



Best practices guide

Cabin interior retrofits and
entry into service program



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Executive Summary

Commercial aircraft interiors are complex, rapidly evolving with new technology, and highly regulated area of the aviation industry. Modifying and upgrading aircraft interiors poses exceptional challenges including (but not limited to) technical, regulatory, operational, financial, logistical, implementation and schedule challenges.

IATA's Engineering and Maintenance Group (EMG) established an ad-hoc Experts Group (EG), comprised of airframe manufacturers, airline representatives and industry experts, to further investigate the challenges of the industry related to aircraft interior modification programs which affect cabin operations safety.

Based on the issues raised initially by IATA member airlines through the IATA Cabin Operations Safety Technical Group (COSTG), airlines regularly experience challenges during aircraft interior modification and Entry into Service (EIS) programs.

These common challenges may include:

- Certification issues such as
 - inconsistent interpretation of existing regulatory requirements
 - inconsistent application of existing regulatory requirements
 - technological advancements outpacing implemented regulations
- Expansive standards and procedures applicable to different generations of cabin products,
- Fleet complexity – Lay Out Passenger Arrangement (LOPA) and crew competency
- Commercial needs that address incorporation of new technologies into the cabin product offering,
- Supply chain and logistics challenges, including aircraft leasing agreements,
- Cooperation between the various airline departments related to the modification
- Budget and schedule overruns

This document has been developed to assist airlines with identifying and addressing key aspects of aircraft interior EIS and modification programs from concept through implementation and certification relevant to cabin interiors.

The document has been segmented into both program chronological order based on a generic aircraft program and into key topics addressing the critical decisions, associated risks and risk mitigation approaches for each key challenge.

As each program inherently contains its own unique challenges, the approaches, tools and suggested processes in this paper have been drafted to allow for general consumption and should be modified and customized for each individual program as appropriate.

In addition, some samples relevant to the type of certification challenges EG member airlines and other industry stake holders¹ have encountered during interior modification programs are listed in Appendix A – Cabin Design & Certification Issues,

¹ Industry stake holders also includes airframe Original Equipment Manufacturers, Tier 1 manufacturers and industry organizations such as SAE International

Glossary

AC	Advisory Circular	KPI	Key Performance Indicator
ACO	Aircraft Certification Office	LOPA	Lay Out Passenger Arrangement
AIS	Abbreviated Injury Scale	MEL	Minimum Equipment List
AMM	Aircraft Maintenance Manual	MOC	Means of Compliance
ARP	Aerospace Recommended Practice (SAE)	MRO	Maintenance Repair Organization
AS	Aerospace Standard (SAE)	MTBR	Mean Time Between Removal
BFE	Buyer Furnished Equipment	Nij	Neck Load Measurement (US National Highway Traffic Safety Administration (NHTSA))
BOM	Bill of Material	ODA	Organization Designation Authorization
CAMI	Civil Aerospace Medical Institute	OEM	Original Equipment Manufacturer
CDR	Critical Design Review	PED	Portable Electronic Devices
CFE	Customer Furnished Equipment	PMA	Parts Manufacturer Approval
CFR	Code of Federal Aviation (FAA)	PDR	Preliminary Design Review
CMM	Component Maintenance Manual	PRM	Passengers with restricted mobility
CRD	Child Restraint Device	PSU	Passenger Service Unit
CS	Certification Standard (EASA)	PY	Premium Economy Class
COSTG	Cabin Operations Safety Technical Group	RFP	Request for Proposal
DER	Designated Engineering Representative	ROI	Return on Investment
EASA	European Aviation Safety Agency	SAE	Society of Automotive Engineers
EG	Expert's Group	SB	Service Bulletin
EIS	Entry into Service	SC	Special Condition
ELA	Electrical Load Analysis	SFAR	Special Federal Aviation Requirements
EMG	IATA's Engineering & Maintenance Group	SFE	Supplier Furnished Equipment
FAA	Federal Aviation Administration	SOW	Scope of Work
FAI	First Article Inspection	SPE	Supplier Purchased Equipment
GUI	Graphical User Interface	STC	Supplemental Type Certificate
HIC	Head Injury Criteria	TAIL	Transport Airplane Issues List
HMV	Heavy Maintenance Visit	TSO	Technical Standard Order
ICA	Instructions for Continued Airworthiness	WDM	Wiring Diagram Manual
ICAO	International Civil Aviation Organization	Y	Economy Class
IFC	In-Flight Connectivity		
IFE	In-Flight Entertainment		
IPC	Illustrated Parts Catalogue		
ITCM	Initial Technical Coordination Meeting		

Abstract

Commercial aircraft interiors are exceptionally complex systems comprised of a large number of different types of equipment manufactured by a wide variety of suppliers. A single wide body aircraft interior can have dozens of different suppliers involved in the design, certification, manufacture and installation of the end product to the operator. The interior must operate seamlessly, reliably and provide comfort, safety and in-service product desired by the operator to meet its service and passenger experience goals. All this complexity is heavily regulated by aviation authorities to provide unrivaled safety for the traveling public.

Aircraft interiors also experience significant wear and tear by passengers and crew. Material and product degradation from wear and tear may change the experience of passengers and crew.

Cabin interiors often require a different retrofit and maintenance cycle that is not aligned with the required aircraft overhaul and maintenance cycles. Some airlines will upgrade their cabin products every 5-7 years, while others may keep on-board products in operation for 20 years or so. Upgrade and retrofit cycles will also vary depending on interior product type. Passenger seating, passenger connectivity and In-Flight Entertainment (IFE) will normally be upgraded more often than overhead bins, galleys or lavatories, which some operators may never replace, but rather keep serviceable through overhauls and regular repairs.

Making changes to an aircraft interior can be a complex, expensive and risky investment for an operator. Depending on the scope of the change / upgrade, the operator may allocate and invest significant resources in research, development and execution of cabin interior upgrades.

The direct Return on Investment (ROI) for these upgrades is often not clear cut as so many market dynamics go into passenger perception, acceptance and subjective opinions of product improvements.

Standards and designs of cabin interiors evolves through time, but often there is a lag in the evolution of regulatory requirements on the interior to keep up with industry innovation. In addition, interpretation of existing regulations is often unclear and subject to interpretation by different parties. This requires care in evaluation and interpretation of existing regulations.

All of these factors impart significant financial and operational risk when undertaking a cabin interior upgrade, modification and retrofit.

IATA's EMG established the EG regarding cabin equipment and interior design modification and certification challenges. The EG included airlines, airframe manufacturers, industry design organizations and other major stake holders. The EG's role is to investigate and discuss cabin interior modifications, industry best practices and member airline experiences, and incorporate them into a "Best Practices Guide" for IATA member airlines and the broader commercial aviation interior's stake holders to utilize when introducing new aircraft interior modification / retrofit programs. This document presents the results of the EG and our Best Practices for successful execution of aircraft interior retrofits and EIS programs.

Initial Considerations for Scope of Work Development

There are many factors that can serve as the initial idea for an operator to consider changes to their existing cabin and/or services. Many times, this may include a wholesale update to its fleet interior products. It may also address just specific fleet types, or even sub fleets within an operator, depending on the operator and the retrofit initiative.

It is common for a product marketing or revenue department within an operator to create an idea for consideration. It is important that the operator work within established protocols and structure to solicit a high-level description of the idea for deliberation and consideration. *For example: a marketing department presents relative justification that the operator needs to incorporate a Premium Economy Class (PY) product on the international long-haul flights.* This process will establish a baseline definition for 'What' change the operator is considering on their aircraft.

Once an operator has determined the base line definition for the retrofit and EIS, the operator's management then needs to define 'Why' the change should be accomplished. *Using the example above of adding PY seating, the baseline driver for this initiative may be justified by simply showing that the operator's top competitors have announced or have already incorporated PY product, and the revenue forecast per PY seat versus an Economy (Y) seat shows a positive increase in revenue potential.*

Project Definition

Any changes to a cabin and/or service offering will have a direct effect on a number of different departments. It is vital that once a high-level concept has been developed and promoted through the initial executive approval process that the concept be properly evaluated by key stakeholders within the operator. Determined by the project size and scope, the operator needs to create and assign a project team consisting of key stakeholders that can make crucial decisions throughout the project. Depending on the scope of the modification, key stakeholders may include engineering, marketing, customer experience, revenue management, IT, catering, corporate training, maintenance, in-flight service, purchasing, aircraft acquisitions/leasing and finance. The Team should ensure representation from all related airline functions (departments). It is important that each member understand their role and the significance of committing to the project through completion. It is also common practice and recommended at this stage that the project be assigned a name that the organization can relate to, and the team rally around. *Using the example above, we can use a generic type project name like 'International PY'.*

During initial concept development several key considerations should be taken into account. These usually will include but not be limited to:

- Why is the concept being considered? i.e., competitive reasons, revenue enhancement, cost savings, operational complexity reduction.
- Will the modification have an impact on cabin service requirements? (e.g. for PY project, will additional galley space or equipment be required for improved meal service to PY passengers? Will the PY cabin require a dedicated lavatory?)
- Will the modification have impact on sales processes (e.g. new booking class)?
- Current availability of products under consideration (e.g. will the operator use an existing PY product available on the market, or does it desire to develop its own customized product)
- High-level consideration of project schedule and identification of key schedule drivers;
 - Product availability and existing certification
 - Extent of new features or modifications to be implemented while minimizing complexity across the fleet

- Number of different suppliers that might be involved and assessment of consolidation of products / suppliers
- Engineering and certification effort that may be required; and
- Availability of aircraft for modification embodiment
- Supplier lead times
- Schedule criticality (lost revenue, lost competitive edge, etc.)
- Will this be considered a major or minor change or modification under the regulations
- The number of aircraft and different aircraft fleets that will be modified or introduced as a new service or product to the fleet
- For all aircraft within a specific targeted fleet, do they all have the same detailed aircraft specification (aka sister aircraft) or is the fleet comprised of similar but not identical aircraft?
- Understanding the impact on lease conditions, especially, lease returns, and effect on aircraft's residual value

High Level Scope of Work

Once the initial concept has been developed, the next step will be a deeper dive by the project team to identify other areas around the International PY initiative that should be taken into consideration, the project milestones, critical paths as well as a target EIS date, and the project completion date. Other areas to consider may be secondary / supplementary cabin product upgrades including passenger seating dress covers, IFE/IFC upgrades, galley electrics, cabin lighting, emergency equipment, etc.

This initial step develops the high-level Scope of Work (SOW) for the project and highlights the major items that need further consideration prior to finalizing the detailed project SOW.

Whatever the case may be, in order to progress forward in the process, at this point a project team should be assigned with a high-level description of the modification, an EIS target date and a project completion target for the initiative (i.e. completion of the install of PY on entire international wide body fleet).

