MANAGING AIRCRAFT/SIMULATOR CONCURRENCY

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ABSTRACT

"Concurrency" is the word being used to describe the situation when a simulator or other aircrew training devices are required for delivery at the same time as the new aircraft it will support. If traditional acquisition approaches are applied to concurrent aircraft and simulation programs, it is practically impossible, in many cases, to deliver a fully capable aircrew training device anywhere near the Initial Operational Capability (IOC) of the aircraft. This is especially true when dealing with aircrew trainers for a complex tactical or strategic weapon system. Using the B-1B Simulator System program as an example, this paper discusses the risks and management challenges involved with concurrency and an innovative acquisition strategy designed to ensure the availability of aircrew training devices at or before the aircraft IOC. Included in this strategy are: 1) a new approach to preparation of the request for proposals documentation, 2) a competitive preliminary design effort, 3) methods for dealing with the acquisition of simulator design data, 4) the concept of providing the user a limited (interim) training capability early in the program, 5) management of a configuration baseline which evolves along with the simulator design, and 6) retrofit/update of all delivered devices to the final aircraft configuration.

INTRODUCTION

The simulator acquisition process is changing. The changes have come about for several different reasons. One reason is the fact that simulators have steadily grown in complexity along with the technology that supports them. Another reason is that simulator users have demanded a higher level of simulator performance in order to support training programs with fewer actual aircraft flight hours. However, the biggest changes in simulator acquisition strategies have come about because of aircraft/simulator concurrency. "Concurrency" is the term being used to describe the situation when simulators or other aircrew training devices are required for delivery at the same time as the new aircraft it will support.

Concurrency has brought with it new challenges for the simulator procurer. No longer can one wait until flight test or even the initial aircraft production run is complete before committing to a simulator acquisition program. The complexity of most of the full mission simulators being acquired by the Air Force today has resulted in simulator development programs which are not much shorter than the aircraft development programs themselves. Therefore simulator development programs, in order to produce and deliver trainers at or before the aircraft IOC, must be started very early in the aircraft development process. Starting a simulator program this early, relative to the aircraft program, carries with it some amount of risk. Most, if not all, of the risk is related to the immaturity of design data and the uncertainty regarding the evolving aircraft configuration. In order to control these risks, new acquisition strategies are required. The B-1B Simulator System program is one example of a concurrent simulator development program. This program is applying several new concepts to the Air Force simulator acquisition process; a new approach to constructing the Request for Proposals (RFP), a competitive preliminary design effort, an integral retrofit (update process) and providing the user a limited early training capability are the key elements of the B-1B Simulator System acqusition strategy.

BACKGROUND

The design, performance and test criteria for simulators is based on aircraft data (test reports, drawings, technical orders, technical reports, etc.). This data defines the design, performance, and operating characteristics of the aircraft and aircraft systems. The degree to which the simulator will be representative of the aircraft depends upon how well the data package describes the aircraft. The data's description of the aircraft depends upon the point in the aircraft development program that the data is baselined and how much the data base is updated to represent the aircraft's production baseline.

The aircraft design is dynamic during the development process. There are, typically, three points in the aircraft program where the design becomes baselined. These points are: the Full Scale Development (FSD) Critical Design Review (CDR), the start of flight test, and the production configuration baseline. In most current simulator programs, the data baseline occurs between the start of flight test and production (Figure 1). The aircraft definition of the simulator is usually the start of flight test with some updating to the production configuration. As a result, the Engineering Change Order (ECO) budget for simulator programs is normally structured to update the simulators to the eventual production configuration.

This typical simulator development approach in which the data baseline depends upon the flight test data baseline of the aircraft (with some updating to the production baseline) minimizes cost risk associated with the simulator updates, but delays simulator availability until late in the aircraft program (usually well after initial aircraft availability and the aircraft Initial Operational Capability (IOC)). *The more optimal* or mature the data package, in terms of

PRESENT SIMULATOR PROGRAMS (AIRCRAFT VS SIMULATOR)

