## AAR Engineering Services/Delta 767-400 Flat Bed Modification

### I. Program Overview

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<tr>
<th>Organization Name/Program Name:</th>
<th>AAR Engineering Services/Delta Air Lines 767-400 Flat Bed Modification</th>
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<tbody>
<tr>
<td>Program Leader Name/Position/Contact information – E-mail, Phone</td>
<td>Keith A. Zacherl/Senior Program Manager/keith.zacherl@aarcorp.com, 317-227-5543</td>
</tr>
<tr>
<td>Customer: Organization/Name/Position/Contact information – E-mail, Phone</td>
<td>Delta Air Lines/Celina Blanco-Boscan/Manager – Fleet Projects/celina.blancoboscan@delta.com, 404-677-0130</td>
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#### Program Category
- System level Production/Sustainment program or project

#### Program Background: What is this program all about? (No more than one page).

Describe:
- The overarching need for this program
- History of the program
- The product that is created by this program
- Scope of work – original & updated
- Expected deliverables
- Current status of the program

- In the Fall of 2007, one of our airline customers contracted us to provide modification of seven (7) Boeing 767-400 aircraft from a domestic to an international configuration. This entailed a complete interior reconfiguration, including business class seats, economy class seats, in-flight entertainment, galleys, lavatories, closets, partitions, overhead bins, sidewalls, and ceiling panels. Furthermore, a Lower Lobe Crew Rest Module (LLCRM) accommodating up to five (5) cabin crew members and installed in the aft cargo compartment, a newly designed galley chiller installation, and a relocation of the vacuum lavatory waste tanks in the area aft of the aft cargo bulkhead were included in the scope of work.
- In addition to the engineering required to complete the aforementioned modifications, Federal Aviation Administration (FAA) approvals in the form of Supplemental Type Certificates (STCs) were required prior to returning the aircraft to revenue service. A total of four (4) STC’s were applied for and received, one each for the following; Interior Reconfiguration and LLCRM Provisions, LLCRM Installation, Galley Chiller Installation, and Lavatory Tank Relocation.
- Our responsibilities also included providing a full kit of parts necessary to modify the aircraft.
- Completion of these first seven (7) aircraft was difficult as we historically had not managed a program as complex or with as many variables. Ultimately the prototype aircraft was returned to service late due to certification challenges, late parts kit deliveries from some of our sub-
suppliers, and lack of a robust and well-defined process for managing complex engineering integration programs. As a prerequisite to regaining their confidence, AAR accomplished an exhaustive post-mortem review of the entire program from start to finish led by Sr. Management possessing a wealth of past experience. During this review, both positive and negative aspects of our program management were identified. For every deficient process identified, a comprehensive corrective action was implemented.

- This entire process resulted in the introduction of a new, overarching Program Management philosophy introduced by our Group Vice President for Maintenance, Repair and Overhaul – Dany Kleiman, and adopted in the Fall of 2009.

- Subsequent to the completion of these first seven (7) aircraft, the customer identified an additional fourteen (14) Boeing 767-400 aircraft to be modified. This project was awarded in the Fall of 2009 with the added complexity of having a different starting point configuration. Under the program leadership of Sr. Program Manager Keith Zacherl, modification of these next 14 aircraft was completed with the prototype aircraft successfully modified and returned to service 10 days ahead of schedule and the final aircraft returning to service 15 days ahead of schedule.

II. **Value Creation = 20 Points**

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<th><strong>Value:</strong> What is the value, competitive positioning, advantage, and return created by this program to your:</th>
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<td>• Customers – National interests, war fighter</td>
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<td>• Company – Strength, bottom line, and shareholders</td>
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<tr>
<td>• Scientific/technical value (particularly for R&amp;D programs)</td>
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**Excellence and Uniqueness:** What makes this program unique? Why should this program be awarded the Program Excellence Award?

- Airline competition for international passengers, especially those that purchase tickets in lucrative First/Business Class sections of the aircraft, is stiff. International routes bring increased revenue and are vital to an airline’s long term prosperity. Accomplishment of this program, outfitting fourteen (14) additional 767-400 aircraft in Delta’s fleet with enhanced cabin amenities, including highly coveted flat-bed first class seats and IFE, enables them to command premium prices previously not achievable with their pre-modification seats. Fresh cabin interiors with the latest on demand IFE and seating are important to enhancing passenger satisfaction and ensuring repeat business.

