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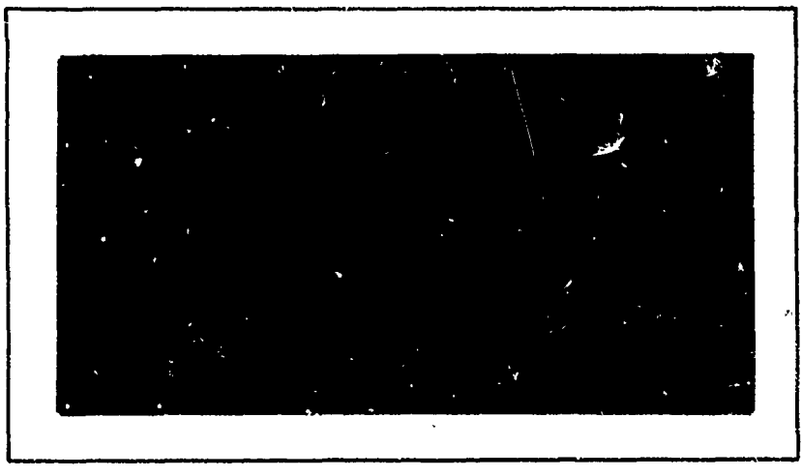

# SCHOOL OF ENGINEERING

WRIGHT-PATTERSON AIR FORCE BASE, OHIO



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# A Systems Management Philosophy For Case Analysis With A Study Of The TFX

THESIS

GSM/SM/68-07,14

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# A SYSTEMS MANAGEMENT PHILOSOPHY FOR CASE ANALYSIS WITH A STUDY OF THE TFX

THESIS

Presented to the Faculty of the School of Engineering of
the Air Force Institute of Technology
Air University
in Partial Fulfillment of the
Requirements for the Degree of
Master of Science

by

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# GLOSSARY

| | |
|---|---|
| ADC | Aerospace Defense Command |
| AFLC | Air Force Logistic Command |
| AFSC | Air Force Systems Command |
| AMPR | Aircraft Manufacturers Planning Report |
| ASD | Aeronautical Systems Division (of AFSC) |
| BuWeps | Bureau of Weapons (Navy) |
| CPFE | Cost Plus Fixed Fee Contract |
| CPIF | Cost Plus Incentive Fee Contract |
| DDC | Defense Documentation Center |
| DoD | Department of Defense |
| FOD | Foreign Objects Damage |
| FPIF | Fixed Price Incentive Fee Contract |
| FY | Fiscal Year |
| IFB | Invitation for Bid |
| JCS | Joint Chiefs of Staff |
| MASD | Military Aircraft System Division |
| NACA | National Advisory Committee for Aeronautics |
| NASA | National Aeronautical and Space Administration |
| OSD | Office, Secretary of Defense |
| R&D | Research and Development |
| RDT&E | Research, Development, Test and Evaluation |
| RFP | Request for Proposal |
| SAC | Strategic Air Command |
| SOR | System Operational Requirement |
| SPD | System Program Director |
| SPO | System Program Office |
| SSB | Source Selection Board |
| TAC | Tactical Air Command |

| | |
|---|---|
| TFX | Tactical Fighter, Experimental |
| USA | United States Army |
| USAF | United States Air Force |
| USMC | United States Marine Corps |
| USN | United States Navy |

## ABSTRACT

This report presents a philosophy for the use of the case method in systems management education. The case method is defined and its background and development are discussed. The use of cases, and their analyses, is discussed from two viewpoints; that of the teacher and that of the student. Explicit suggestions are offered to the teacher to help him in forming a *modus operandi* which will insure maximum results from case studies. Guidance is offered which will assist the student in analyzing cases. A systematic problem solving model is developed which can be reproduced and handed out to a class. This model can also be used by managers analyzing problems on the job. The concluding chapters of this paper are devoted to a case study of the acquisition of the Tactical Fighter, Experimental (TFX). This case is designed primarily for study by systems managers; it is a study of the inter-relationships and complexities involved in a major Defense Department decision. Following the case is the teacher's aid which discusses some of the salient features of the study.