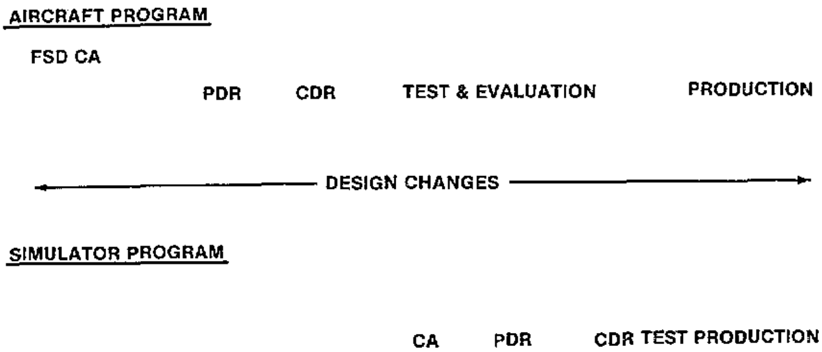

FIGURE 1

completeness and currency, the later it becomes available and the later the simulator will be delivered in relationship to the aircraft. The B-1 simulator program has been structured to gain concurrency with the aircraft program (to the degree possible) but with acceptable risk associated with the changing aircraft baseline and concurrent aircraft and simulator developments. The B-1B simulator program will have the design data freeze dates tentatively established based upon the aircraft software Physical Configuration Audit (PCA) baseline (for Prototype and Lot 1 production simulators) and completion of flight test (for Lot 2 production simulators) (Figure 2). These baseline or freeze dates seem most appropriate when viewed from the perspective of the simulator program not being initiated until almost a full year after the aircraft contract go-ahead and the fact that the B-1B aircraft program itself has concurrent development and production activities.

B-1B SIMULATOR SYSTEM

Program Overview

The B-1B simulator acquisition strategy is based upon a two-phase program intended to provide a training capability as close to the aircraft IOC as possible. Phase 1 is a competitive effort by two contractors to complete the system definition and the FSD effort through the Preliminary Design Review (PDR) milestone. The Phase 1 contractor activities include:

a. Writing detailed performance specifications.

b. Writing vendor and subcontractor work packages.

c. Formulating contractual agreements covering data, parts, and services with each of the B-1B weapon system associate contractors.

d. Conducting trade studies in design and logistics (to identify and reduce cost drivers).

e. Completing the simulator system design to the PDR level.

f. Conducting detailed cost, schedule and technical planning for Phase 11.

Phase 11 of the program will include completion of FSD and production of the simulators. During Phase 11, five Weapon System Trainers (WST), two Mission Trainers (MT) and a Software Support Center (SSC) will be developed, fabricated and delivered to the Strategic Air Command.

The Request for Proposals

Given concurrency and the initiation of the B-1B Simulator System program nearly a full year after the B-1B aircraft go-ahead, it was necessary to find a way to condense the front end of the acquisition process referred to as the RFP generation phase.

The Requests for Proposals (RFPs) for Air Force simulator acquisitions are typically comprised of a Statement of Work (SOW), a Contract Data Requirements List (CDRL), the model contract and one or more Prime Item Development Specifications (PIDS).

Specifications. The PIDS typically define the detailed performance of the simulator or major simulator subsystem being acquired. When the simulation device being acquired is to represent an aircraft or aircraft subsystem (e.g., radar) which has been in the inventory for some time or at least has completed developmental flight test, the writing of the PIDS is relatively straightforward; actual performance of the "to be simulated" system is documented by both design and performance specifications and some flight test data is normally available. In the concurrent aircraft/simulator design situation, actual system performance data is, at best, speculative when the simulator RFP needs to be written. For the B-1B Simulator System program, the solution was to write a system level specification which relates the major system components to be acquired and their basic functional characteristics. The prime item development specifications will be written by the competing contractors during Phase 1 of the program. The competing contractors will develop separate prime item specifications for the WSTs, the MTs, and the Software Support Center. These