- Returning the prototype aircraft to service 10 days early provided the customer with extra “lift” and afforded schedule flexibility and contingency for the remaining 13 aircraft.
AAR was able to build on the platform established during the previous seven (7) aircraft program, facilitating sufficient time to negotiate pricing, eliminate expedite charges and maximize internal resource utilization to significantly reduce costs and ensure maximum financial returns for the company.

- By exceeding the customer’s expectations, AAR has strengthened our long-standing relationship with Delta and placed ourselves in a prime position to win future engineering integration business.

- This unique program is deserving of the Program Excellence Award based on our ability to take a poorly executed previous program and turn it into a significant lessons-learned opportunity. After accomplishment of the first seven aircraft, AAR was able to identify teachable lessons in program execution. By evaluating best practices and implementing a game-changing program management methodology, AAR was able to successfully address the challenging issues and difficult requirements presented by the follow-on 14 aircraft mod and ultimately deliver a successful project to the customer.

### III. ORGANIZATIONAL PROCESSES/BEST PRACTICES: (HOW DO YOU DO THINGS) = 30 POINTS

**Strategic:**

**Opportunity Management -** Describe how your program has identified its operational and business opportunity, and manages this opportunity throughout the program’s life cycle.

AAR’s proposal ensured the customer that we would make every effort to correct issues of the past program, make requested improvements to the proposed program and do so on-time and at a cost below that of the competition. With much of the engineering and certification accomplished during the previous program, AAR could beat all competitors pricing while ensuring favorable margins. AAR was able to control costs throughout the program by sourcing part suppliers early, obtaining quotes from multiple suppliers, tracking budgets closely (NRE and Recurring) and delivering parts kits ahead of schedule.

**Strategic:**

**Strategic Supply Chain Integration and Cost Effectiveness Management:** - Describe how your program is integrating its supply chain to assure visibility and adapting long-term cost effectiveness up and down the supply chain.

AAR took major steps to maximize supply chain integration for this program. Approximately 2/3rds of the materials provided for this program came from key AAR sub-suppliers who specialize in building interior commodities or hold FAA parts manufacturing authorization (PMA) on products.

In an effort to leverage our significant internal manufacturing capabilities and maximize AAR kit content, AAR took full operational control of the existing
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<th>Strategic: Operational Integration and Systems Engineering –</th>
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<td>Describe the challenges faced by your program in terms of integrating the system into its operational environment and its impact on systems engineering planning and management.</td>
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<tr>
<th>Operational: Planning, Monitoring, and Controlling -</th>
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<td>Describe your planning and resource allocation processes. How do you monitor and review your program’s progress and make corrections to keep the program on track?</td>
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<td>in-house metal fabrication shop and added to it wire harness fabrication capability. AAR produced all 14 ship-sets of both metal fabricated parts and harness assemblies within the same building as our Engineering Services group enabling monthly, weekly and daily meetings as necessary to ensure parts were fabricated per design and on time. Requiring a formal proposal process from our internal fabrication shop enabled AAR Engineering Services to effectively control costs by requiring competitive bids to ensure accurate internal pricing. AAR also mandated that our major sub-suppliers purchase composite panels from a sister AAR business unit. Early design completion enabled early sourcing of parts and material without loss of profit due to customary expedite charges.</td>
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<td>The program’s main focus ensured that all new systems, including galleys, lavatories, IFE, Flat Bed Seats, Crew Rest and other lighting and system mods were seamlessly integrated into the existing aircraft systems while meeting all FAA certification and testing requirements. Each new system is functionally tested to ensure proper operation while ensuring full system operation does not affect critical flight systems, through a combination of ground and flight Electromagnetic Interference (EMI) tests under the supervision of an FAA Designated Engineering Representative (DER). Efficient, operational, and compliant integration of aircraft systems was paramount to the ultimate success of this program.</td>
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<td>Evaluation of the scope of work initially occurred during the proposal stage to identify key engineering elements that would either be accomplished in-house or subcontracted to partner companies with the requisite expertise, experience and capacity. The overall program schedule was developed after program award to identify all program data deliverables and work was “flowed” for both internal and subcontracted resources. Work completion or “burndown” charts were developed to ensure that Fabrication and Installation drawings were being released according to schedule. The burndown charts identify the number of drawings, reports or installation documents that were scheduled to be released each week. These charts provide a visual tool that enables program management to quickly track and report progress on engineering deliverables without having to review the entire schedule. When data release fell behind it was quickly identified and appropriate resources allocated to</td>
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### Operational:
#### Supply Chain and Logistics Management
What processes, tools and relationship-building methods have you used to develop, refine and improve supply chain and stakeholder integration? Please indicate also methods used to analyze/fact-find regarding supplier proposals. This is one of the most imperative needs of our industry – please provide specific details and data that assisted you in gauging the effectiveness.

