base2 solutions

CASE STUDY

FINDING THE ROI ON MANUFACTURING LINE OPTIMIZATION

INDUSTRY
Aerospace

OBJECTIVE
Reduce number of production test flights required to deliver each aircraft.

SOLUTION
Gather and process data on all in-flight anomalies and recurring failures. Drive cross-functional team approach to determine root cause and pursue corrective action. Develop short-term containment actions to reduce likelihood of continuing failure until permanent fix is in place.

SERVICES

Systems Engineering

Program Management

Quality Assurance

Supplier Management

Base2 Solutions consultants led the effort to optimize airplane manufacturer's flight line, resulting in dramatic improvement of production flight test performance, saving tens of millions of dollars per year.

The results of Base2's leadership of the Flight Improvement Team was a dramatic increase in production flight efficiency. Over the course of two years, the average number of flights above the FAA mandated minimum required to deliver an airplane was reduced by 72%. This resulted in improved on-time customer delivery, enhanced customer satisfaction, bolstered brand equity, and a savings of tens of millions of dollars per year.

Base2 determined which problems were causing the largest disruptions to production flight-testing.

There are several phases in getting a large commercial aircraft through production and delivered to an airline. After roll-out from the factory, assembly work is completed on the flight line, final ground tests are completed, and test flights are conducted by both manufacturer and airline test pilots, culminating in airplane delivery to the airline for entry into revenue service.

Unfortunately for the manufacturer, this isn't always a smooth process. In-flight anomalies and failures known as "squawks" can occur during test flights and must be remedied. This is an arduous and expensive process, requiring sign-off by the manufacturer's Engineering, Quality and Operations teams, followed by acceptance by the airline customer and their flight crew. For significant issues or problems without a known and proven fix, additional test flights may be required to demonstrate that the problem was resolved. This sometimes results in recurring issues that require numerous test flights, which are extremely costly – significantly cutting into per-aircraft profit margins.

THE FLIGHT IMPROVEMENT TEAM
Base2 Solutions' Systems Engineers formed the core of a Flight Improvement Team tasked with identifying and resolving chronic flight squawks. As the improvement effort evolved, the role of the team expanded to identify issues occurring during pre-flight testing, allowing the team to implement creative solutions to resolve issues in order to reduce re-work and to minimize flight schedule delays.

Using a systems engineering methodology, Base2 determined which problems were causing the largest disruptions to production flight-testing. The

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manufacturer's Quality Management System used by the Quality and Operations teams failed to flag recurring issues so the Flight Improvement Team created and populated a flight squawk database by reviewing and categorizing every squawk reported by the flight crews. This list was then prioritized based on the rate of occurrence per failure, and its impact to the flight profile. This systematic approach resulted in a comprehensive, prioritized list of chronic issues. Using this priority ranking, the team then worked to determine the root cause of the failures, and devised a short-term containment strategy to reduce impact to future flights as well as pursuing a final resolution to the issue.

DETERMINING THE CHRONIC ISSUES
To devise final resolutions to squawks, Base2 investigated each chronic issue in order to identify the underlying cause for these repeated failures. While the specific root causes were different, Base2 frequently identified patterns that fell into broad categories, such as manufacturer quality, supplier quality, and engineering design errors and inadequacies.

Base2 worked with Industrial and Manufacturing Engineering teams to get airplane assembly drawings updated and corrected, and to get functional tests clarified or rewritten to better catch chronic issues. Base2 also worked with the Quality and Operations teams to identify areas where retraining was required to ensure compliance with released engineering.

Base2 worked with both the manufacturer's Supplier Management and Design Engineering teams and directly with the supplier's Engineering and Operations teams to identify and resolve recurring issues that were occurring at the Supplier's manufacturing site. Base2 involved the manufacturer's Supplier Quality representatives to ensure supplier audits were performed as required. In some cases, the manufacturer's production experts, both engineers and seasoned factory mechanics, were brought in to help suppliers optimize their production process.

DEFINING THE ISSUES

Base2 worked with the Design Engineering community to identify errors in design that were resulting in failures. These issues included; inconsistent released engineering; inadequate analysis of tolerance stack-ups that resulted in failures when products that were within the allowed tolerance stack were unable to meet the system's higher level requirement; and failure to account for environmental effects, usually temperature and pressure, causing failures in flight on systems that tested "good" on the ground.

Depending on the scope of investigation required, the identified corrective action, and the certification requirements, there can be a significant delay between problem identification and final resolution implementation on flight line airplanes. One of the most crucial tasks of the Flight Improvement Team was to identify containment approaches to shield the flight line from continuing failures while waiting for the resolution to be implemented. A common method to provide this protection was to institute new ground tests, or rewrite existing tests, to capture the specific failures while the corrective action was in process. Additional tests increased the labor burden in the factory and on the field, so this action needed to be carefully weighed against the likelihood the added testing would screen out the problem. Ideally, improved supplier acceptance tests would be immediately implemented to reduce the amount of time that these tests would have to be performed on the assembled aircraft as they moved down the assembly line and into flight test. Base2 worked closely with the responsible engineers in design, test, and at the supplier, to devise potential screening measures for implementation up the value chain as quickly as possible.

Resolving Flight Issues.

Base2 Engineering consultants were able to work across organizational silos to bring a multi-functional team approach to identifying and resolving flight issues.

For the engineering communities, Base2 was able to communicate with the design teams directly and inform them of failures of their systems, and then work with Engineering leadership to ensure that the resolution of these failures was properly prioritized.

Base2 was also able to bring together the Quality, Operations, and Supplier Management organizations to ensure that problems were examined throughout the value stream, and final corrective action, as well as containment strategies, were vetted by all stakeholders and undertaken as a full team initiative.