Backgrounder

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Change Management: Actionable Steps; Leaps of Progress

Change happens, and it does so for a variety of reasons. For commercial airplane manufacturers such as Boeing, product changes are driven by the need to adapt to evolving market conditions, keep pace with technology advancements and remain competitive. Sometimes, change is required because an airplane does not perform as expected.

Making design changes to an airplane such as the 787 Dreamliner, which has 2.3 million parts and complex, integrated systems, is no small undertaking. One change – no matter how simple – can have significant engineering and production implications.

But Boeing teams, using a disciplined and thorough change-management methodology, have taken the task from daunting to doable.

Why change?

Change is pursued as part of an ongoing effort that is rooted in the Boeing philosophy of continuous improvement and delivering on promises. Design teams view the change process as an opportunity to, among other things:

- Make design improvements that yield efficiencies and cost savings.
- Boost airplane performance.
- Meet new regulatory requirements.
- Incorporate new customer requirements.
- Address obsolete parts and materials.
- Provide airplane-on-the-ground and spares support.

Mobilizing the right team

When the need for a product change is identified, representatives from across Boeing step into action. Tooling, scheduling, finance, design engineering, manufacturing engineering, contracts and other functions all have a role and provide diverse perspective to discussions.

If a design solution is not easily identified, or multiple options are under consideration, technical or trade studies may be conducted before launching the official process. In some cases, early action may include prototyping or design/build workshops to validate conceptual solutions.

Due diligence and exploring multiple alternatives are key to finding the best solution.

Laying the Foundation for Change

The Boeing change management proposal process comprises four core steps: approval to initiate a request, technical coordination, impact assessment and estimating costs. The process begins with the creation of a change proposal, in which Boeing engineers and business teams outline the situation and solution. Considerations fall into two categories: design and business. Design considerations include safety requirements, weight, technical performance measures and configuration. On the business side, resources, schedule, and organizational effects are assessed. To move forward through the process, the change proposal must pass through a series of approvals known as change control boards.

Once the proposal is approved by a management team – known as Change Control Board 3 – the lead engineer gathers data from affected organizations and supplier partners and initiates a change request. An impact assessment review board is convened to ensure that all groups have been identified and asked for input. After all groups have weighed in, the change is examined from various perspectives, and a decision whether to proceed with the design change is made.

Moving forward

To control and manage change to the airplane configuration, three additional levels of reviews are conducted after the change proposal has been accepted. Change Control Board 2 comprises senior managers who review the proposal with an eye to

understanding the implications for their areas of responsibility. For example, engineering leaders from the fuselage team, wing team, interiors team and others are involved.

After passing through Change Control Board 2, the design solution is then examined by a Technical Review Board, consisting of deputy chief project engineers, Boeing Research & Technology experts and Boeing technical fellows. This committee ensures that the change is technically sound and the best solution for the airplane. Finally, the change reaches Change Control Board 1. At this review, program leaders and the chief project engineer evaluate the change and make the determination whether to proceed. In some exceptional cases, a further review by all of the program leaders may be required.

Building the Plan

Once a change is approved, the lead engineer and change analysts begin developing a plan to execute the change. Plan elements include detailed work statements for each affected organization, schedule quotes from production teams and the supply chain, and an approach to integrating requirements into one master plan.

Swift and Sure Execution

With a validated design and approval, and with the plan in place, the design change is deployed into the Boeing engineering system. Once new engineering drawings are reviewed and approved, teams from Manufacturing Engineering create production plans for technicians to drive the creation of new parts and installation onto the airplane. Engineering teams then validate that the data has been properly incorporated and is proceeding through the system.

Certifying the Change

Certifying a change is necessary when it results in a change to the already approved design of the airplane. If certification plans are required, special engineering teams are tapped early in the process to define the testing required for certification, which must be validated by the U.S. Federal Aviation Administration before tests can proceed. The FAA may decide to observe tests in addition to analyzing report and test

data to ensure that all regulatory requirements are met and to approve the closure of the certification plan associated with the change.

Change Onboard the 787 Dreamliner

With any new airplane, change is inevitable. The Boeing change management process ensures responsive solutions and value-added product modifications that lead to improved safety, greater efficiency and satisfied customers. A few examples:

- *Rain gutter:* When customers found that water was not being properly deflected over a passenger entry door, they requested a change. Boeing relocated the gutter to function more efficiently. The solution means happy customers, who had fewer water and maintenance issues, and happier and drier passengers. This was a significant enough change to process to require certification work with the FAA.
- *Incorrect shimming:* Boeing found that shimming was performed incorrectly on a support structure in the aft fuselage. All production and in-service 787s were inspected, and engineers developed a solution and implemented procedures to prevent a recurrence. This process did require FAA approval, which was achieved through a combination of testing and analysis.
- *Side-of-body*: During testing, Boeing engineers found the need to reinforce the side-of-body section of the airplane where the wing is joined to the fuselage. New fittings were installed at 34 stringer locations. Swift corrective action was implemented across the production system to solve the problem. This change was defined before the 787 was certified so all testing and analysis was complete as part of the baseline design of the airplane.
- *Elevator actuator assembly:* Engineers revised drawings to split assembly of the actuator assembly into two parts, which means improved access and reduced installation time, less susceptibility to damage, and ultimately, a better manufacturing process and avoided cost. This was a significant enough change to process to require certification work with the FAA.

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