An example for this PY project would be as follows:

- *Introduction of PY seats for all international long-haul routes;*
- *Cabin supplementary / secondary upgrades to new colors;*
- *IFE upgrade to a latest generation system throughout the aircraft;*
- *Upgrade cabin lighting system to a mood lighting system;*
- *Target EIS by spring of 20XX with completed fleet integration by fall of 202XX*

This establishes a high-level project description and a desired time line for the project.

Balancing Project Scope, Costs and Objectives

Once the initial project description and desired time frame has been identified, the next step in the process is for the project team to begin an evaluation of each high-level aspect within the project definition. The purpose of this will be to determine if the full scope can be accomplished within the desired time frame and general budget guidelines. This will help define what compromises might need to be considered.

Components with Major Impacts

In general, when considering new products and cabin retrofits, there are some elements that can have extensive impacts on the overall schedule and costs including:

- New product or major system developments
- Galley / monument changes or relocation
- IFE replacements / installations (including new IFE software/Graphical User Interface [GU]) development)
- Engineering efforts
- Engagement of certifying authority to establish the modifications certification basis and plan
- Stakeholders' engagement to address safety standards, procedures and operational health and safety issues and other areas of concerns by end users

Utilizing the PY example here, if installation of a PY cabin requires removal of an existing galley complex and installation of a new galley complex at a slightly different location, this may have a 12-16-month lead time for the development of the required engineering and integration kit for the new location. A customized new PY seat development program could easily run 24-36 months from contracting. These are the types of high-level schedule and cost drivers that need to be considered initially by the project team and management to decide if compromising by modifying existing galleys and utilizing currently available and certified PY seat products might be worth pursuing to meet overall program goals and budgets.

Start the process by evaluating the key elements that is driving the retrofit initiative. *In this example, the PY seat:*

- Would like to have a unique product offering, however based on the project budget and time frame, can live with existing certified product and customer specified branding and feature selections.
- Would like to incorporate four (4) rows of PY, however based on the current monument arrangement it only makes sense to consider three (3) rows and avoid losing galley space considering additional hot meal service required for PY customers.
- Would like to incorporate 16" seat back video screens, however most of the potential PY seat products available would only accommodate a 12" seat back screen based on the current designs and certification.
- Will the modification appreciably affect weight, or CG of the aircraft, which may affect overall aircraft range / performance?
- Will the PY product require any aircraft electrical system modifications or require review of the aircraft Electrical Load Analysis (ELA)?
- Changes in procedures and locations of safety equipment should be minimized or standardized for the end user.

Like any project, there should be a clearly defined objective and mission statement. Once the high-level analysis to determine what options may be possible has been completed, the team should review the project initiative, budget, and

time frame and evaluate incorporation of any compromises to meet the overall project goals considering any limitations that have been discovered. Following this, the team is ready to start the process of developing a detailed scope of work.

Detailed Scope of Work Development

Once the high-level scope of work (SOW) has been developed including reviewing the initial considerations and evaluating budgets, schedules and incorporating any high-level compromises, the next step is to develop a detailed SOW. This is probably the most critical part of any interior modification project and the one that often gets the most neglected. The SOW is the foundation of the entire program, the document that all others refer to and is the baseline for supplier and service provider sourcing, product specification development, schedule development, budget development, bill of material development, etc.

A detailed SOW is an extensive description of all the work that will be required to complete the modification on the aircraft. It will list all the materials, products and equipment that will be removed, designed, installed and/or modified during accomplishment of the modification, and the certification requirements. The SOW is a technical document and it is recommended that lead responsibility for its drafting rests with an experienced and technically competent interiors / system engineer or technical program manager very familiar with interior reconfigurations.

At this stage a list of safety risks associated with the project should be developed to mitigate, minimize or remove potential safety risks from the end cabin product. The residual risks should be regularly reviewed as the project progresses based on the detailed SOW. This is to ensure at any time, all stakeholders are well-informed of their exposure to risk.

Scope of Work Development Process

A good start at tackling SOW development is to start with the existing aircraft LOPA and develop the final post modification LOPA. Begin at the flight deck and work back along the cabin using the fuselage exit doors to define the various zones. Within each zone start at the front of the zone, working backward and at the floor level working up to the ceiling. Identify every stowage, component, monument, or part that will be removed, modified, relocated or newly installed to complete the modification. The critical risk point is in the details, hence why the lead responsibility for SOW development should be with an experienced engineer or technical program manager to develop it. Identification of the layout and location of emergency equipment, which may be affected by the modification or require new installation is also a critical item to ensure is captured in the detailed SOW.

During development of the SOW, you are also developing a high-level Bill of Material (BOM) of the major items that will be required to complete the modification. IFE seat to seat cables, placard kits, Passenger Service Units (PSU), PSU spacer panels, overhead bins or ceiling panels (installs where a full height monument might be removed), seat track raceways and covers, galley designs, etc. are often forgotten until later in the program and overlooking them early on can affect the overall success, budget goals and timelines of the program. These items should be completed throughout all zones in the aircraft which will be affected. Once the initial SOW is drafted, it should be cross checked/reviewed by another person/party to help ensure nothing has been missed. The "reviewer" should be another experienced engineer or technical program manager familiar with interior reconfigurations.

For any new components that will be installed (or existing components that will be removed, modified and reinstalled) detailed specifications should also be developed of what is desired. With our example of PY seats, a detailed technical specification for the PY seat should be developed at this stage. Even though sourcing/selection of the seat has not been completed at this stage, it is important for the SOW to start to define the requirements of the seat (which will be carried into the detailed seat specification used for seat sourcing). This should include basic items such as number of seats abreast, anticipated installed pitch, seat-back or in-console IFE, articulating bottoms, head rests, leg or foot rests, etc. It is not uncommon for product specifications to include a list of "must haves" (base specification) plus options which you will have evaluated and quoted by suppliers during the sourcing program (depending on budgets, might be included in the final product specification).

In addition to developing detailed product specifications at this stage, this SOW development process will also define the engineering and certification requirements for the program. It is important to define the certification basis and the

certification jurisdiction (e.g. Supplemental Type Certificate, FAA jurisdiction, etc.) as it will not only guide the certification basis of the products to be installed, but also the overall reconfiguration engineering and certification service provider. It is also relevant to mention that some jurisdictions have unique requirements that will need to be taken into consideration throughout the product selection, design, certification and installation process.

Multiple Scopes of Work

Because interior modifications or new interior introductions can be complex, extensive, and often be affected by variations within an operator's fleet of aircraft, there may be a need to have multiple scopes of work individualized for the variances between aircraft. *As an example, an operator might have a fleet of 10 narrow body aircraft, all of the same model, however, they might have been acquired from 2 or 3 different sources or lessors and have variances on their build specification or existing interior configurations and product installations.* The most effective way to evaluate and discuss multiple configuration types is to group them, e.g. Group A, B and C.

To harmonize these into a common "post modification" interior installation, the operator should develop the primary SOW based on the group of aircraft that requires the highest level of activity, and then define the differences of the other group types. This creates a primary SOW with subset SOW's within based on the different starting configurations. This is especially important when developing and evaluating engineering and certification costs as it will typically require additional design and certification efforts when starting with multiple configurations/specifications and ending with a common configuration. The certification can be accomplished using multiple STC's (one for each aircraft initial configuration) or under a single STC with amendments for the starting configuration differences, the latter of which is the most common and preferred method for certification.

The master SOW document should also include a summary of the touch labor and/or installation required. This may be in concert with a maintenance visit and if so, a high-level description of that maintenance visit should be included in the SOW.

Schedule Development and Initial Schedule Estimates

Developing the initial project schedule is the next crucial step in a successful program execution. The SOW developed 13 is a generic guide for operators to build the project schedule based upon the program details. Program schedules can range from weeks to years depending on the Scope of Work., the critical path and the project milestones. Major schedule impacts may include engineering/design (for newly designed products or very unique installations) and long-lead parts such as seats, galleys and In-Flight Entertainment or Passenger Connectivity systems.

Adequate time needs to be built into the program to take into consideration a robust sourcing program for all products and services, engineering, design, certification, kit production and installation. The most common underestimations in schedule development usually pertain to product development, engineering and certification. Keep in mind that even pre-certified off the shelf products may require some customizations or modifications to meet the program and installation requirements. This may drive additional tooling development, certification testing, approval from the regulatory authority etc. Even the tightest and most expedited schedules should include some built-in safety margin or buffer around major milestone events.

Interior programs almost never go exactly to plan and having realistic expectations and a realistic initial schedule with safety margins will provide a solid base for management and operations to plan appropriately. In addition, it is important to consider that other departments within the operator's operations could be significantly affected by the interior modification program. Also note that often extended time for executive review and consideration with no change in the expected completion date can derail a program schedule before it even begins.

For the PY example, in-flight service, revenue management, network planning, ticketing, reservations, flight operations, ground operations, purchasing, maintenance, customer service will all have a course of action when the aircraft start to go into service following the modification. They all need to plan well in advance how and when to implement changes to

their operations to accommodate the new interior. Each department will have to prepare and adjust to the new operation, post configuration, as part of their readiness exercise. Project schedule shifts will greatly affect the entire airline operation beyond what most people originally assume.

Six (6) Main Program Phases

It helps to think of the schedule development in its six (6) main phases as follows:

1. Scope of Work Development
2. Services and Product Supplier Sourcing
3. Engineering Design/Certification
4. Product production
5. First installation / STC release / PMA issuance
6. Follow-on / fleet installation

Within each of the above phases, there will be detailed schedules built out for each phase and each supplier / partner. Part of proper project management is reviewing the schedule regularly and adjusting the timeline as issues / challenges arise, suppliers are selected, and their internal production schedules are developed.

A schedule is a living, breathing document that will shift and adjust throughout the project execution. It is important to define and understand in the schedule the interconnectivity of the various parties and phases as a delay in one will most often perpetuate a delay in another. Working the schedule as a whole will assist during the execution phase for all partners to come together with recovery plans when issues arise.

Common Schedule Mistakes

The most common schedule mistake is underestimation of schedules. This often occurs due to either underestimation of the SOW (such as missing a crucial piece in the SOW, *e.g. discovering at modification installation that previous STC installations or configuration changes have been implemented that affect the current modification program and certification*) or development of an unrealistic schedule by inexperience. Proper sourcing of products and services in support of a major interior configuration can take months depending on the products and services required.

There is a significant difference between Buyer Furnished Equipment (BFE) and Supplier/Seller Furnished Equipment (SFE) programs. Sourcing of major BFE type parts such as seats, galleys, and IFE is an extensive process requiring allocation of resources and manpower to complete thoroughly and properly to ensure you are selecting the right products and partners for your project.

Sourcing can take a minimum of 6-8 weeks to do properly, especially if sourcing new equipment, or newly designed equipment (see Sourcing and Selection of Suppliers and Service Providers).

Other common schedule underestimations include development schedules for new products (seats, galleys, IFE Graphical User Interface [GUI], etc.), being overly aggressive with certification schedules and not allowing time for certification failures / retesting / certification authority response delays, etc. and allowing adequate time for customer acceptance of key product decisions.