GSM/SM/68-07,14

# A SYSTEMS MANAGEMENT PHILOSOPHY FOR CASE ANALYSIS WITH A STUDY OF THE TFX

## PART ONE

## PHILOSOPHY FOR CASE ANALYSIS

# I

# INTRODUCTION

## General

The research topic initially selected by the writers was that of developing a case study of the acquisition and production of the Tactical Fighter, Experimental (TFX), subsequently named the F-111, aircraft. The intent was that this case study would complement and update a four part case on the same subject that had been developed by students at the Harvard Business School [Ref 178]. The only appreciation the writers had for the case method of instruction had been gleaned through its use in Graduate Systems Management classes by four professors. Preparatory research into the case method resulted in exposure to a variety of philosophies and suggested practices dealing with the use of cases in the classroom and in industry. However, none of these provided a guide for use, or analysis, of cases by systems management students. Also, no cases intended specifically for systems management study could be found. Consequently, the researchers decided to engage in such an effort.

## Purpose

The purpose of this paper is

a. to develop a systematic method of case analysis for use by systems management students and,

b. to provide a completely new case on the TFX which is suited for study by systems managers.

## Scope

This paper is an admonition from two Graduate Systems Management students to academicians on the use and analysis

of cases in the teaching of systems management. Since the perception of systems management varies among individuals, the writers offer a synopsis of their management philosophy in Appendix Z.

The value of the case method as an education device has long been well established. What is of particular interest herein is the development of a pragmatic approach to the use of cases. General comments are given on the background of the case method and considerations to be borne in mind when writing a case study. A philosophy for teachers using cases in the classroom is offered. Discussion then centers on the development of a systematic method of case analysis for use by students or practitioners. The method is a conceptual scheme for general problem solving.

The TFX case in Part Two of this paper is a chronology of controversy which is used to stimulate group discussion, extrapolation and analysis. The case is organized in such a manner that it is usable either piecemeal, in year by year events, or in total, to demonstrate the myriad of considerations involved in a major Department of Defense weapons acquisition.

Methodology

The research effort was divided into two parts; first, gaining information on the TFX acquisition and, second, gaining information on the case method. The research into the TFX was restricted to copyright and public domain literature. The main sources of material for this area were records of Congressional Hearings and periodical literature.

Research into the case method was also by means of a comprehensive literature search. Management sources, such as texts, and business or management periodicals, rather than education sources, were used primarily. The resultant

conglomerate of information has been tempered by the writers' classroom experiences with the case method and their own philosophy of systems management.

Organization of the Paper

Succeeding chapters provide a synopsis of the case method's background and its purposes and objectives. Comments on writing cases are offered based on the experience of writing the TFX case. Chapter III contains the development of a rationale for case analysis. The 'systems', or integrated, approach is used to show teacher, student and executive considerations. A systematic methodology for analyzing cases, which will have carry-over capability into practice, is offered for student guidance. Part One of the paper is concluded with recommendations for the use of the case method.

Part Two of the paper contains the TFX case study and teacher's aid.

# II

# THE CASE METHOD

## Definition

A business or management case is defined as *a carefully written description of an actual situation in business which provokes in the reader the need to decide what is going on, what the situation really is, or what the problems are and what can and should be done* [Ref 9:368]. Cases can be descriptive of a pattern or situation; they can be designed to drill the student in the use of a conceptual scheme or they may be expository reports of systematic research. The value of cases is that, like real-life situations, they present simply the fragmentary symptoms of a problem as it might initially come to the attention of the responsible manager [Ref 16:viii].

A case used in management education is a written or filmed description of an actual or imaginary situation usually presented in some detail. Innovations of the case method have led to the use of scripts in skits, or role-playing, or simulations of situations in order to preserve the drama of a situation [Ref 32:31].

