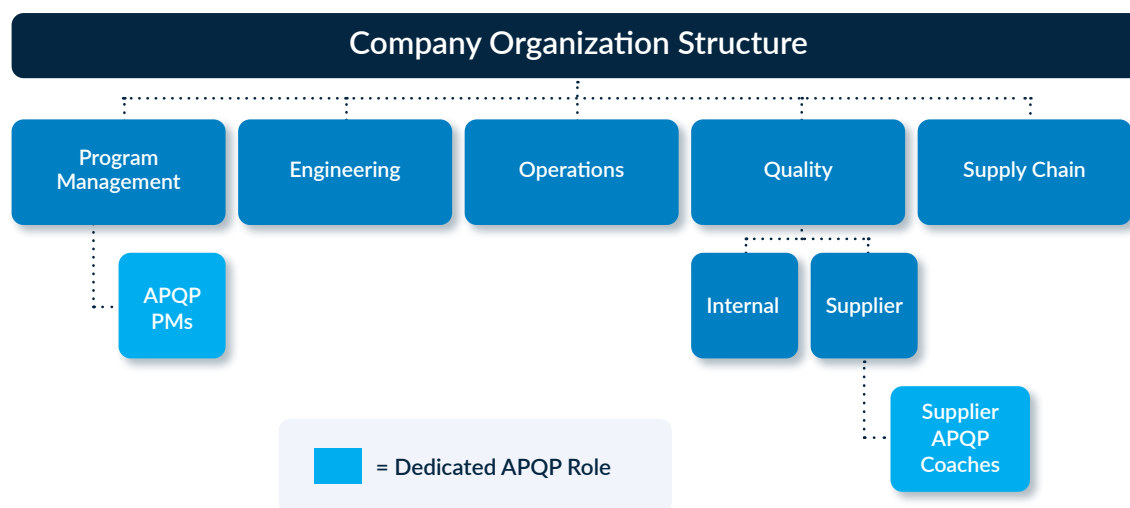


Figure 8: Organizational Structure with Dedicated APQP Roles

For smaller organizations that are accountable for complying with APQP yet are not able to support a dedicated APQP Project Manager role, program managers must take on the above APQP project management responsibilities. However, such organizations are more likely to instead continue relying on quality and other production-related functions for PPAP as an output, not full-blown APQP as a process (see **Figure 6**).

While the need is greater for internal adoption, there is also benefit in dedicated APQP roles that interface with suppliers. Boeing, for example, has recently posted several positions for “APQP Coaches” on its careers site intended to support supplier APQP adoption efforts that complement Boeing’s approach. As with internal adoption, smaller organizations that cannot support a dedicated role must distribute the workload to other roles, such as supplier quality engineers and/or supplier development engineers.

Action 3 – Establish Program Management “Infrastructure” Aligned to AS9145

Program management leadership and/or dedicated APQP Project Managers should be tasked with better aligning program-management-related processes, procedures, and tools with AS9145. High-priority items include existing procedures that govern NPI activity (e.g., a company’s “tollgate” process), project planning templates, design review checklists, and checklists for other reviews (e.g., production rate readiness). Sample questions that should be addressed include:

- “Are the right types of reviews scheduled at the right points in time?”
- “Does the preliminary design review process call for the right artifacts?”
- “Am I conducting production-related reviews soon enough?”

The effort should also ensure that templates and guidance are readily available for all APQP deliverables, not just the PPAP elements. The [IAQG SCMH](#) is an excellent source for such templates and guidance. **Figure 9** provides an example of guidance for the “Preliminary Risk Analysis of Sourcing Plan” deliverable called for during APQP Phase 2 (see **Figure 3**).

	A	B	C	D	E	F	G	H
	#	Question	Y*	N	N/A	RAG		Evident
1	1	Have all make/buy decisions been made?						
2	2	Have key suppliers been identified?						
3	3	Are selected suppliers capable of supporting the development effort, i.e. lead time, capacity, capability, etc.?						
4	4	Have new suppliers been qualified and evaluated for risk?						
5	5	Has risk been evaluated for outsourced new and unique designs?						
6	6	Are design responsible suppliers engaged in the organizations APQP activities?						
7	7	Have design requirements been provided to design responsible suppliers?						
8	8	Have design responsible suppliers confirmed their understanding and capability to meet the design requirements?						
9	9	Have the supplier risks been summarized in the sourcing plan?						
10	10	Have risk mitigation plans been established for the identified risks?						
11	11	Are the sourcing risks and mitigation plans reviewed at the design reviews?						
12	12	Is there a plan for transitioning hardware from developmental suppliers to production suppliers when developmental hardware is not procured from the production suppliers?						
14								Deliverable R
16		Status (%)	25% - Action Identified	50% - Owner Identified	75% - Action in Progress	100% - Action Closed		
17								
18								

Figure 9: “Preliminary Risk Analysis of Sourcing Plan” Deliverable - Guidance/Template
Source: IAQG Supply Chain Management Handbook

CONCLUSION

2023 should be a dynamic year for aerospace APQP as organizations refocus on pre-Covid-19 initiatives and industry heavyweights like Boeing, GE Aviation, Pratt & Whitney, Rolls-Royce, and other engine OEMs encourage adoption among their supply base. For maximum impact and success, these organizations would be wise to encourage greater APQP ownership from program management.

Ultimately, achieving a transformational shift takes time—especially in an industry known for its complexity. To that end, 2023 is more likely to be a year devoted to increasing awareness among aerospace program management teams and continuing mastery of PPAP. If 2024 is to be the year APQP takes off, organizations need to give themselves a long runway and act now.

ABOUT BELCAN

Belcan is a global supplier of design, software, manufacturing, supply chain, information technology, and digital engineering solutions to the aerospace, defense, space, government services, automotive, and industrial markets. Belcan engineers better outcomes for customers – from jet engines, airframe, and avionics to heavy vehicles, automobiles, and cybersecurity. Belcan takes a partnering approach to provide solutions that are adaptable, integrated, and value-added, and has been earning the trust of its customers for over 60 years. For more information, please visit www.belcan.com.

ABOUT THE AUTHOR

Scott O'Day, based in Boston, is a Vice President within Belcan's Manufacturing & Supply Chain Solutions organization. Since the release of AS9145 (aerospace standard for APQP) in November 2016, Scott has led multiple strategic engagements with leading aerospace companies looking to adopt APQP internally as well as flow down to their respective supply chains. **Scott can be reached at soday@belcan.com.**