AAR strives to achieve supply chain and stakeholder integration by first keeping as much manufacturing as possible in house to enable closer oversight; and second, by using the same strategic sub-suppliers/partners that we have a successful history with on previous programs. Starting with this program and the adoption of our new program management methodology, new techniques were implemented to ensure all suppliers remain on schedule for both engineering and parts.

Parts were tracked to the second tier level by requiring weekly updates to “burndown” charts for engineering as previously discussed and “train” charts to track the progress of all parts in manufacture from P.O. issuance, material receipt, stage of manufacturing and finishing to final delivery and acceptance. AAR and our main sub-suppliers made mandatory visits to each second tier supplier to verify firsthand that production progress was as indicated per their train chart. A full “carpet” chart is used to identify all parts required for the program to determine if the POs were cut, planned delivery date and if the parts had been received as well as identifying if the parts were either off the shelf (hardware, standard parts or Boeing parts), fabricated in-house or fabricated externally.

A supplier score card is maintained as part of our standard program review which tracks budget, negotiation status and part manufacturing goals for each major supplier. These score cards are also used to keep program notes on each supplier and are graded as Green, Yellow and Red to visually identify their overall status.

### Operational:
#### System Integration, Testing & Reviews
Describe the activities and processes used to succeed in your system integration, and testing. How did you conduct system design and technical reviews?

All systems were functionally tested to ensure proper operation. These functional tests were accomplished per published standard maintenance practices or new functional tests were created where new systems were installed. During modification of the prototype aircraft, ground and flight EMI tests were accomplished to ensure no negative impact to flight critical systems occurs when operating the new and existing systems. FAA representatives observe the EMI testing as well as functional testing for any new or unique systems. FAA representatives also inspect the aircraft during and after the modification to ensure that all parts, components and monuments are installed per the previously reviewed and approved design data. These representatives also inspect the aircraft to ensure that all regulations are complied
System design and technical reviews were accomplished via a formal design review process utilizing the following key milestones – Initial Technical Coordination Meeting (ITCM), Preliminary Design Review (PDR), and Critical Design Review (CDR). These reviews were essential to ensure that both AAR and Delta were on the same page with respect to the engineering design approach and deliverable status.

**Operational:**

*Risk / Opportunity Management*

Describe the processes used to identify both risks and opportunity and to assure potential for both is addressed effectively. Please indicate any forward-leaning processes to support.

Risks are identified and tracked on a monthly basis and categorized as either program or engineering risks. A standard risk assessment is used to determine the criticality of each risk. Additionally, a series of planned steps are identified to mitigate each medium or high risk item until it is no longer a risk or completely addressed. Detailed periodic review of program risks is vital to allocate the appropriate resources and expertise to mitigate each risk.

**Team Leadership:**

*Team Culture and Motivation*

Describe how you created your team spirit and culture, and accomplished entire team integration and individual team member motivation.

The team culture is a departmental culture where we strive to ensure the customer is satisfied through on time product delivery. The management and program team are willing to provide the appropriate level of resources, including overtime as required, to ensure program success. The program team is close due to having worked a number of projects together, including the initial program which saw unfortunate customer delays. The program team was eager to implement and participate in a totally new approach to program management in an effort to avoid problems encountered on past programs. The issues from the initial program were not attributable to team attitude but rather lack of proper tracking tools and metrics.

**Team Leadership:**

*Lessons Learned and Knowledge Management*

Describe how you collect lessons learned and best practices, and how they are shared with your team and company to improve performance. Also how are you capturing expertise and knowledge to assure availability over the life of the program?

With the implementation of our new program management methodology, internal program reviews are accomplished on a monthly basis with Sr. Leadership participation at least quarterly. When internal program reviews take place, all Program Managers attend to ensure that teachable lessons from one program can be shared with other programs firsthand. This process of mandatory attendance at every program review also facilitates familiarity with each other’s respective projects and cross-training for future benefit.

**Team Leadership:**

*Leadership Development*

How do you develop team’s skills and build future leaders?

Program Managers, both presenting and observing during reviews with Sr. Leadership, gain the benefit of sage advice and exposure for both themselves and their projects. Aspiring Program Managers will typically work
under the tutelage of a more experienced Program Manager for several months prior to taking on their own project.