## Background

The case method of instruction was started at the Harvard Law School prior to 1908. It was used primarily to teach law students about practices and principles in operation. In 1908, the Harvard School of Business was started with Edwin F. Gay as its first Dean. Mr. Gay started what was then called the *problem method* in one course at the Business School. This *problem method* was simply a

verbal presentation of a hypothetical or real problem by the teacher followed by student discussion. Success in this program led to the start of the *Business Policy* course the following year. This was a skills-integrating course dealing with top-management problems. Verbal presentation was still the only process used. In 1912, a new course, titled *Marketing*, was started on the same basis but with an added flair; executives, former graduates, and academicians would recount their actual experiences to the class. Discussion would then center on these narrations. This was the fore-runner of the case method as used today. Interest in this process led to the publication of the first case book, *per se*, titled Marketing Problems, in 1920. During that same year, the Harvard Bureau of Business Research was organized to start the systematic gathering of case material and to conduct case research [Ref 6:25-33]. The case method of instruction has since grown to find application in all major business and management schools and by industry.

Wide differences exist among business schools in the extent to which, and in the ways in which, they make use of cases. However, cases now carry more flexible connotations than they once did. Teaching by the case method may range from the non-directive type of discussion characteristic of classes at the Harvard Business School, to closely supervised discussions centering around specific questions which the class is asked to answer [Ref 9:369].

The case method is used to create a broader perspective and a greater tolerance and sensitivity toward other points of view [Ref 28:567]. The main problem of the case method lies in obtaining dependable data from which valid interpretations can be derived. Voids are bound to exist in the data; invariably data are incomplete, inaccurate and otherwise inadequate [Ref 25:354]. However, one must learn by doing; use of the case method is based on this principle and is aimed at developing in the student the willingness

and capacity to take action [Ref 31:434].

Purposes and Objectives

As mentioned earlier, cases are used to illustrate techniques and principles. Their more basic purpose is to give the student responsibility for working his way through the facts of a management situation to a logical, consistent, specific and practical course of action [Ref 13:8].

Another purpose of the case method is to broaden the student's educational base. Cases can easily condense over ten years of management experience into class and preparation time. Thus, as a learning device, cases cause students to develop the habit of asking questions rather than answering them [Ref 14:12]. Perhaps the most difficult transition for students to make is to learn what questions to ask.

Some authors feel that management will never be wholly scientific. They feel that it will remain largely an art in which the practitioner uses whatever exact knowledge is available but must supplement it with a great deal of personal judgment [Ref 15:2]. A main purpose of the case method is to hone this judgment in the classroom and to enable the student to develop an effective operational grasp of central management [Ref 18:6]. Cases provide an environment wherein clinical practice of management can be achieved without the absoluteness of the real world.

The most significant purpose of the case method, from a systems manager's point of view, lies in its participative and democratic nature. The teacher and the students possess the same material and each has an identical opportunity for contributing to the remainder of the group. Since there is no single, demonstrably correct answer, each must be weighed on its own merit. This provides a new dimension to personal relationships. It is a basis for the exchange of thoughts and a lesson in how to learn from others. Analysis of a case is a vehicle which is directed toward developing in

students those managerial qualities of understanding, judgment and communication leading to action. To put it succinctly, the purpose of case study is to accelerate the student's ability to act in mature fashion under conditions of responsibility [Ref 10:8].

The objectives of the case method are primarily to encourage self-involvement and self-education, thereby enabling the student to shift from hastily contrived opinions or views (and discussions) about a situation to more resourceful observations, good listening, reasoned questions, and examination of alternative solutions. These mark the exercise of sound analysis and judgment in managemement [Ref 186:2].

Another fundamental objective of studying cases is, in reality, a challenge to the teacher. The urgency and drama of a real life situation must be created in the classroom and the student must be projected into the situation emotionally and intellectually [Ref 13:8].

Whatever purposes or objectives are emphasized, the essence of the case method is that it is student (as well as problem) oriented. This means that the student is the central figure [Ref 9:370]; it is he who subjects himself, his ideas and his judgment to the scrutiny of his peers as well as to that of his teacher.

## Prognosis

Cases, as a means of instruction, are suited not only for students at school, but for practitioners as well. Of particular importance is the fact that cases provide a manager with an opportunity to learn how other managers are handling problems or environments similar to his own. Further, they keep the manager current on rising problems, state of the art, and assist in identifying potential problems. Perhaps most importantly, they provide the manager with an exercise in analytical problem-solving for practice

only [Ref 14:7].