Project Schedule and Provider Sourcing

As part of the project sourcing program, the project schedule should be incorporated in the Request for Proposal to each potential supplier / services provider so that they can respond accordingly on their capabilities and capacities to meet the schedule proposed.

As each partner is selected and awarded work, the overall program schedule will be expanded and may shift based upon their detailed internal execution schedules and their major milestones should be highlighted in the master schedule.

There is a significant amount of inter-company deliverables within a project team (e.g. IFE prototype parts delivered from IFE supplier to seat supplier for installation on seats for development and dynamic testing). Each inter-company project team deliverable milestone should be clearly identified and tracked in the project master schedule as delays in those will have an appreciable effect on the receiving party and their ability to meet their dedicated schedule.

Project management schedule software can be useful in developing and managing the program schedule, especially when delays and changes occur which can affect the program critical path.

Sourcing and Selection of Suppliers and Service Providers

Sourcing and selection of suppliers and service providers is often where many programs start out on the wrong foot. Due to the complexity of interior systems, the interaction and inter-connectivity of parts and systems and the fact that multiple suppliers and systems all must integrate seamlessly for project execution, certification and operation, choosing the right products and the right suppliers / partners is a critical component in a successful interior modification program. In this market, it truly is “Buyer beware” and the wrong partners will add significant risk to the program.

There are seven (7) main phases to a well-managed sourcing program.

1. Request for Proposal (RFP) development and release
2. Supplier response development
3. Supplier response consolidation and analysis
4. Supplier evaluations
5. Contract negotiations
6. Final award
7. Supplier approval

Request For Proposal (RFP) Development

Common mistakes are often found throughout the process but start with an under-developed Request For Proposal (RFP). The RFP should pull heavily from the detailed program SOW for specific details of the overall program and the products or services required by each party.

Ensuring the product RFPs are as detailed as possible in the product specification is critical to a successful project. This is especially applicable when a safety risk assessment is required due to introduction of new products / services or changes in the modification / retrofit program.

In addition to a detailed description of the product itself, requirements for maintenance, reliability, Mean Time Between Removals (MTBR), product weights, operating / spares estimates, customer support, training (if needed), warranty and other critical items are good practices. It is also appropriate to ask for recent delivery performance information and current client references.

Providing the operator requirements upfront to a supplier in the RFP will better allow them to respond to meet the project and specific operator requirements. It is also a “Best Practice” to develop the evaluation criteria for the selection process and communicate them to the suppliers. A thoroughly defined RFP will assist the operator in evaluating the supplier responses as they will be responding to a comprehensive request, as opposed to creating their own definitions. This allows for a more even comparison of the supplier responses for each particular product or service and levels the playing field. Include initial schedules along with certification jurisdictional requirements and the overall fleet installation plan (beyond just the first shipset schedule). These elements will give the supplier a comprehensive picture of the program, so they can properly evaluate internal capacities, capabilities and risk.

What most operators need to understand is that suppliers will often price “risk” into a program quote. A more organized and complete RFP shows the supplier that the entire program has been well planned, thought out and is being managed properly. This will usually result in a lower “risk” profile assigned by the supplier to the program which can result in an optimized price to the operator.

It is common for a supplier to receive a one-page RFP just stating an operator's request for 189 Y class passenger seats for a 737-800 installation without much more information than that. The unknown details of the program may cause the supplier to price in risk and also opens the possibility of significant price increases and change orders driven by a disconnected understanding of the project requirements between the operator and the supplier.

Including a draft of the operator's standard contract terms and conditions in the RFP can be beneficial. This assists in helping to eliminate major contracting issues during later stages of the contract negotiations and ensures a supplier/provider can meet the majority of an operator's requirements prior to final negotiations.

Identifying for the suppliers, what the key business requirements and criteria will be for evaluation (e.g. cost, innovation, quality assurance of supply, product safety / reliability) and examples of how the assessment will be completed can improve the RFP responses and ease the evaluation of the responses.

Selecting Suppliers and Providers to participate in the RFP Process

Based on the products and services needed, an operator's current "performing" suppliers are typically top of the list for RFP distribution. Review the current marketplace for available suppliers and develop a list of potential suppliers for the RFP distribution. There are a number of sources to consult with when considering the list:

- The airframe OEM for current approved suppliers for the specific product type: The major airframe OEMs have a very robust process for supplier performance monitoring. A supplier that is currently approved for line fit delivery usually indicates they are capable of performing.
- Operator partners within your alliance or own industry network: Check within your partnership network for any current supplier successes and performance / product issues. Use your contact network to find other recent customers of a supplier to discuss their performance.
- Supplier web sites and media outlets: Most major suppliers, whether well-established or up and coming are advertising their latest products and capabilities. Most suppliers are delighted to take a 'cold call' from an operator inquiring about latest products and shopping an RFP.
- Consulting services: Today a number of operators are staffed to focus on operational needs and do not have adequate or experienced staff to perform robust sourcing and supplier selection activities. There are a number of experienced firms that can assist with this.
- Industry exhibitions and conferences can provide an overview of available and new products and suppliers available in the marketplace.

The Supplier / Provider Selection Process

An adequate number of suppliers for the RFP distribution is usually around five (5). Once you have determined a potential supplier listing, distribute the RFP to the supplier candidates. It is good practice to include a time frame for initial evaluation, submittal of supplier questions, responses to questions, and a response deadline. It is also imperative that an operator provide a reasonable time for a supplier to respond to an RFP. For most major seat or IFE sourcing programs, 2-3 weeks should be adequate for a response depending on the complexity of the product being sourced. Trying to get a response in less than 2 weeks will greatly degrade the supplier's ability to properly vet the opportunity, capacities, capabilities, risks, etc. This can lead to higher pricing and higher risks in the program.

Operators can choose to make all questions and answers visible to all participants or manage on a direct basis. Depending on the product, the time frame for this may vary. However, the process should consider the following detailed steps/elements:

- RFP release
- Response evaluation criteria
- RFP questions from suppliers
- Responses to supplier questions

- RFP response submittal
- Response evaluation
- Questions, clarification, interaction with individual suppliers
- Down select (typically 2-3 suppliers)
- Notify suppliers of initial RFP results
- Second round of negotiations and questions, clarifications, etc.
- Submittal of suppliers' best and final proposals
- Best and final response evaluation
- Questions, clarification, interaction with individual suppliers
- Site visit to potential suppliers (see below)
- Final evaluation
- Contractual discussion and agreement
- Supplier selection

Include a defined and ridged protocol for supplier communication and responses within the RFP instructions. The operator should want to manage integrity and a fair response process. Designate a primary point of contact for the RFP communications and the submittal process. Note that a supplier is subject to exclusion of consideration for circumventing this process.

Evaluating Potential Suppliers/Providers

Once an operator has received the responses, utilize a balanced process to determine the top candidates for consideration. Most airlines will have their specific procurement toolkit / processes to guide them in making the necessary decisions. Business requirements are set based on key elements which may include cost, innovation, quality assurance of supply, safety, etc.

Evaluating on a both a quantitative and qualitative basis is crucial. Some of the key qualitative indicators may include:

- How responsive were they to the RFP? Did they acknowledge receipt and open lines of communication?
- Did they have any questions about the RFP? Was there communication and back and forth during their development of their RFP?
- Were the questions they asked already clearly covered in the RFP documentation? (i.e., did they thoroughly read the RFP)?
- Was their RFP format consistent with what was requested, and did they answer all the questions and provide all the requested data in the RFP?
- Did they highlight any additional program or schedule risks which may have been previously missed?

Be particularly aware of responses that seem significantly outside the realm of other proposals. Was the response limited in detail and is the pricing orders of magnitude below the rest of the field? A proposal that seems too good to be true often is. The respondent may not have a clear understanding of the full scope of what is required to deliver on a proposal, or they have priced it so aggressively just to win business, regardless of it being at a business loss. The concern here becomes that if the program enters significant problems, delays, etc. will they be prepared to continue to lose money to try and recover a program that is already a loss for them? Or will your program be a low priority for them as it is not financially stable?

In some cases, a new supplier or an existing supplier entering new market space may have included a budget to buy their way into the market. With these outlier responses, it is reasonable and recommended to be direct and try to understand what is driving this. For a new supplier or a new product line, the supplier needs good references to help capture

business. An operator may get lucky and have a 'buy in' pricing offer with the highest level of importance and effort from a supplier but this should be confirmed through discussions and references before an award is made.

In most cases, consider the top two-three (2-3) candidates for a down selection process.

For most major product and/or service suppliers in a program it is imperative to perform an on-site supplier evaluation after down-selection process. Most suppliers have health / performance monitoring systems in place for operational and supplier performance. Key elements to evaluate to help determine a supplier's capability to perform are:

- capacity planning in development engineering and production
- sub-supplier performance including on-time delivery and quality oversight
- internal performance to schedule on recent development programs including engineering development, certification, and delivery
- overtime usage, and percentage of contract labor
- warranty claims (quality)

Additional qualitative items to evaluate during the site visit include: Is the facility clean, organized, well-staffed? Ask detailed questions about capacity in all areas (product design/engineering, production, etc.) that affect the program. How easy and quickly can the supplier increase capacity or staffing if workloads require it? How many of their employees are temporary staff versus full time employees? During the site visit is senior management available to meet with? Are they attentive and responsive to any questions? Is the facility clean and well organized and do the employees look happy to be there? What is their recent capacity growth, and does it look sustainable? Using temporary buildings (i.e. tents or mobile trailers) to add extra production capacity is never a good sign. What is the financial health of the entity (e.g. credit report or similar)? Can they provide references?

Supplier / Provider Approval

In parallel with the final selection / award of a supplier, an operator may also have to get the selected supplier / provider approved within their procurement and quality systems. Depending on the operator's internal processes and systems, this may include completion by the selected provider by a self-audit for or it may include an on-site audit by the operator's quality inspection personnel, procurement / contract auditors, or other appropriate personnel. It is imperative that the program schedule take into account the time required for supplier / provider approval within their quality and procurement systems.

A successful program is highly predicated on selecting capable suppliers. Poor supplier selection and resulting poor performance drives the overwhelming majority of program issues. Dedicate adequate time and resources to the process to enable you to make the best decision possible.

Coordination and Interaction with the Certification Authority

Once a project has been defined, the certification applicant will develop a Certification Plan that defines the classification type for the modification, the affected regulatory areas, systems, etc. Upon acceptance of the Certification Plan, the regulatory authority with jurisdiction will issue a Project Number and disclose whether or not they mandate oversight of the project. From this point forward, the line of communication related to the specific project has been opened pertaining to communication between the certification applicant, and the regulatory authority(s).