B-1 SIMULATOR PROGRAM SCHEDULE
AIRCRAFT/AVIONICS CONTRACTOR INTERFACES

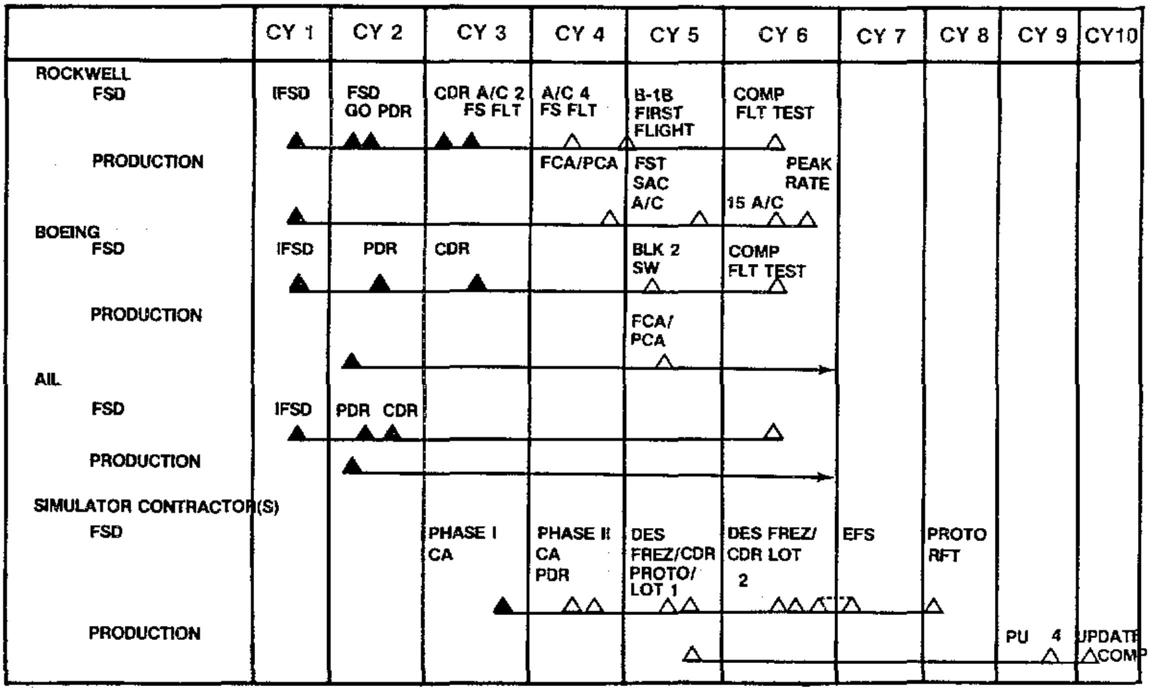

FIGURE 2

specifications will be written based not only on the system specification issued with the Phase 1 RFP, but also on the user's (Strategic Air Command) stated training concepts and concept of employment of the trainers within the overall B-1B training curriculum.

The advantages of having the contractor write the prime item specifications are three-fold: 1) It normally takes the Air Force engineers six to nine months to generate prime item specifications for simulators as complex as the B-1B Simulator System. This presupposes that the essential aircraft or subsystem performance data is available at the time the task is undertaken. Hence, by having the contractors generate the detailed specifications after the contract is underway, several months of front-end lead time can be eliminated. In addition, the Air Force's specification writing team is normally rather small. The contractor can usually devote more manpower to the task and, therefore, complete it in a shorter period of time. 2) Data on the various aircraft subsystems usually becomes available in a sequential fashion as the aircraft development proceeds. Therefore, the simulator contractor can acquire aircraft design specifications and performance data, write the PIDS and create the preliminary design for the simulator on a piecewise basis. The complete prime item specifications, then, can be assembled as the contract (and the preliminary design effort) progresses. 3) When a new weapon system is in its early stages of development, the user is not able to provide details of exactly how the simulator will be used in the training curriculum. Based on experience, the user is capable of describing the general types of devices that will be needed to train the aircrews, but specific training device characteristics cannot be provided until the design of the weapon system and its subsystems reaches some level of maturity. When the weapon system design matures sufficiently to allow the user to identify the various specific aircrew tasks, the user can then make some definitive statements regarding how the training devices will be employed. In the B-1B Simulator System program, the training concept and training task analysis data have been provided to the contractors shortly after Phase 1 contract award. At that time, all of the airframe and major subsystem critical design reviews were completed and the majority of the aircrew training tasks were identifiable.

In the two-phased B-1B Simulator System acquisition program, the Prime Item Development Specifications generated by the contractors during Phase 1 will become the focal point of their proposals for Phase 11. During the preliminary design review, which essentially completes Phase 1 activity, the simulator designs will be evaluated in light of the prime item specifications. These specifications will then become the contractual basis for simulator performance in Phase 11.

Statement of Work. Another advantage of using the two-phased approach for a concurrent simulator development program is that the Statement of Work (SOW) can be written in two parts. The first part of the SOW covers only those tasks to be accomplished during Phase 1. Since part of the contractors' Phase 1 effort is to plan the optimal development and production approach for Phase 11, it was necessary to give the Phase 1 offerors some insight into the work envisioned for Phase 11. Accordingly, an annex to the Phase 1 SOW outlines the major tasks planned for Phase 11. While written in SOW language and format, this annex is provided *"for information only"* and is not contractually binding during Phase 1. In addition to the Phase 11 insights this annex afforded the offerors, it also provides the procuring agency a certain amount of flexibility and additional time to define the detailed Phase 11 work requirements. Given the concurrent evaluation of the weapon system to be simulated, the simulator procuring agency is afforded more time to finalize development and production details. In fact, it allows the Air Force to factor information gained during Phase 1 source selection and the initial part of Phase 1 contractual activity into the Phase 11 SOW. It is believed that the result will be a much more accurate and definitive document. Also, since the contractors are encouraged to refine the government's overall program planning schedules during Phase 1, the realism of the Phase 11 SOW can be enhanced by incorporating the contractor's relevant comments.