Development Programs. Executive and manager development programs at the post-graduate level are making extensive use of cases. Harvard's Graduate School of Business conducts the *Advanced Management Program.* This thirteen-week case study course is aimed at giving executives a sharper ability to make decisions, a more critical judgment and a broader business perspective--one that cuts across all operational functions of a firm [Ref 146:47]. The consistency between these goals and those of systems management programs should be obvious. The University of California receives executives from such companies as Monsanto, Boeing, Bank of America, and U. S. Steel, among others. These practitioners go through an intensive, four-week advanced management training program which uses the case method exclusively [Ref 54:104]. Bechtel Corporation has a seven-course management program administered at their regional headquarters by members of the staff of the University of California. Again, their intent is to broaden and sharpen their in-house management resources; the case method is employed here as well [Ref 53:72].

## Writing a Case

The collection of case material is an increasingly important aspect of the case method. The case-writer preserves the consistency of the situation in the field and is also responsive to the needs of the classroom. Some abstraction is usually necessary; however, reasonable simplification of the facts should not lead to the exercise of literary license. The purpose of the case and its intended use primarily determine the case's content [Ref 186:23].

Some cases are written so that they are the soul of brevity, lacking adequate data for a thorough analysis of a problem. However, inadequacy of data does not render

such cases useless [Ref 26:xi]. These cases are intended to allow the student to hypothesize and to use his imagination. Cases intended for systems management students require a mixture of qualitative and quantitative decisions. These are written into a case in such a manner that the student is made to discern one from the other and to substitute careful, logical analysis for intuition and hunch [Ref 13:3].

Writing a case requires the review of volumes of data and material and distillation of the results down to a workable package. Above all, it is borne in mind that cases are not written to prove some theory. They are written to provide a basis for discussion--not as illustrations of correct or incorrect handling of a situation. It the subject is centered in a problem or controversy, the case-writer recognizes that there will be no single, unequivocal solution; he realizes that each reader of the case will perceive the problem or controversy differently [Ref 7:9]. Thus, the case-writer cannot afford the luxury of seeding a case with personal bias.

The writers intend the TFX case for use primarily by systems management students. As an integrator-generalist, or point of synthesis, of a system [Ref 5:13 and Ref 58:65], the systems manager is cognizant and appreciative of the dynamic interplay between his system and the others with which it is interrelated [Ref 95:383]. Therefore, the TFX case is an expository report of research which has been integrated in order to reflect the interactions among the participants. In this way, various student perceptions of the strategies, policies and objectives of the participants will provide for diverse discussions and a variety of decisions.

# III

# A RATIONALE FOR CASE ANALYSIS

## General

Most medical educators agree that *the most we can hope to do while we have a student is to get him to think like a doctor* [Ref 16:3]. This challenge faces management educators as well. The use of cases is a means for achieving this thought process in management students. As an educational philosophy, the case method is an approach which encourages logical probing for reasoned answers to reasoned questions, and to raise more reasoned questions. This is much more than an intellectual exercise because the goal is to inculcate in the student a method of seeking out alternatives and conducting sound analysis [Ref 186:1]. The foundation of this process is the teacher's approach and expertise.

## The Teacher

Learning is cautiously defined as changing the behavior of an individual. However, for the learning situations of interest here, it is more precise to say that the goal is improvement in behavior [Ref 3:10]. Research shows that behavior change (or improvement) is more effective when an individual participates in a group that forms its own ideas than when information is provided by lecture [Ref 3:231]. Furthermore, learning is most efficient when the plan for imparting learning (by the teacher) takes into account the present knowledge and skill of the learners [Ref 3:33]. Appreciation of these facts forms a sound atmosphere for the use of cases in management education.

Experience shows that the teacher's primary roles in using the case method are:

a. to help the student meet, in action, problems arising out of the new situations in ever-changing environments.
b. to help the student relate the case material to his own experience and background.

Best results are achieved when the teacher is open-minded and non-parochial. This provides a basis for stimulation of student participation. When receptivity and group interaction are demonstrated and encouraged, the value of the case method is maximized [Ref 10:9].