In some cases, the project will require a primary certification basis, such as under FAA or EASA guidance (aka "prime"), followed by local regulatory validation in the jurisdiction of where the aircraft is registered and / or the location of the certificate of operation. The certification plan will identify this and make a formal request for certification validation by subsequent authority. The normal process flow is that the certification plan is submitted to the regulatory authority that is acting as "prime". The "prime" will review and accept the certification plan. Following acceptance, the "prime" will formally notify any other required regulatory office that a modification project request has been opened for an aircraft registered under their jurisdiction. Once this has taken place, it opens the lines of communication between the applicant, primary regulatory authority, and the local regulatory office.

Depending on the complexity of the project or if there are any new technologies or products being introduced that lack defined regulations, the regulatory agency(s) may request oversight on specific aspects. If so, there is usually an initial project review meeting (Type Certification Board ["TCB"] meeting) following the project application process. This will open the lines of communication between the certification applicant and the regulatory authorities.

If a 3rd party is contracted to act as the certification applicant, it is recommended to track the status of the certification plan, plan approval, and any stipulations / guidance issued with the project number.

The overall project plan needs to contain key milestones for certification events. During the routinely scheduled project review meetings, certification milestones need to be discussed. This includes certification of the individual products (seats, galleys, etc. as applicable) and the overall program certification (aka STC if applicable). Do not underestimate the time required for certification authority review and response to the program submittals. Understanding the relationship between the certification applicant and the regulatory authority is crucial. A good working relationship between the two will have a positive impact on the overall program and its certification schedule.

Program Management Best Practices

Effective program management is the adhesive that binds the project and holds everything together. It is essential that the project is managed by an experienced professional. There are a number of great tools available today to assist with organization, tracking, measuring, and reporting the health and status of the program. It is recommended to utilize cloud based or access permitted electronic portals to have real time access to the program status and ensure all applicable parties have access to the data they need for proper and efficient execution of the program. This also helps from a record-keeping perspective as your data warehouse will already be complete for future reference.

The three (3) keys to proper program management are:

1. Proper and detailed planning
2. Communication
3. Project status tracking

These can be thought of as a three-legged stool. If any one of the legs is not installed or does not “carry its weight” the program will topple over.

Proper and detailed planning

Developing detailed SOW and schedules and understanding that these are living documents that will adjust over the life of the program and maintaining each of them current is key to proper program management and a project’s success. They are the foundation of the entire project and have been covered at length previously in Detailed Scope of Work Development and Schedule Development and Initial Schedule Estimates.

Communication

Communication should be planned, regularly scheduled, have discrete goals and also be flexible to adjust to the program’s ebb and flow.

Communication will take a variety of forms during the project including email, telecons, meeting minutes, letters, etc. Regardless of the form, there needs to be a clearly defined responsible party and communication flow path within and between each partner in the program. A central communication pathway is crucial to proper and successful program management. There is nothing more confusing than a supplier speaking with three (3) different contacts within an operator and obtain three different sets of conflicting direction. It is a recipe for disaster. Each party involved in the program (operator, product suppliers, service providers, etc.) should designate a single responsible party for all communication related to the program. The hub of all program communication should lie with the overall program manager. The program manager has primary responsibility in coordinating between all the stakeholders and involved parties. All communications between these parties should be run through the program manager. These parties include, but may not be limited to:

- Operator (and all internal stakeholders within the operator)
- Owner (or lessor as applicable)
- Airframe OEM (as appropriate)
- Engineering / certification service provider
- Product suppliers
- 3rd party product / interior designers
- 3rd party MRO / integrator

Operator internal stakeholders (as aforementioned) need to be consulted and their concerns need to be addressed via proper representation in the core airline Team. Representatives from at least the areas listed below should provide their input depending on the specific program but may not be limited to:

- Technical Operations (Engineering and Maintenance)
- Flight Operations (cockpit crew)
- In Flight Service (flight attendants)
- Ground Operations (e.g. cabin cleaning, pre-flight cabin checks)
- Marketing (including customer input, frequent flyer program)
- Information Technology
- Catering
- Revenue Management
- Purchasing and Aircraft Acquisitions
- Safety
- Contracts (e.g. Leasing agreements)
- Finance

The Program Manager is the overall program manager, whether an employee of the operator or a third-party program manager expert.

Establishing a healthy working relationship and trust amongst the team is essential. Every project will have challenges and the key is to have a team that is willing to report the risk before it becomes a crisis. One key to building this relationship and trust is regular communication between the program parties.

Regularly scheduled program status meetings and/or conference calls should be a staple of any properly run program. Depending on the complexity and the size of the project, this may be bi-weekly at the onset, progress to weekly on or around the program Preliminary Design Review (PDR) meeting and Critical Design Review (CDR), and daily on or around the initial kit deliveries through the aircraft modification. It very important that the operator as the end customer participate in the regularly scheduled project meetings even if they have hired a 3rd party program management firm to assist in managing the project. The operator will be viewed as the 'end customer' and most participants will be prompt, organized, and responsive to promote a positive reputation with the operator.

When the project status or schedule changes dictate, the regular communications should be adjusted accordingly to ensure a reasonable and quick flow of information to all involved parties. It is also important to keep the communication lines limited to those with a direct need to be on the calls or in the meetings. The lead communication designee from each involved party (supplier, operator, service provider, etc.) should be involved in the program calls when appropriate and they can pull in subject matter experts as necessary from call/meeting to call/meeting.

It is also crucially important to summarize all the discussions, decisions and action items on each of the program status calls and circulate those to all parties that participated. This helps memorialize decisions, agreed schedules or schedule adjustments, etc. that may have occurred during the call/meeting.

These regular program review calls / meetings should include a review of the program status (aka Stop Light Chart, see Figure 2 below), high-level updates from the participants, a review of the action item list with any updates since the last call/meeting, schedule reviews and discussion of any newly identified risks or issues since the last call/meeting.

The whole program and each element of the project will have its own risks. If not managed, a simple issue with an individual supplier can develop into a major problem. Reviewing them regularly will help to identify issues early enough that recovery plans can be properly developed and implemented. Risk assessments should also include elements of operational safety. An example of operational safety risk assessment considerations in relation to cabin design can be found in the [IATA Cabin Operations Safety Best Practices Guide](#).

<https://www.iata.org/publications/store/Pages/cabin-safety-guide.aspx>

It is common for a larger program to have an overall regularly scheduled program call and then the program manager will hold separate more detailed program calls with each of the program participants to dive into the details of each of their schedules, action items, program status', etc. This is often required to protect each supplier's IP as a single program may have direct competitors working on the same program. It is important that whatever calls / meetings are held an agenda is set for that call/meeting ahead of time and that the participants in that call/meeting are relevant to the agenda. Time is a precious commodity in any program and it is not beneficial to have participants who are not receiving or providing information relevant to the program at the time.

Consideration should be given to ease of access to information and effective communication. Web based sites that offer on-line access to program information and documentation are a common approach to facilitate communications.

Clear Decision-Making Authority and Customer Acceptance

Coupled with communications is a clear and concise identification within the project teams of who maintains decision authority for the program and various program decisions.

A complex program may include the operator, the OEM / MRO, engineering/certification provider, product suppliers and often the operator may also employ an Industrial Designer to assist in cabin and product design.

This complex web of parties, opinions and varying goals, etc. can quickly become a source of confusion for the suppliers and service providers participating. This often results in program delays, rework, change costs, budget overruns, etc. At the start of program with each supplier / provider (e.g. the Initial Technical Coordination Meeting [ITCM]) a clear review of decision making authority is crucial so that all involved parties understand who can make binding final decisions for the program.

Coupled with decision-making authority is planning for, scheduling and managing customer acceptance. Throughout the process of an interior modification program, key products, design decisions, etc. will require formal "customer acceptance" to meet contractual requirements and ensure the final modification meets the operator's expectations and requirements.

Project Status

As the customer, the operator needs to be completely engaged in the project from the onset, even if a 3rd party program manager has been contracted to assist in management of the project. This includes establishing expectations on communications including when and how the project health reporting is to be presented. It is common to utilize Key Performance Indicators ("KPI's") and milestones from the program schedule as project health reporting. This includes using items such as a "stop light" chart as a simple format for overall program health on a single page. A sample stop light chart is shown in Figure 1.

A good start would be to work with the primary program manager and ask them for their standard project KPI's. Some of the key elements to track and understand are as follows:

- Performance to schedule regarding key milestones events (design, testing, production start, etc.)
- Open action items and overall performance for completing actions items
- Sub-supplier performance (on-time delivery, quality)
- Ongoing risk assessment analysis
- Budget tracking

It is common for larger programs to have a master schedule, stop light chart and action item list. Then each major portion of the program (e.g. seat development/production, IFE, engineering/certification, etc.) has its own detailed schedule, stop light chart and detailed action list dealing with its specific deliverables and program particulars. It is the overall program manager's responsibility to track and coordinate the master tracking with the detailed tracking and status reports of each supplier / service provider. The overall program manager should also focus on the interfaces between the different suppliers (Interface Control Drawings) as that is an area that often drives program delays.

XXX Program Status Update

-  On track
-  At risk
-  Program slide

Program	Status	Key Developments	Next Steps
Master Program		<ul style="list-style-type: none"> • Xxx • Xxx • Xxx 	<ul style="list-style-type: none"> • XXXXX • XXXX
Engineering/Cert			
Seat Programs			
Galley Program			
IFE Program			
MRO/Install			
Program Budget			

Figure 1 - Program Stop Light Sample Chart

Action item lists should track all actions and deliverables due from each party to the program and they should include the following:

1. Detailed description of the required deliverable or item
2. Clear responsibility assigned to the appropriate party
3. Due dates
4. Comment / tracking field so that weekly updates can be tracked against each item and its progress
5. Field to capture a detailed description of the closing action of each action item

The master program tracking tools include development of the following:

- Project Master Schedule containing the critical path and key milestone events
- Rolled up major deliverables from key suppliers
- Regularly scheduled program review meetings with key project members
- Master action item list
- Supplier performance metrics
- Schedule performance metrics
- Risk management assessment
- Budget performance to plan

Each primary supplier has a significant role in the process. The following should also be tracked for each supplier and should be maintained to properly report up to the overall project:

- A primary point of contact assigned to the project
- Project schedule including critical path and key milestone events for that supplier's project deliverables
- Performance to schedule metrics
- Action item list for internal flow down
- Supplier performance metrics
- Risk management assessment

It must be clear that the overall program manager has the responsibility for monitoring, documenting, and reporting the overall program status. This includes the sub-supplier activities. In many cases program delays occur because a sub-supplier fails to deliver. Proactively making site visits to the major suppliers throughout the development process can be helpful to avoid delays.

Identification and Management of Major Program Risks

Program risks are going to vary depending on the type of product, the overall SOW, fleet type, fleet size, multiple starting configurations, schedule, etc. If the project contains new products that have not been previously certified, that may elevate the overall risk level. Determining program risks begins with analyzing the major elements of the project scope. The two most common major risks are associated with not selecting the right suppliers / partners for the program (see Section 0 Sourcing and Selection of Suppliers and Service Providers) and not developing and utilizing a detailed, well developed SOW as the foundation of the program (see Section 0 Detailed Scope of Work Development).