The Competitive Design Effort

As outlined earlier, Phase 1 of the B-1B Simulator System program is a competitive design effort by two contractors. The competitive Phase 1 design effort will ensure that the simulators to be delivered during Phase 11 will provide an optimal mix of performance, fidelity and instructional features. Equally as important is the fact that the cost of the development and production of the simulators (Phase 11) will be bid on a competitive basis. Hence, the delivered simulators should provide the best possible training capability at the lowest possible cost.

Design Data Acquisition

The topic of who is or should be responsible for obtaining the simulator design data is always sharply debated. The sides are usually clearly drawn. It appears that the simulator manufacturers think the Air Force should collect and provide the data to the contractor, yet the Air Force many times structures contracts to handle design data or design criteria by having the simulator contractor obtain the data directly from the airframe and avionics contractors. The reasoning on both sides of the debate is sound; the contractor would like to avoid the acquisition cost of the data and the Air Force would like to "stay out of the data business". Also, it is generally held that the organization which collects the data is ultimately responsible for its completeness and accuracy. Hence, one more reason to shun the role of data collector.

In reality, the responsibility for obtaining simulator design criteria best lies with the simulator developer. The developer knows first-hand exactly what amount and types of data are required to fully and accurately design the simulator. Dealing directly with the airframe and avionics contractor, the simulator contractor can usually obtain the required data more quickly without the Air Force "middleman". The contractor can also usually specify to the airframe and avionics contractors his most preferable format for the data.

In the concurrent aircraft/simulator development situation of the B-1B, having the simulator contractor be responsible for obtaining the design criteria is the only practical approach. Speed in obtaining the basic design data and timely updates thereto is of paramount importance. In the concurrent development scenario, the simulator contractor must be capable of obtaining preliminary engineering data concerning potential aircraft Engineering Change Proposals (ECP) before the aircraft ECPs are formally submitted to the Air Force. This will allow the simulator contractor to prepare simulator design change impact studies in parallel with the generation of the aircraft ECP. Hence, when the aircraft ECP is considered for incorporation into the aircraft, the potential impact of the change on the simulator can be thoroughly evaluated by the Air Force at the same time. If the change data were not available to the simulator contractor until after the ECP was formally approved, the associated change to the simulator would most often occur well after the aircraft change.

Configuration Management and Update

The non-concurrent simulator program normally has a single design criteria freeze date and a single CDR. All changes to design criteria occurring after the freeze date, whether representing more mature data or aircraft design changes, result in "cost" ECPs. In a concurrent simulator development program, many changes in design criteria can be expected throughout the program. Processing a cost ECP for every design criteria change would present a configuration nightmare and an unacceptable cost risk. In the B-1B Simulator System program, multiple freeze dates and incremental CDRs are planned. An initial freeze date and CDR will cover the prototype WST and the first production lot (two WSTs, an MT and the Software Support Center). A second freeze date and a delta CDR will cover the second production lot (2 WSTs and an MT). All configuration update activity required to bring the prototype WST and the Lot 1 devices up to the production aircraft design baseline will be part of the initial Phase 11 contract cost. This integral update approach reduces the cost risk associated with attempting to maintain aircraft/simulator concurrency.

An Early Training Capability

Every attempt was made to structure a program to deliver B-1B simulators at or before the aircraft IOC. Due to a late start of the simulator program relative to the aircraft program as well as limited early availability of offensive and defensive avionics data, delivery of the first WST is not possible until approximately one year after the aircraft IOC. In order to provide an earlier training capability, a concept called the "early flight station" was developed. Since a large portion of the B-1B aircraft development is in the avionics area, the design data for the WST avionics stations (offensive systems officer and defensive systems officer positions) is the pacing item in the WST design, development and delivery schedules. However, due to extensive flight testing of the existing B-1A aircraft, relatively mature B-1B flight performance (aerodynamics and propulsion) data will be available early in the simulator program and the development and availability of a simulator flight station (pilot and copilot positions) is possible at or slightly before the aircraft IOC. The early flight station is expected to be essentially the same as the flight station portion of the WSTs. The early flight station will be made available for SAC aircrew training until the prototype WST becomes ready for training. At that time, the early flight station will be deactivated and its residual hardware assets applied to one of the production WSTs.

CONCLUSIONS

Applying traditional acquisition strategies to the problem of aircraft/simulator concurrency results in excessive cost and performance risks. New acquisition strategies such as those being applied to the B-1B Simulator System program are required in order to control risks and assure the timely delivery of training devices to the user.

ABOUT THE AUTHORS

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