TRANSFORMING SAFETY:
Intelligent Engineering with AI-Powered Quality Control

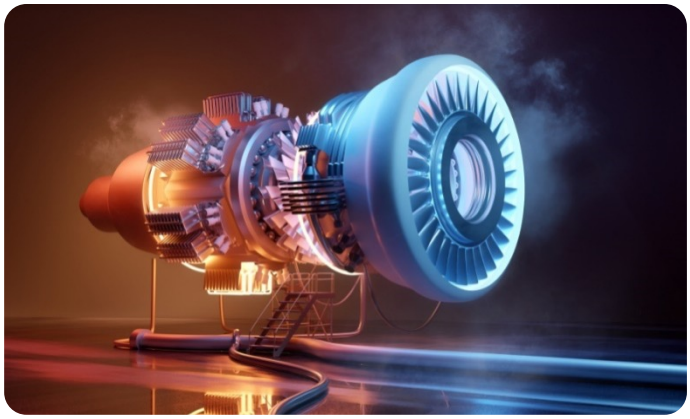
Introduction

Aerospace and other safety-critical industries operate in environments where precision, reliability, and safety are paramount. These sectors, which include the manufacturing of aircraft or rail components, defense systems, healthcare products, demand the highest standards of quality conformity to ensure that every part and process meets rigorous specifications. The complexity and potential consequences of failures in these industries necessitate stringent quality control measures throughout the manufacturing process and beyond. In the realm of aircraft design and manufacturing, given the importance of safety and the potential consequences of failure, every component—from structural elements to avionics systems — must adhere to stringent quality standards and regulatory requirements. Ensuring conformity not only supports the safe operation of aircraft but also drives efficiency within the industry.

Despite meticulous design according to stringent parameters and standards, discrepancies in fit, form, and function often only become apparent during the manufacturing or assembly phase of aircraft production. Precision is crucial in aircraft design and manufacturing; identification and quick resolution of quality issues is challenging. Even with rigorous supplier onboarding processes, issues can still arise due to the inherent complexity of the design and its producibility. Long lead times and high costs associated with certain components, further complicated by supply chain difficulties also impact timely delivery.

Aerospace Industry struggles with high volumes of quality non-conformities, creating huge backlog of ECNs (Engineering Change Notices). Typically engineering managers see about 15 to 20% of their team's effort goes in dealing with ECN or non-conformity approvals, rather than focus on design improvements coming from field issues, innovation or new product development.

We will delve into the specific challenges faced in this domain and explore how advanced technology and innovative solutions can effectively address these issues. By examining these challenges in detail, we aim to identify strategies that can enhance quality and operational efficiency, driving significant improvements across the industry.



Industry Challenges

Having highlighted the critical role of quality and non-conformity in safety-critical industries, let's now explore the specific challenges these sectors face. We will examine how these challenges impact operations and performance, providing a detailed look at the issues and their broader implications for industry efficiency and safety.

Safety Risks: Minor deviations from quality standards can lead to severe accidents or failures, potentially jeopardizing the safety of consumers.

Complexity of Systems: Modern systems involve numerous interconnected components, where a single non-conforming part can disrupt the entire system. Identifying and addressing these non-conformities is resource-intensive, requiring advanced diagnostic tools and extensive testing.

Regulatory and Safety Compliance: Adhering to stringent standards and regulations is mandatory, with non-conformities potentially resulting in penalties and legal issues. Additionally, maintaining comprehensive documentation and traceability to demonstrate compliance adds to the complexity and cost of operations.

Economic Impact: Rectifying defects incurs immediate costs such as repairs, redesigns, or recalls, while long-term financial consequences can include increased insurance premiums, loss of contracts, and diminished market competitiveness.

Operational Efficiency: The volume of Engineering Change Notices (ECNs) can reach tens of thousands, making it challenging to find appropriate resolutions. The immense effort required to review varied and recurring issues in documentation can lead to production delays and operational inefficiencies. Addressing these quality problems often demands extra resources, raising overheads and impacting budgets.

Reputational and Market Impact: Persistent quality issues can damage an organization's reputation, eroding customer and stakeholder confidence, while also weakening its competitive edge in the market.

As the industry grapples with these challenges, the imperative for robust quality control systems and proactive risk management becomes even clearer. Addressing these issues not only enhances safety and performance but also streamlines operations, paving the way for sustained progress and excellence in these critical fields. In addressing the multifaceted challenges of quality non-conformity, technology and artificial intelligence (AI) are proving to be transformative allies. These advanced tools offer innovative solutions to streamline processes, enhance precision, and reduce the impact of quality issues. AI provides a great opportunity to contextualize the issues and remediation combing through all the documentation and history. It provides a great assistance to improve the throughput, consistent resolution and consolidate the input for further design improvements. AI and machine learning can optimize the management of Engineering Change Notices (ECNs) by automating routine approvals and integrating them into the broader design and production workflow. AI systems can prioritize ECNs based on their potential impact, expedite approvals for low-risk changes, and facilitate faster updates to designs and processes.

Intelligent Engineering Solution

When a product fails to meet its quality requirements, an Engineering Quality Notification (EQN) is raised to assess and implement appropriate remedial actions that align with design, functional, and regulatory standards. In aircraft manufacturing, the high volume of EQNs complicates the timely and efficient application of corrective measures. Manually addressing these non-conformities is not only time-consuming but also consumes 15 to 20% of core engineering resources, which could otherwise be allocated to innovative product development or more value-adding activities.

At the Cyient-Microsoft 'EnGeneer' Center of Excellence which was established to leverage AI and Generative AI technologies, we developed an advanced digital platform. It is designed to electronically document, manage, and track non-conformities in materials, work-in-process, and finished components. Utilizing AI, our platform quickly provides dispositions based on historical engineering decisions. The data sources that our system distills information from includes concessions data, plants data, maintenance logs, and repair actions. The platform correlates the data sources with the components on which the EQN was noticed. Has the ability to feed the data from the non-conformance into Product development or Engineering to reduce future non conformances. By improving the productivity by 80-90% and reducing resolution time from days to minutes, this solution accelerates time-to-market, reduces inventory and scrap, and enhances quality management. It also improves cross-functional communication among inventory control managers, manufacturing engineering managers, production control managers, and quality inspectors, streamlining the product development process.

Conclusion

As we reach the end of our reflections, it is quite evident that addressing the quality challenges in safety-critical industries requires a strategic approach supported by advanced technology. The key takeaways would be:

Complexity and Impact

High volumes of Engineering Quality Notifications (EQNs) and the inherent complexities in manufacturing processes make it challenging to resolve non-conformities efficiently, impacting overall performance and resource allocation.

Technological Solutions

Leveraging intelligent digital platforms and AI-driven tools can significantly enhance the management of non-conformities, streamline corrective actions, and improve cross-functional communication among key stakeholders.

Comprehensive Advantages

Implementing these technologies not only accelerates time-to-market but also reduces inventory, minimizes scrap, and enhances quality management, ultimately leading to more efficient product development and better alignment with design and regulatory standards.

By adopting these innovative solutions, industries can more effectively address their quality challenges, leading to improvements in safety, efficiency, and overall operational excellence. Our partnership with Microsoft through the EnGeneer Center of Excellence focuses on enhancing engineering lifecycle agility by developing platforms and tools that provide engineers with advanced automation and support, ultimately boosting productivity and quality through Generative AI.

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