Identifying Potential Program Risks

The following questions about the SOW and your potential partners/suppliers can assist in identification of major risk factors:

1. **Products:**
 - a) Certification: Have the products you are considering been previously certified for installation on the targeted aircraft model(s) and type(s)? If not what type of testing will be required? Dynamic or static structural testing? DO-160, flammability, EMI, Head Injury Criteria, abuse load, etc.? Tests such as dynamic testing of seats or DO-160 testing of newly designed components are often the riskier types of testing which a program can encounter
 - b) Customer experience and acceptance (if applicable): Do customers (e.g. frequent flyers) provide input? Will passengers enjoy the modification?
2. **Aircraft type and configuration:** Are there multiple starting configurations (mixed fleet) in the retrofit program (i.e. differences in "starting" LOPA's for similar aircraft types)? Is the current aircraft configuration being considered as the "starting configuration" taking into account previously installed STC's or configuration changes? Is this a fleet wide campaign with multiple fleet types? Have aircraft owners been informed? Do lessors need to acknowledge and/or approve?
3. **Suppliers:** Has a thorough process been completed in validating the supplier's capability and capacity to deliver quality products and services on time? (See Section 0 Sourcing and Selection of Suppliers and Service Providers)
4. **Reconfiguration engineering and certification firm:** Is the integration firm experienced with this level / type of modification program and do they have experience on the specific airframe type(s) associated with the program? (See Section 0 Sourcing and Selection of Suppliers and Service Providers). Is there a solid certification plan in place and does the selected firm have extensive experience and a positive relationship with its regulatory authority? What will be the OEM involvement? How issues like "lack of data from the OEM" will be handled?
5. **Modification facility:** Is the facility selected to perform the touch labor experienced in cabin retrofit work? Will this work be stand alone and performed in conjunction with a heavy maintenance visit (HMV)? Are there any limitations during the HMV that would preclude administering the cabin reconfiguration simultaneously? What time of year is the modification scheduled to occur as this can have an effect on aircraft availability, capacity peaks, etc.? Who will accomplish the modification part kitting and where will the kits be staged?
6. **Schedule:** Major milestones that have a significant downstream effect such as Critical Design Review (aka Design Freeze), Bill of Material (BOM) release dates, Customer Furnished Equipment (CFE) on-dock dates at selected suppliers, certification test dates or project plan submittal milestones.

7. **Integration:** What parts and components will need to integrate together for the final modification installation? Often, the focus on integration is solely at the aircraft installation level but in interior modifications, product integration at the assembly / component level is often not provided the appropriate attention and risk analysis. (e.g. IFE integration into a seat or galley insert integration into a galley unit).
8. **Logistics:** How many major partners are involved in the program and where are they physically located? Who will produce which parts and who and where will parts kits be produced, staged and where do they need to be shipped to? Ensure a comprehensive logistics plan is in place.
9. **Training and Documentation/ Operations Manual:** Allow plenty of time for end user engagement, training, trials and documentation process such as incorporation of the new information in to the operation manuals. This is also an area which regulators will be working consistently with the engineering and training departments to evaluate the exposure to risk. It may be necessary to conduct a proving flight for some operators especially when new technology is involved such as introduction of Wi-Fi onboard or new electronic flight bag (EFB) and electronic aircraft maintenance logbooks as part of the secondary or supplementary product during EIS or retrofit program.

Every aspect of the project will have some level of risk inherent within the scope. The key is to identify each risk area working directly with the responsible party, capture each risk in the project planning, and routinely analyze progress in overcoming the risk areas, and take immediate action when they start progressing towards becoming an issue.

Measuring and Tracking Risk

Many suppliers and program managers utilize methods of measuring risks such as 'stop light' categorization: green, yellow, and red. Project schedule buffers and back-up plans are also commonly used to track risk items. A good indicator of risk is to regularly evaluate at the level of schedule penetration into the individual task buffer(s). A combination of task buffers around areas of identified risk as well as an overall project buffer are good methods to help identify the overall health of the project development.

As we have discussed in Section 0 Program Management Best Practices, regular and consistent reporting and communication is a key hallmark of a successful program. Weekly evaluation of the schedule, its changes, delays, early deliveries, etc. is imperative to properly managing the project to a successful outcome.

Certification Considerations and Certification Risk Identification / Mitigation Techniques

Today there are two primary methods to achieve certification of a retrofit program. One is working directly with the airframe manufacturer who will typically provide modification instructions and approval under an approved Service Bulletin using their certification authority. This approach is generally considered higher cost but low risk because the Type Certificate Data is generally developed by the airframe manufacturer, who is also the Type Certificate Holder. The potential downside to this method is that depending on the aircraft manufacturer, it may be limited to pre-certified content. This means it is limited to products and systems that have previously been certified within the airframe manufacturer's quality system. If considering new innovation products and systems, then this may not be the most viable solution. The second primary method is working the certification through a 3rd party engineering / certification / integrator or an operator's internal engineering staff coordinating directly with the certification authority.

Depending on the scope and complexity of the modification, there may be several other methods available to obtain the certification. These include minor modifications through basic regulatory approved data and Engineering Orders or Service Bulletins, to obtaining a Supplemental Type Certification (STC) for more significant modifications. These can be achieved using an in-house engineering system that has the proper authority from the governing regulatory agency or utilizing a third-party firm that specializes in reconfiguration engineering development and STC activity. In both cases, the firm that is generating the reconfiguration engineering and applying for the STC is commonly referred to as the certification applicant ("applicant"). The risks associated with these methods can vary depending on the complexity of the project, and the level of experience and reputation of the applicant.

Certification Plans

Typically, the first step in the EIS or retrofit engineering development process is to create the certification plan. This is a very critical phase as it establishes the approach, method of compliance and builds out the scope of work for the certification requirements of the project.

The certification plan is a document that is created to outline the overall project definition from a technical and regulatory standpoint. Within the certification plan it outlines the current certified areas and systems disturbed by the retrofit, establishes means of compliance for the applicable regulations, and defines the method in which the retrofit will be validated in order to obtain an approved STC and apply for entry to service when the project is complete.

Compliance Matrix

Developing a certification compliance matrix is a key part of the certification approach and identifying certification risks. The compliance matrix lists all the applicable regulations which the post-modified aircraft must meet. By developing the compliance matrix and identifying the method of compliance for each regulation, you begin to highlight areas of concern where proof of compliance has increased risk. This process also develops the list of products and systems which are being affected and whether compliance with the regulations will be shown via testing, computation, similarity or other acceptable methods. In some instances, an Alternative Means of Compliance ("AMOC") may be required. It also starts to highlight areas where the regulations are not clear and concise, especially where new technology or new configurations may be concerned. In those circumstances, often an Issue Paper is developed in cooperation with the regulatory authority. The Issue Paper will define how all parties intend to address a unique or new situation and prove regulatory compliance.

Certification Risks

There is significant risk in using firms or professionals without adequate experience to develop the certification plan. In addition, the firm's relationship with their regulatory authority is a significant factor in their ability to execute the program in a timely manner without undue or burdensome oversight. Generally, experienced engineering firms and professionals can typically produce a certification plan in 2-4 weeks depending on the complexity of the project. If it is taking substantially longer, that is a general indicator that there may be increased risk in a program and/or an operator has selected the wrong partner for the job.

Every aspect of the modification that is introduced onto the aircraft needs to be substantiated and certified at the component level and the aircraft installation level. There are many elements that can be involved such as structural, mechanical, electrical, decompression, flammability, safety, etc. In many projects, the risks are often more likely to be at the product / component level. Most experienced product manufacturers are aware of limitations their specific products must maintain on each airframe type.

The phrase "exceeds allowables" refers to a specific aspect of the product design that exceeds an allowed maximum criteria established by the airframe manufacturer. These criteria are commonly referred to as "published allowables." When developing an RFP for products, it is standard to list as a requirement of the supplier to comply with the airframe published allowables. For the latest generation aircraft, the published allowables may have very limited availability for aftermarket modification without airframe OEM assistance.

For existing certified products that are customized for a specific program, even requiring full component certification activities, there are generally existing defined regulations and examples of already qualified products that can be used to assist with the certification approach.

For innovation, most suppliers developing the product have already developed a method of compliance they will use for qualification. Normally, as part of the product concept and development process, means of compliance are thoroughly analyzed and a methodology is developed in conjunction with the design.

It is highly recommended to be very proactive and engage with the suppliers during the RFP selection process regarding their experience, expertise, and plan for certifying the products (see Section 0 Sourcing and Selection of Suppliers and Service Providers).

When considering new innovative products, certification approach and risks need to be discussed during the RFP process. An operator should obtain a clear understanding of the intended methods of compliance to be used, the associated risks of those methods, and alternate paths of compliance as options. As part of their internal RFP review and response development, most product companies will have already conducted an unofficial conversation with their regulatory oversight office to get an initial indication of the intended plan for substantiation and certification. It is recommended to have an experienced certification expert on your team when seeking new innovative solutions.

All BFE is also normally managed by the operator and outside the purview of the airframe manufacturer. BFE suppliers will take on greater responsibility for certification of their products and must ensure they are certified for aircraft installation in the proposed configuration.

Another area of certification risk is related to modifying the first aircraft. The first aircraft to be modified is typically referred to as the prototype aircraft. The installation of the modification onto the prototype aircraft is a major part of the overall program certification and requires a tremendous amount of in-process inspection and certification conformity. The certification applicant generally has an authorized and licensed/designated member on sight to perform these duties. A significant risk with the prototype installation relates to ensuring material and installation conformity during accomplishment of the modification embodiment. A common mistake made by inexperienced installation facilities is to continue installation work beyond a milestone / gate that requires in-process conformity inspections. This often will result in significant disassembly to access areas for compliance inspection. This can increase the aircraft modification/installation time by multiple weeks if encountered. In the situation where there may be multiple starting configurations of the pre-modified aircraft (as previously discussed in Sections 4 and 6), there could be multiple prototype aircraft in the program requiring multiple conformities for installation of the modification from each starting configuration.

To help mitigate delays on the aircraft modification certification process, it is recommended to meet with the modification facility in advance of the aircraft input to thoroughly review the modification conformity process. This includes ensuring a clear understanding of the process and responsibilities related to finding of regulatory compliance. Who will be responsible for compliance coordination, inspections, etc. and where / when will those findings of compliance be completed during the program?



Communication and awareness of these requirements is essential. Again, this is not 'routine' type work for most MRO facilities and each modification project has its own unique challenges and risks. Pre-planning and identification of those risk areas is key to successful risk mitigation. It is also helpful to have the ability to make real-time drawing changes while completing the first aircraft as otherwise that tends to be critical path to completion of the first modification.

Another area of risk is related to performance and success of any ground testing and flight testing that may be required to complete the compliance process. These requirements should be defined within the certification plan. In most cases these testing procedures require specific equipment. The certification applicant should have a list of these requirements and the project management process should capture and track responsibility for obtaining the required testing equipment within a schedule to support the program.