AAR’s overarching Program Management philosophy, while based on Risk Assessment and Mitigation, contains several other key elements that, when combined, provide a formidable tool to manage complex programs. These major elements include:

- Schedule – Milestones (including deliverable requirements), Engineering and Mod Kit Delivery
- Budget – Contract Requirements, Recurring and Non-Recurring, Contingency
- Resources – Program Team, Manpower Build-up
- Engineering – Engineering Activities Score Card, Scope of Work Definition, Drawing and Report Release Schedules/Burndown Charts
- Program Risk Analysis – Program and Engineering Risks, Identification and Mitigation
- Supply Chain – Supplier Management Methodology, Supplier Score Cards, Production Milestone Tracking, Reporting and Metrics for managing work in process
- Communication – Action Items, Coordination Memos (CM), Change Requests (CR), Executive Reviews, Customer Reviews, Senior Level Steering Committee
- Metrics – Score Cards

The methodologies described above have been fully adopted and embraced by our Program Management Team and are being utilized on all of our projects.

Identify your program’s specific Best Practices that you believe are unique, and could be shared with others and become industry’s Next Practices.

Best (& Next) Practices:

AAR’s follow-on program to integrate new galleys, lavatories, seats, IFE, etc. would best fit into the “New to the Market” category. In order for airlines to compete for the higher revenues generated from international flights, they must upgrade their aircraft to include the latest in cabin amenities. AAR had a great deal of experience with the 767-400 aircraft and new systems installed as part of this modification resulting from the initial program and was the logical choice to accomplish the follow-on program. Although full flat-bed seating programs are not unique to airlines, the complete cabin modification and especially the installation and integration of the Flight Attendant crew rest quarters in the
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| Cargo compartment is new for the 767-400. The customer’s goal is to enhance flight attendant job satisfaction as well as their performance by providing crew rest quarters which are far superior to the typical attendant rest seat in the cabin. Additionally, the crew rest enabled the customer to free up a number of seats that would have otherwise needed to be blocked off for attendant rest and therefore, increase revenue. In light of rising fuel prices, the increased revenue resulting from incremental seating capacity in economy class and the addition of premium first class seating for international flights enables Delta to increase revenue and obtain a quicker return on their investment compared to modification of a domestically configured aircraft. |

Identify the Program’s **Technological Uncertainty** using the definitions below. Then describe how you deal and address this uncertainty:

- **Low-tech**: application of mature, well-established technology
- **Medium Technology**: existing technology modified to meet new design requirements
- **High-Technology**: recently developed new technology
- **Super High-Technology**: non-existing technology that needs to be developed during the program.

AARs follow-on program to integrate new galleys, lavatories, seats, IFE, etc. would best fit into the “Medium Technology” category. AAR possessed a great deal of experience with the aircraft and new systems being integrated as part of this modification, but was starting from a different aircraft configuration. In addition to the starting configuration, there were a number of workscope items added, including a new light installation that was requested at CDR which was months after the agreed upon cut-off date for design changes. Differences/uncertainty on this program were identified very early when the customer first approached AAR. Subsequently, AAR made a presentation detailing each of the differences and our plan to address them with the engineering package. Additional risk and uncertainty was identified during the program when the FAA rules for wire separation from fuel quantity wiring deviated from what integrators had previously understood. AAR identified this risk and mitigated it by ensuring that our newly hired certification manager and electrical lead engineer with the most experience coordinated the necessary Alternate Means of Compliance (AMOC) paperwork with the FAA. The AMOC as well as other electrical reports (Electrical Wire Interconnection Systems or EWIS) were considered ground breaking in their scope and were used by the FAA and other integrators as templates for achieving compliance with wire separation and EWIS.

Identify the level of your **System Complexity** using the definitions below. Then explain how you are dealing with this level of complexity:

- An **Assembly** performing a single function.
- A **Sub-system** fitting within a larger system.
- A **System** – a collection of subsystems performing multiple functions.

This program would be categorized as a “System” whose main focus was to ensure all new systems - new galleys, lavatories, In-Flight Entertainment, Flat Bed Seats, Crew Rest and other lighting and system mods - are seamlessly integrated into the existing aircraft systems while meeting all FAA certification and testing requirements. All systems are functionally tested to ensure proper operation individually and at the same time to ensure full system operation does not
**An Array** – a “System of Systems”; a widely dispersed collection of systems serving a common mission.

Affect critical flight systems. Understanding the changes to the aircraft systems and how to address them while meeting all published FAA guidance was paramount to this program.

