Replacement of an Obsolete Absolute Pressure Sensor in an Engine Electronic Control Unit

Francisco Rivera Alvarado
Advisor: Dr. Héctor J. Cruzado
Graduate School

Abstract

This project analyzed the replacement of an obsolete absolute pressure sensor in an Engine Electronic Control (EEC) system used in aerospace applications. The obsolescence of the absolute pressure sensor created a supply continuity risk that could impact production. The project implemented a PMBOK-based project management framework to coordinate technical evaluations, qualification testing, and configuration updates. Results demonstrated that the selected replacement sensor met form, fit, and function requirements, maintaining EEC performance and certification standards. The work ensured production continuity and compliance while mitigating risks related to obsolescence.

Introduction

The Engine Electronic Control (EEC) is a computer system that regulates engine fuel flow, manages thrust, and interfaces with flight crew alert systems. One of its key components, the absolute pressure sensor, has recently become obsolete by its manufacturer. This obsolescence can create a significant challenge for production. This project involved coordination among engineering, supply chain and manufacturing teams to ensure the replacement meets the standards and certification requirements.

The problem addressed by this project is the loss of supply continuity for the absolute pressure sensor due to obsolescence. Without a qualified replacement, the production of the EEC is at risk, potentially impacting delivery schedules to customers. Furthermore, replacing the absolute pressure sensor requires comprehensive engineering management since it will involve engineering, supply chain and manufacturing teams to perform a requalification of the part.

The objective of this project is to have a fully qualified and implemented replacement for the obsolete absolute pressure sensor in the EEC unit, meeting all program standards. This will ensure continuity of production and compliance with all certification requirements.

Literature Review

Obsolescence in avionics represents a challenge due to the mismatch between the long service life of aircraft systems and the much shorter technology cycles of electronic components. Obsolescence is the inevitable consequence of the dependence of aerospace on a supply base whose major markets are outside of aerospace and whose technology life cycles are much shorter than those of other markets [1]. This means that manufacturers and operators must constantly deal with supply risks and find ways to manage these changes so aircraft can remain safe and compliant.

One of the components affected by this challenge is the absolute pressure sensor. These devices measure pressure against a fixed vacuum, which allows them to provide stable and accurate readings regardless of outside conditions.

Literature Review

Absolute pressure sensors are suited to applications demanding consistent and precise pressure measurement, irrespective of external conditions [2]. Figure 1 shows a typical absolute pressure sensor used in aerospace applications, which illustrates the type of component affected by obsolescence in this project. This reliable performance is critical in fields like altimetry, barometric weather sensing, and aerospace instrumentation, where even small variations in pressure readings can lead to performance issues.

Figure 1
Absolute Pressure Sensor (Source: kulite.com)

Replacing obsolete parts in electronic engine controls requires more than just swapping components. New parts must prove they are as reliable as the old systems. A basic criterion for FAA acceptance of the replacement of hydromechanical technology with electronic technology for engine controls is that the new technology must have an equivalent level of integrity and reliability as the technology being replaced [3]. This standard underscores why avionics component obsolescence cannot be managed by substitution alone, but instead requires comprehensive validation.

The development of electronic engine control units (EECUs) has emphasized the need for rigorous testing to ensure reliability. The EECU is a very important component in aircraft engines, and the verification test for numerous items should be carried out in its development process [4]. Figure 2 illustrates the EEC Unit, which integrates critical sensing and control components involved in this qualification process. Their work on simulation-based testing highlights how performance verification not only ensures compliance but also mitigates risks associated with costly engine testing.

Figure 2
Engine Electronic Control Unit (Source: safran-group.com)

Finally, project management practices can help organizations handle obsolescence in a structured way. Emerging technology, new approaches, and rapid market changes disrupted our ways of working, driving the project management profession to evolve [5]. Applying this framework to engineering projects emphasizes planning for technology transitions and addressing obsolescence within structured methodologies.

Methodology

To replace the obsolete absolute pressure sensor in the EEC, the project implemented the PMBOK process framework modified for engineering management activities. The methodology consisted of five phases, each executed collaboratively between engineering, supply chain, and quality teams.

- Initiation: The scope of the project was defined to include sensor selection, qualification, and EEC integration. Stakeholders were identified across mechanical, electrical, and systems engineering disciplines. Engineering drawings, supplier notices, and customer specifications served as primary inputs to establish the technical baseline.
- Planning: A comprehensive project plan was developed that included a schedule, cost estimates, and a risk management plan. Qualification and verification requirements were defined based on FAA standards and historical test data. Microsoft Project was used to manage schedules, and Excel was used to track costs and risks. The deliverable for this phase was a detailed project plan with milestone tracking.
- Execution: Candidate absolute pressure sensors were procured from qualified aerospace suppliers. Technical evaluations compared sensor specifications, signal output, and environmental durability to the obsolete design. The engineering team updated the EEC drawings through a Class II change process and coordinated laboratory validation testing. Test data confirmed that the new sensor met all form, fit, and function requirements for integration.
- Monitoring & Controlling: Project progress was monitored against the established schedule and risk register. Weekly stakeholder reviews ensured that technical and schedule risks were addressed promptly. Data from qualification testing were analyzed to confirm sensor stability, temperature range compliance, and reliability. Adjustments were made to mitigate supply chain risks through the identification of a second-source supplier.
- Closing: Final qualification documentation was completed, including supplier validation reports, updated EEC drawings, and test results. The qualified replacement sensor was released to production, ensuring compliance with FAA and customer requirements. The final deliverable was an approved configuration package and a project summary report documenting all activities and results.

Results

The project successfully identified and qualified a replacement absolute pressure sensor that satisfied all performance and regulatory criteria. The selected sensor demonstrated equivalent characteristics to the obsolete part. The qualification test validated sensor performance and confirmed that the new sensor maintained stable readings and met all acceptance criteria. Additionally, risk mitigation efforts resulted in the approval of a secondary source supplier, reducing long-term supply vulnerability. The project was completed on schedule and within budget, enabling uninterrupted EEC production and ensuring alignment with customer requirements and FAA compliance standards.

Conclusions

The replacement of the obsolete absolute pressure sensor in the Engine Electronic Control system was successfully completed through a structured engineering management process. The PMBOK-based framework facilitated coordination across technical and organizational boundaries, enabling effective risk control and compliance verification.

The results confirmed that the new sensor met all technical requirements and maintained EEC performance integrity. The qualification process ensured that FAA standards for reliability and integrity, as well as for customer requirements, were achieved.

References

[1] Federal Aviation Administration. (2015). *Obsolescence and life cycle management for avionics (DOT/FAA/TC-15/33)*. U.S. Department of Transportation, Federal Aviation Administration, William J. Hughes Technical Center. https://rosap.ntl.bts.gov/view/dot/57637

[2] Superior Sensor Technology. (2024, November 6). *Understanding absolute and gauge pressure sensors.* AZoM. https://www.azom.com/article.aspx?ArticleID=24030

[3] Federal Aviation Administration. (2001). Compliance criteria for 14 CFR § 33.28—Electrical and electronic engine control systems (Advisory Circular AC 33.28-1).

[4] Kho, S., & Park, H. (2021). *Design of the Electronic Engine Control Unit Performance Test System of Aircraft.* Aerospace, 8(6), 158. https://www.mdpi.com/2226-4310/8/6/158

[5] PMI. (2021). A Guide to the Project Management Body of Knowledge (PMBOK Guide) (7th Ed). Project Management Institute