Communication and Coordination of Certification Program

Communication and coordination are keys to success in regards to the overall certification portion of the program. This begins on day one with the development of the certification plan, coordination with suppliers, understanding of product and systems certification basis, specific local regulatory and operator requirements, as well as the overall specific airframe requirements.

The FAA has also developed guidance material and the step by step process for STC certification programs. FAA Advisory Circular 21-40A is the "Guide for Obtaining Supplemental Type Certificate". The normal steps of an FAA STC program and more information can be found at the following link:

www.faa.gov/aircraft/air_cert/design_approvals/stc/stc_app

Even if an operator outsources all the certification to a highly qualified partner, it is highly recommended that the program manager for the entire project have a general familiarity with the certification process and the above referenced documents and procedures.

It is important for an operator to understand the responsibilities of the applicant, as well as, have a clear understanding of ownership of the STC or any Intellectual Property ("IP") that will be developed as part of the program development. Discussing IP ownership, STC submittal / management post certification are key items many operators do not properly address upfront in a program, leaving confusion on who owns what and who is responsible for STC management after the STC has been approved. It is recommended to state within the RFP requirements an operator's position in regard to IP ownership, especially if the operator is funding the development costs.

Common Risk Areas and Delays

There are a number of different factors and variations within a general cabin reconfiguration program that are common risk areas. These include general reconfiguration development, product qualification and certification, supplier performance, aircraft modification, and overall certification of the reconfiguration.

To assist in evaluating these, we can look at the major elements within a cabin reconfiguration program and highlight some common risk areas.

General Program Risks:

When it comes to cabin products, whether considering new designs or specific enhancements to existing products, there is generally some level of testing required to certify the product for the intended program.

Local Regulatory Requirements

It is also important to understand any local regulatory compliance requirements, as well as workers' unions such as pilot and flight attendant associations, European Union's REACH, etc. and pass those down to suppliers where applicable. New aircraft delivery delays have occurred due to S.E Asia regulatory requirements having been overlooked as a program requirement by the airframe OEM, so this risk can occur at any level.

Data Access

Aircraft design and specification data access needed to develop the reconfiguration engineering, certification and interfaces of the product to the aircraft, including structures, mechanical, electrical, decompression, previous modification, etc. can be a significant challenge. Depending on the aircraft type, and age, this may carry different levels of risk. It is important to have this discussion with the perspective suppliers during the RFP process to ensure there is an understanding of responsibility and a path to acquiring the required aircraft data. This is especially important with modern aircraft as a lot of the data has very limited to no access outside of the airframe OEM.

Setting Program Expectations

Make sure there is a clear understanding and documentation of expectation with all the program suppliers and service providers. Do the suppliers clearly understand what the expectations are?

Early Buy-In and Consensus from Airline Stake Holders

It may sound ridiculous however time and time again at major program review meetings there are requested program changes for things that have been overlooked or changes in direction. It is common occurrence that a program delay is caused by a lack of understanding by the operator itself of the criticality of making decisions in a timely manner and sticking to those decisions once they are made. Dedicate the time upfront to work with internal stake holders to obtain a consensus on the design and scope, as well as the operator requirements and local regulatory agency. Changing a direction or decision is common but should be kept to a minimum during a program and the effects of those changes should be clearly understood by the operator management prior to making the decision. Budget and schedule effects can be significant due to changes in direction, reversing a decision weeks or months after it was made or not making decisions within the program established and published deadlines. Identification, inclusivity and communications between key airline stakeholders is essential to the success of the program and avoidance of costly delays.

Currency Risks

Depending on the program size and global distribution of the selected suppliers, there is a risk that currency value adjustments over the life of the program can cause unexpected financial impacts. Close coordination with the operator's finance group and the purchasing team are important to capitalize on potential natural hedges of incoming operator revenue, as well as currency selection in each of the supplier contracts.

Logistics and Contractual Understanding

Complex interior modification programs can involve a significant number of suppliers with some shipping their products to other suppliers for incorporation in next higher level assemblies. Having a comprehensive understanding of the program logistics and a solid logistics plan is imperative. Products may be kitted at different levels and at different locations shipping between product suppliers and to the final installation location. A clear plan on who is responsible for which products and which kits will mitigate shipment delays, damage, missing parts, etc.

In addition to logistics having a clear understanding of contractual responsibilities for the supply of various products is imperative. There are generally three (3) typical categories of product supply responsibility / definitions:

1. Buyer Furnished Equipment (BFE) – operator is purchasing the equipment and responsible for its delivery to the integrator (or, if applicable) next level assembly provider
2. Seller Furnished Equipment (SFE) – operator has contract with modification integrator (or MRO) for installation and integrator has responsibility for delivery of those parts.
3. Seller Purchased Equipment (SPE) – operator has the contract to purchase the equipment directly from the parts supplier and the modification integrator is paid a fee to manage the project and integrate the parts and schedule

It is important that all parties have a clear understanding of which category each product falls into and where final responsibility rests.

Baseline Aircraft Configuration Accuracy

As previously discussed in Section 0 Identification and Management of Major Program Risks, a clear understanding and communication with all participating parties of the aircraft's initial baseline configuration inclusive of all previously embodied modifications is critical. It is all too common that lack of concise configuration identification at the beginning of a program results in surprises during modification installation at the end of the program requiring significant rework, expense and schedule delays.

Training and Service Delivery Preparation

Communication and coordination with stakeholders responsible for training, crew scheduling, service delivery is necessary to ensure that the design of training syllabi and necessary communications with cabin crews, catering teams, etc. can be accomplished concurrently throughout the main program phases.

Low Risk:

Material Finishes:

Operator specific finishes such as passenger seating dress covers, cabin monument decorative lamination, and interior finishes in general typically require flammability substantiation specific to the project. In most cases, this is relatively standard and performed with success routinely. Most finish products are marketed and advertised as compliant to latest flammability requirements. However, for program specific use, many cases require flammability substantiation of that specific product with that unique finish. This is commonly referred to as combination testing, the combination of the product substrate and the finish material that the finish material is applied to.

An area of caution would be the use of leather material for passenger seating dress covers. Traditionally, leather material has a higher risk factor in failing to meet flammability requirements versus fabrics or synthetic leathers. Regardless of the material chosen, it is recommended to conduct initial flammability testing (commonly referred to as engineering testing) quickly once the material has been chosen.

Moderate Risk:

Dynamic and Structural Testing

Passenger seating is a popular commodity to incorporate operator specific look and features. In some cases, with existing 'pre-certified' seating products, specific features that are offered, or a combination there of, may require product qualification testing. As the base seat design itself has already proven viability through previous certification efforts, incorporating operator specific features generally doesn't carry the same level of risk as initial product design testing. However, any time a program requires dynamic testing of seats, there is an increased program risk level to certification.

Aircraft seating Head Injury Criteria (HIC) in conjunction with various seat installations, pitches and variances in seatback IFE installations may result in additional risk to a program.

The same can be said for cabin monuments such as wardrobe closets, stowage cabinets, galley units, etc. In most cases the variations of these products and the operator specific features will not require a complete redesign or new design all together.

Interior Modification Installations

The service provider selected for the aircraft modification can have different levels of risks. If an operator has selected a provider that is currently under contract for their aircraft MRO services, and has relative experience performing cabin reconfigurations, the risk level is generally moderate. If the aircraft is going into a new provider for the cabin reconfiguration, the risk level increases simply from a working relationship standpoint.

Most aircraft maintenance facilities are focused and geared towards providing Heavy Maintenance Visit (HMV) services. This is somewhat routine work that is repeated time and time again. Interior cabin reconfigurations are generally unique to the operator and is NOT routine work. The best performing MRO providers for HMV services may very well still have challenges completing the first aircraft reconfiguration event on time. It is just the nature of non-routine type work and reconfiguring an aircraft.

Creating a schedule buffer and having a contingency plan for a late redelivery on the first modification aircraft is highly recommended.

Instructions for Continued Airworthiness

Instructions for Continued Airworthiness (ICA) is a regulatory requirement for products and systems developed and installed on the aircraft. Often the ICA is left until the end of the program by product suppliers and the certification/engineering service provider(s). Not having ICA ready will delay STC release as they are a regulatory requirement. A common program delay is not having the ICA ready at STC final submittal. ICA development, submittal and release should be an item that is closely tracked by the overall program manager to ensure it does not result in a program delay at the 11th hour. ICA requirements will be dictated by the types of products being installed but may include items such as Component Maintenance Manuals (CMM), Illustrated Parts Catalogues (IPC), Aircraft Maintenance Manual (AMM) supplements, Wire Diagram Manual (WDM) supplements, Minimum Equipment List (MEL) revisions / supplements, etc.

Software programming

The development of product software (e.g. customized IFE GUI) and software certification can often add significant risk to a project. Depending on the complexity of the program, the software development effort should not be underestimated. Software may also require significant certification testing depending on its interface with other aircraft systems.

High Risk:

New Product Development

Anytime a program involves development of a new product design or first of model certification and installation, it becomes high risk. Extensive design efforts, substantiation, cycle testing, abuse load testing, qualification testing, etc. are required. As such it is important to monitor every task from the development cycle, through qualification testing, and production build to help mitigate the risk. Due to the involved qualification testing and high risk an operator should plan on ample time for product redesigns and repeat testing.

New Industry Suppliers

New suppliers to the market, whether for products or services should be considered high risk. While there are many benefits to considering a new supplier on the market, a potential lack of experience in execution of these complex programs makes them more susceptible to challenges that can quickly turn into significant issues. All suppliers require monitoring throughout the program development, testing, and production process. If selecting a new supplier to the market, an operator should consider increased oversight, management and a number of meetings and visits to their facility to provide a higher level of oversight and program management to mitigate the risk.

Program Recovery

A program team that is effectively working together, regularly meeting, communicating, managing a program action item list, monitoring schedules to completion, and managing program risk areas, will usually have visibility of a problem brewing prior to it becoming critical. Whether it is predicted or a surprise, once the problem arises the first step is to create visibility within the program participants.

Quick identification and communication between all affected parties is the first crucial step to identifying and developing recovery plans and mitigating damage and delays. Organize the project team for a meeting specifically to address the issue at hand. Document what is known about the issue. There are a number of program management tools to assist with this. The key is to dissect the issue so that all parties have a clear understanding of what the problem is.

Once the problem is properly defined, the team can identify resolution steps. In most cases there are a number of different factors and potential resolutions. The key is to generate a consensus by the team on a path forward and begin the recovery plan. A supplier or provider trying to recover on their own and hiding the issue from the rest of the team is a recipe for major problems and delays. This is another reason why participation and continued monitoring at the customer level is important. If an operator has selected the right partners for their program and developed the management and teamwork approach to operate effectively in the program, then the team will pull together to develop workable solutions. Often other parties can adjust their internal schedules to accommodate delays from others while mitigating overall program delays. However, these resolutions can only occur if all parties are aware of the issue and working cooperatively to find a solution.