**Pace and Urgency** of your team’s effort using the definitions below. Then describe how you deal with the program’s pace requirements:

- **Regular timing** – no specific time pressures.
- **Fast/Competitive** – time to market is important for competitiveness.
- **Time Critical** – there is an absolute and critical-to-success deadline.
- **Blitz** – there is a crisis element driving the need for immediate response

This program would be categorized as “Time Critical”. Elapsed time from program award to the customer required STC date was just under 12 months. A typical program of this scale would normally be allotted 12 to 18 months. Due to the use of the same suppliers and our previous experience with this modification, AAR was able to beat the customer’s schedule for returning their prototype aircraft to service.

Utilizing the same major suppliers for parts and engineering, ensuring timely release of fabrication drawings and applying the new program management techniques help to ensure a successful program.

**Other Complexities & Uncertainties**

- Additional Certification uncertainty was identified during the program when the FAA rules for wire separation from fuel quantity wiring deviated from what integrators had previously understood. AAR identified this risk and mitigated it by ensuring that the newly hired certification manager and electrical lead with the most experience coordinated the necessary paperwork (AMOC) with the FAA. The AMOC as well as other electrical reports (EWIS) were considered ground breaking in their scope and were used by the FAA and other integrators as templates for achieving the compliance with wire separation and EWIS.

- Additional engineering uncertainties included a new flat-bed seat program to incorporate a removable arm to meet new DOT compliance requirements. Additional design to minimize the amount of incremental testing was coordinated with the seat manufacturer and the FAA representative (DER) responsible for seat compliance.

- AAR also certified and installed an LED light and switch which was requested at CDR. All of these complexities were addressed by fully identifying their impact and data and cert requirements to incorporate the changes. This then included plugging them in the program schedule and ensuring that the appropriate resources with the necessary skills and experience worked to meet the aggressive deadlines.

V. **Metrics** (How do you measure program’s performance) = 30 points

(Note: We are not looking for $ results, but the relative percentage achieved. In particular indicate what specific metrics and data you are using that drive the program beyond standard measures of schedule, budget, and performance, and which have contributed to your program’s focus and its success.)

AAR does not currently have a post mod survey that is sent to
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<th><strong>Customer</strong> - How do you measure the impact of your program on your customer and your customer's satisfaction? Include a description of your metrics, as well as numerical evidence.</th>
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<td>the customer. AAR’s measure of customer satisfaction has either come from a customer required post mod “lessons learned” meetings which is an indicator of an unsuccessful program or from letters of commendation coupled with awards for future business which is an indicator of a very successful program. For the 767-400 follow-on program, AAR received a number of e-mails as well as a formal letter thanking AAR for their dedication to the program and recommending AAR to other customers. AAR was also awarded another very large program by this customer primarily due to recognition for the 767-400 program achievements.</td>
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<th><strong>Performance</strong> - How do you measure your program’s performance in traditional terms such as schedule, budget, requirements, and business results?</th>
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<tr>
<td>Part of our Program Review process includes a detailed review of both the Recurring and Non-Recurring budgets. This occurs on a monthly basis and allows us to track status versus original budget. Deviations are discussed and analyzed. Operating Profit is tracked by project to know whether budgetary numbers were achieved, thus signifying a successful project.</td>
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<th><strong>Preparing the Future</strong> - How do you measure and assess the long-term contribution of your program to the corporation/organization?</th>
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<tr>
<td>The future and long-term contribution is measured by being awarded additional work from the customer. AAR has won additional work from this customer as well as others over the past year which enables us to grow our business and make key financial contributions to the overall company.</td>
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<th><strong>Team</strong> - How do you measure and assess the impact of your program on your team development and employee satisfaction?</th>
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<tr>
<td>This particular program enabled our team to grow both in number and in expertise in the area of Program Management. Growth in size will facilitate future project awards and mitigate resource concerns that customers occasionally express due to the relatively small size of our group.</td>
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<th><strong>Unique Metrics</strong> - Describe any unique metrics you are using to measure your program’s progress and how do you focus it for outstanding success.</th>
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<td>AAR utilized “train” charts to track the progress of all parts in manufacture from PO issuance, material receipt, stage of manufacturing and finishing to final delivery and acceptance. A full “carpet” chart is used to identify all parts required for the program to determine if the POs were cut, planned delivery date and if the parts had been received as well as identifying if the parts were either off the shelf, fabricated in-house or fabricated externally. Internally a supplier scorecard is maintained with each major supplier to track budget, negotiation status and part manufacturing goals at a high level for senior management review. These scorecards are also used to keep program notes on each supplier and are graded as Green, Yellow and Red to identify their overall status.</td>
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