For example, a leather supplier (sourced by the operator) suffers a delay in leather tanning production and the leather will now be delivered three weeks late to the seat supplier for cut and sew. If the seat supplier is notified early enough, they may be able to adjust their production schedule and/or their cut & sew supplier to expedite the work. Furthermore, the MRO installing the seats may be able to adjust its schedule to accept the seats one week later than originally scheduled. With all the program participants working together as a team, a recovery plan is put in place with all parties participating and making adjustment for a successful outcome.

It is generally a good practice for the overall project program management to assign a person from the team to head the recovery initiative. The program manager needs to continue managing the overall project while also making sure the recovery initiative is resourced and fully supported. The recovery initiative leader then needs to have team members identified that will work together on this initiative until resolved.

The recovery initiative becomes an elevated task within the overall program schedule. Once the recovery team has been identified, the recovery initiative leader should initiate regularly scheduled meetings for the team. Depending on

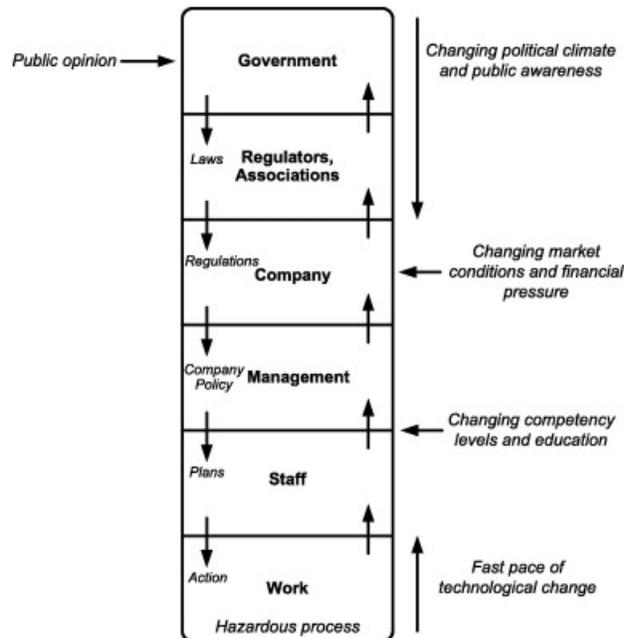
the severity of the issue and the size of the recovery effort, this may include morning briefs to outline the individual tasks for the day, assignments of responsibility, and acknowledgement of objective. Then the team assembles again at the end of the day to evaluate successes, update the progress, raise any issues that may have occurred, etc. This process continues until the issue is resolved. The overall project manager is generally briefed on a regular basis with a simple, we are on track for recovery, or we have additional challenges to overcome type update.

Conclusion

Commercial aircraft interior retrofit programs can be as simple as changing of placard colors to incredibly complex complete cabin product refits. Whether the program is simple and affects just a single aircraft or is a complex large fleet wide campaign, the approach and execution of proper program management will give the program the best chance of success.

There are a variety of program management tools and approaches that can be applied to these programs. This document includes some high-level guidance and suggestions for the tools, approach and key steps to effectively executing a successful program. Each program is unique and will require adjustments to its particular team members, scope and complexity, but the key factors for success are always the same: proper planning, scheduling, partner sourcing, early engagement with the certifying authority and robust program management during execution.

For more complex programs utilizing a more developed risk management process, such as the Rasmussen Risk Management Model framework, maybe applicable. Although the Rasmussen model framework was initially developed for system safety risk management, its holistic top down approach to defining risk and understanding the key factors driving that risk is applicable to all complex systems and projects.



(Rasmussen, 1997)

A cabin interior modification is “changing the product” and often the most difficult thing for any business is change management.

Understanding the scope and complexity of the “change”, its risk factors and their driving force, and applying appropriate levels of management, oversight, reporting and management is crucial to program success.

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Appendix A – Cabin Design & Certification Issues

The following table is a sample list of cabin certification issues and challenges that EG members have encountered during accomplishment of aircraft interior modifications.

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Safety Briefing Card	- Stowage for the insertion of the safety briefing card should be positioned in such a manner as to be clearly visible from the seated position in order to cover the requirements of ICAO Doc 100086			<p><i>ARP1384D, Passenger Safety Briefing Materials</i>, sponsored by S-9B, Cabin Interiors and Furnishings Committee contains presentation requirements for safety briefing cards.</p> <p>No SAE Seat Committee standards or proposed activity.</p>
Lifejacket Stowage	- The lifejacket stowage should be fitted with a tamper proof seal which can be easily (but not too easily in normal operations) broken. This is to prevent the operator from having to remove each individual lifejacket and security search the stowage on each turnaround, which would impact their ability to operate efficiently.			<p><i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i>, released in August 2018 documents the latest knowledge on Design for Security including object sizes accepted by the FAA and EASA. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.</p> <p><i>ARP997D, Installation and Stowage Provisions for Emergency Equipment in the Transport Aircraft Passenger Cabin</i>, was stabilized in 2012 by SAE S-9C, Cabin Safety Operational & Human Factors Committee but does not address security.</p>
Children Seatbelts	<ul style="list-style-type: none"> - Seatbelt percentile requirements should include children aged between 2 and 12 - Safe position of the harness for children aside from meeting HIC requirement - For example, 3-point harness – need to consider the safe position of the shoulder strap for children - Booster seats compatibility and adjustable shoulder strap (height) 			<p><i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i>, already includes design guidelines for children 2 years and up to fit the seat. The specific issue of the shoulder belt and smaller occupants is the subject of proprietary means of compliance agreed between the aircraft OEMs and the regulators and has not been developed into an industry standard yet. Adjustable shoulder belt strap height can already be accommodated into seats under the current standards. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.</p>

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Personal Item Stowage	<ul style="list-style-type: none"> - Design standard required for stowage area to allow stowing small personal items - Due to lack of a personal stowage area passengers keep small personal items in their pockets or loose on the sides and they subsequently fall into the seat mechanisms during articulation, sometimes resulting in fires. 			<p>The SAE Seat Committee has attempted to define design guidelines for small open stowage areas on more than one occasion. The Seat Committee has not developed a solution that adequately addresses the requirement of 25.787 for stowages to be enclosed. The committee is willing to further revise the document as new knowledge is agreed.</p>
Brace Position	<ul style="list-style-type: none"> - Suitable brace position to be recommended as part of the certification process - Different types of seatbelts – 3-point harness, inflatable seatbelt etc. - Seat orientation – oblique/angled seat, aft facing etc. 			<p><i>ARP4771, Recommended Brace Positions</i>, was published by SAE S-9C, Cabin Safety Operational & Human Factors Committee in 2008. It could be revised if necessary.</p> <p>The requirements documented in <i>AS8049C, Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft</i>, define a standardized test regimen to evaluate seat structure, not occupant positioning. Brace positioning is a separate issue that has been studied by the regulators who have published guidance. Documentation within the SAE Seat Committee is unlikely.</p>
PED Stowage	<ul style="list-style-type: none"> - Design criteria for certification should eliminate gaps in seats that all PEDs to become caught/crushed or fallen in the mechanism. - Specific stowage for PED and personal effects around the seat must be certified for use during taxi, take-off and landing - Stowages should be designed to help prevent small PEDs forgotten in seat pocket (e.g. transparent, removable, shallow). 			<p>The SAE Seat Committee has attempted to define design guidelines for small open stowage areas on more than one occasion. The Seat Committee has not developed a solution that adequately addresses the requirement of 25.787 for stowages to be enclosed. The committee is willing to further revise the document as new knowledge is agreed.</p>
Manual Control & Power Isolation Switches	<ul style="list-style-type: none"> - Design criteria should aim to make location of such controls and switches easily accessible by cabin crew - Mechanism for manual return to seat mode should be easy to facilitate and not require multiple crew members, or excessive strength or dexterity 			<p><i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i>, documents manual override design guidelines. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.</p>

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Arm Rest Release	- Design criteria for arm rest release (used for PRMs) to be standardized. Should aim to make it easier to locate/operate, with less likelihood of trapping fingers.			<i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i> , documents hinged armrest design guidelines. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.
Proper Placarding	- Certification to include proper placarding on the appropriate usage of all compartments or stowage around the seat for taxi, take-off and landing For example: IFE monitors, Premium Cabin Seats with doors (sliding or non-sliding, beds etc.			<i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i> , documents safety placard design guidelines. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.
Handholds	- Design criteria to include appropriate handholds around seats especially Premium Cabin seats Note: To provide a chance for crew or passenger to secure themselves during unexpected turbulence when not at their seats.			<i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i> , documents seat back handhold design guidelines. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.
Large Percentile Passenger Accommodation	-To introduce design criteria for the conversion of two or more Economy Class seats to accommodate obese passenger.			No standards exist or are being considered for development
Roll-Onboard Wheelchairs	-Need a way of easily removing seats and also enabling aisle width to be enlarged to enable passenger's wheelchair to get to any wheelchair space in the cabin.			No standards exist or are being considered for development within the SAE Seat Committee. The SAE S-9B Cabin Interiors and Furnishings Committee maintains <i>ARP4120C, Foldable On-Board Wheelchairs for Passengers with Disabilities</i> .

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Composite Structure in Aircraft Seats	- An issue paper is needed to establish means of compliance for seats fabricated using composite materials or bonded joints in the primary load path. While the applicable regulations remain unchanged, the means of compliance for composite construction may differ from those traditionally used for seats of metallic construction.	Y		<i>ARP6337, Composite Seats</i> under development in SAE Seat Committee.
Child Shoulder Harnesses for Seats	- You need special conditions for child shoulder harnesses for seats. The airworthiness regulations do not contain adequate or appropriate safety standards for safety restraint devices, such as a shoulder harness, specifically designed for use by small children. Note, the operating requirements prohibit the use of "vest-type child restraints, and harness-type child restraints." You will likely need to petition for an exemption from the applicable operating rules to be allowed to use these devices in the U.S.	Y		<i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i> , already includes design guidelines for children 2 years and up to fit the seat. The specific issue of the shoulder belt and smaller occupants is the subject of proprietary means of compliance agreed between the aircraft OEMs and the regulators and has not been developed into an industry standard yet. Adjustable shoulder belt strap height can already be accommodated into seats under the current standards. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed
Inflatable Restraints in Seats/Walls	- You need special conditions for inflatable restraints in seats and walls because the regulations do not contain adequate or appropriate safety standards for inflatable restraints. The special conditions address the safety performance of the system and the system's integrity against inadvertent activation.	Y		<i>AS5785, Component Standard for Airbag Systems Installed in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft</i> and <i>AS6466, Installation Performance Standard for Airbag Systems Installed in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft</i> under development in SAE Seat Committee.
Large Surface Area Seat Panels	- You may need special conditions to address heat release and smoke emission requirements for seats with large surface area composite or plastic panels (such as those often installed in first class or business class sections) in airplanes with 20 or more passenger seats.	Y		<i>ARP6199A, Method to Evaluate Aircraft Passenger Seats for the Test Requirements of 14 CFR Part 25 Appendix F, Parts IV and V</i> , documents standards to satisfy the Heat Release Special Conditions. The document is currently under revision to incorporate the latest consensus with the regulators. <i>AS6960, Performance Standard for Seat Furnishings in Transport Aircraft</i> , under development in SAE Seat Committee.
Medical Stretchers	- You may need to petition for an exemption for medical stretchers for an airplane certification basis that includes §§ 25.562 and 25.785 at Amendment 25-64 or later.	Y		



Cabin interior retrofits and entry into service program

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Mini-suites	- Installation of mini-suites, i.e., single occupant seat installations surrounded by 4 walls, may require an issue paper to address several compliance concerns. Direct view, egress and potential ramifications on security are all areas that may require specific methods of compliance, or in some cases an exemption or equivalent level of safety finding.	Y		<i>AS6960, Performance Standard for Seat Furnishings in Transport Aircraft</i> , under development in SAE Seat Committee. Initial release will not incorporate mini-suites, but many of the requirements defined will be applicable to mini-suites and future revisions could be expanded to include them.
Side-Facing Seat	- You need special conditions for single and multiple place side-facing seats on airplanes that include Amendment 25-64 in their certification basis. Seats meeting these special conditions have no operational limitations. Special Federal Aviation Requirements (SFAR 109) can be used for airplanes that meet the applicability criteria of the SFAR.	Y		<i>AS8049/1, Performance Standards for Side-Facing Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft</i> , and <i>AS6316, Performance Standards for Oblique Facing Passenger Seats in Transport Aircraft</i> , document requirements for side and oblique facing seats respectively. The contents of these standards are currently being incorporated into <i>AS8049, Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft</i> . The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.
Child Restraint Device Usage with Inflatable Seat Belts	Operators are left to take the decision on whether CRD's can be used directly with inflatable seat belts. AMSAFE (OEM) provides the following statement: - The use of child loop does not make the lap held child any safer. AmSafe does not recommend or endorse this option as a safe condition for protection during a crash event. However, the presence of the seat belt air bag for this application will not affect the condition or position of child loop restrained children. If the operator chooses to permit the use of child loop, it is an operational consideration regarding the use of the belt-extender to disable the airbag system for the passenger.			No standards exist or are being considered for development in the SAE Seat Committee.

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Galley inserts and cabin furniture (excluding seat assemblies)	Most galley inserts, and cabin furniture are not covered under TSO requirements, accordingly, various OEMs do not have the requisite certification authority to issue SBs and it hindered incorporation of certain product improvements.			<i>AS1426C, Minimum Performance Standards for Galleys in Transport Aircraft</i> , is under development in SAE S-9B, Cabin Interiors & Furnishings Committee. The committee also maintains <i>AS8056, Minimum Design and Performance of Airplane Galley In-Flight Carts, Containers, and Associated Components</i> , and <i>AS8057, Minimum Design and Performance of Airplane Galley Insert Equipment, Electrical/Pressurized</i> .
Common standards for operating rules for emergency equipment	Differing interpretations, for example portable O ₂ , between OEM, DER's, etc. leads to differing quantity of O ₂ bottles			<i>ARP997D, Installation and Stowage Provisions for Emergency Equipment in the Transport Aircraft Passenger Cabin</i> , was stabilized in 2012 by SAE S-9C, Cabin Safety Operational & Human Factors Committee.
Clear understanding on acceptable data for dynamic seat installation	The DER accepted seat supplier data to certify and install seats at 38" pitch. OEM's internal process did not allow to accept same data thus aircraft delivered from OEM could not be installed at 38" pitch.			This is a certification process issue not addressed by SAE documents
OEM have own interpretation of regs and do not share guidance used.	Stew step on end bay not acceptable to OEM. They only accept the saddle "stew" step. This interpretation differs from other ODA's.			<i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i> , documents flight attendant step design guidelines. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.



Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Shoulder harness and the 35-inch arc	<p>Delethalization regulation 14 CFR 25.785(d) requires compliance with one of its sub-sections. Generally, (d)(2) is used, which requires "the elimination of any injurious object within striking radius of the head". The striking radius is defined by AC 25-17 as 35 inches. Instead, compliance can be shown via (d)(2) by installing a shoulder harness. However, the full text of the regulation states "shoulder harness <i>that will prevent the head from contacting any injurious object</i>" {emphasis added}. No known guidance exists to define how this is done. Opinions vary; examples include assessing the 16g dynamic head path at 10 degrees of yaw, assessing the 16g dynamic head path with any additional 3 inches, or assessing all objects in the 35-inch arc (thus invoking (d)(2), instead).</p>			<p><i>ARP5526E, Aircraft Seat Design Guidance and Clarifications</i>, documents design guidelines that should cover most installation including shoulder harnesses. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.</p>
Serious Injury	<p>14 CFR 25.785(b) requires "Each seat ... must be designed so that a person ... will not suffer serious injury in an emergency landing...". No FAA definition of serious injury exists. Recently, the FAA verbally rejected using medical industry standard definition – the Abbreviated Injury Scale (AIS) -- for serious eye injury but provided no alternate definition other than requiring <i>no</i> injury. Requiring no injury exceeds the regulation's limit of "serious" injury.</p>			<p>The SAE Seat Committee continues to discuss this topic but has so far been unable to reach an actionable consensus with the regulators.</p>

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Neck injury / neck impingement	Little official guidance has been provided publicly on neck injury. Pieces of information are provided via letter to the SAE Seat Committee. Pieces of information are obtained verbally. For example, the letter sent to the SAE Seat Committee in March 2017 stated that if the test dummy's "head is stopped (for more than 10 milliseconds) from sliding down the seat back while the torso is still moving downward..." Multiple persons have reviewed sample test videos; no two persons chose the same start time and stop time for assessing this 10 millisecond criteria. The industry still awaits training (or alternate criteria).			<i>AS8049 rev D, Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft</i> , currently under development, documents the current understanding of the Seat Committee. As further knowledge is agreed, revisions will be undertaken.
Cracks on Dynamically Tested Seats	AC 25.562-1B states that "Cracking of structural elements ..., provided a continuous load path remains between the occupant and the seat attachments." Verbal guidance to one company resulted in a conservative position that no cracks are allowed, because any crack could propagate and eliminate the load path. At another company, two DERs reviewed a long crack in a seat pan and assessed that a load path still existed; the ACO issued TSO approving the seat.			This is a certification process issue not addressed by SAE documents
High wall Suites	Revise § 25.813(e) to allow for a door between a single occupant and an exit. Research to determine if latest FAA exemption limitations and Special Conditions are sufficient. Document appropriate performance based guidance material for high wall suites variants. Suggest that CAMI testing is completed to show the reduced capacity in zones improves overall evacuation capability			<i>AS6960, Performance Standard for Seat Furnishings in Transport Aircraft</i> , under development in SAE Seat Committee. Initial release will not incorporate mini-suites, but many of the requirements defined will be applicable to mini-suites and future revisions could be expanded to include them.
Access to Type III exits 25.813	There are several differences between FAR and CS. Propose harmonization of the Type III exit access requirements with EASA CS 25.813			



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Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Crew Rest Special Conditions (SC's)	Harmonize and release as regulations (14 CFRs and CSs) to avoid SCs on each new project			<i>ARP6503, Cabin Crew Rest Facilities</i> was published in March 2018 by the SAE S-9 Cabin Interiors and Furnishings Committee and provides guidance for the design, installation, and operation of in-flight rest facilities for cabin crews.
Dynamic Seats - Flight Crew	Flight deck crew seats has different requirement (FAA and EASA). Leads to systematic requests for exemption from 14 CFR Part 25.562 floor warpage test case. FAA/EASA to harmonize the requirement with CS 25.562 or develop a rule change to remove the flight deck seat floor warpage requirement.			The FAA and EASA have harmonized requirements. No action is being considered by the SAE Seat Committee.
Cabin Attendant Direct View	Review intent of the rule in relation to in-service incidents, other cabin safety improvements, operational procedures, and current trends in cabin configurations. Develop appropriate and harmonized performance based guidance material. Industry contends that a view of aisle and exits is sufficient.			No standards exist or are being considered for development in SAE.
Lavatory Ashtray	Base the requirement for an ashtray on the lavatory door, on if smoking is allowed. Rule to read something like ""if smoking is allowed then a self-contained removable ashtray is required on the exterior of the lavatory door. Or one ashtray may serve multiple lavatories if visible from all the lavatory locations"". When smoking is not allowed, a person disobeying that rule will not use the ashtray as that is evidence of not following the rule.			<i>ARP4740A, Safety Considerations - Smoking in Lavatories of Transport Aircraft</i> was stabilized in 2016 by the S-9C Operational and Human Factors Issues Committee. It does not address lavatory ashtrays.

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Protection of Critical Systems (Freighters)	Publish harmonized 14 CFR Part 25 and CS Part 25 requirements to reduce workload			
Symbolic Placards	FAA and EASA adopt ARP8996 (when complete). Provides appropriate guidance for symbolic placard approvals			<i>ARP8996, Comprehensibility Testing for Pictogram-based Aircraft Markings and Placards</i> , is under development by SAE S-9C, Cabin Safety Operational & Human Factors Committee.
Codify standard Special Conditions: Oblique Seats	Publish harmonized performance based FAA and EASA requirements based on existing Special Conditions			This is a certification process issue not addressed by SAE documents. See also Side-Facing Seat Item.
Seats with Non-Traditional, Large, Non-Metallic Panels	Harmonize and release as regulations (14 CFRs and CSs) to avoid SCs on each new project. Also harmonize the associated MOCs			This is a certification process issue not addressed by SAE documents
Definition of small parts	There is no concise definition of "Small Part" in EASA and FAA documents. It can be found only in Boeing document.			ARP5526E, <i>Aircraft Seat Design Guidance and Clarifications</i> , documents small part design guidelines. The SAE Seat Committee is willing to further revise the document as new knowledge is agreed.

Item	Description	Covered by FAA TAIL (note 1)	Covered by EASA Certification Memoranda (note 2)	SAE International Comments
Applicability of the requirement	It is not always but sometimes not clear when the requirement (for example Nij) becomes applicable. If the requirement become applicable after seat ITCM, it should not be applicable for the project because seat supplier already started their design and development. (Some additional condition could be added. For example: the duration of the seat project is less than 24 months between ITCM and seat FAI)			This is a certification process issue not addressed by SAE documents

Note 1:

FAA Transport Aircraft Issue List (TAIL) - http://www.faa.gov/aircraft/air_cert/design_approvals/transport/media/rpttailistforpublicweb.pdf

Note 2:

EASA Certification Memoranda - <https://www.easa.europa.eu/document-library/public-consultations/certification-memoranda>