Some teachers are reluctant to leave the safe haven of dogma. They fail to realize that the question is not whether the student pleases the teacher; it is whether the student can support his views or disagreements, or cooperate and accept the merits of his antagonists' arguments. Implicit in this understanding is the teacher's avoidance of the patriarchal role. Similarly, he bears in mind that most students are reluctant to place themselves in a position which results in their judgment being questioned or challenged. Therefore, the teacher's task is to encourage provocative and useful discussion; the promotion of creativity and logical analysis is his goal [Ref 10:12]. The teacher is constantly shaping the behavior of the student by the way in which he utilizes the rewards at his disposal.

Perhaps most important is the teacher's recognition that the use of cases adds to his repertoire of knowledge. There is a research function, or service, provided to the teacher in that he sees fresh, imaginative points of view with each new class analyzing a case [Ref 120:106].

The use of the case method gives flexibility to a course. However, because of the aforementioned considerations, case usage requires extra care and control by the teacher. In the writers' experience, cases were concurrent supplements to a text-book course and a means to coordinate and apply principles learned in earlier courses.

Case problems are used as a basis for discussion or, if more rigor is desired, for written assignments. A balance of written and oral analyses in a course provides a good means for definitive evaluation of a student's ability to document his judgment -- which is something all managers should be capable of doing.

In this light, the teacher's *modus operandi* is shaped by the following responsibilities.

1. Develop an appreciation for the nearly infinite complexities of modern management problems. Inherent in this appreciation is the acceptance of the hopelessness of finding a singularly correct answer and the realization that the solutions are only carefully reasoned, logical lines of action resulting from analysis [Ref 7:17].
2. Create an atmosphere of learning in the class. This is achieved by encouraging the participation and contribution of students and elimination of sarcasm and disdain [Ref 12:8]. Emphasis is on allowing students to relate the case to their own experiences and backgrounds. Learning from a case is reinforced when the teacher acts as a responsible member of the group, not as a lecturer or paternal guide. Occasionally, this requires the teacher to assume the role of *devil's advocate* to provoke and stimulate verbalization in response to decision situations. Implications of his actions are important and require deliberate control on the part of the teacher [Ref 12:33].
3. Coordinate cases to class assignments, i.e. use suggested background readings or related material. Students are more receptive when a course starts with an arrangement in which earlier cases are basic, and oriented toward a specific function

(planning, finance, marketing, etc.). In this way, the student becomes adjusted to the teacher's style [Ref 13:iii]. Then the student is ready to handle complex, integrated cases with zeal.

4. Establish a consistent discipline in the classroom. Research shows that most students embarking on a graduate level course are not accustomed to the participative environment of case studies. In fact, the permissiveness may be a shock to those students previously dominated by restrictive teachers. The gamesmanship of cases is enhanced when the teacher is continuously cognizant of the students' right to participate and their right of appeal [Ref 12:23].
5. The ability of the teacher determines the success of the case method. This requires the teacher to use his initiative in keeping student interest alive. The literature has several examples of how cases are made more conducive to participation, e.g. role-playing, simulation, taped dialogues, etc. [Ref 28:563].

Tt must be mentioned that the case method is inefficient, primarily because it is so time consuming. There is no empirical scale of achievement and it lacks technical excellence and precision [Ref 7:12]. However, these inefficiencies are not insurmountable. Evidence suggests that learning a methodology which is based on logic and consistency of approach can be made more efficient when it is:

a. related to the students' knowledge and experience and,
b. shown that the student can expect to use the results in later practice [Ref 3:31].

The teacher whose philosophy incorporates these considerations is in a position to properly motivate students toward case analysis.

The Student

Research shows that the case method is intended for use at the graduate level. Undergraduate education is regarded as a time for absorption of truths and techniques which will be used later. Since the undergraduate environment is not participative, most students entering the graduate level are habituated to the role of listener. However, the learner's dynamic cooperation is needed if the case method is to be successful [Ref 10:10]. Therefore, the management student must transition from the role of passive absorber to that of an active thinker. In the writers' experience, this transition is achievable with a minimum of trauma if the student is told what behavior change (or improvement) is expected of him. Case analysis is also more rewarding and less haphazard if the student is provided some framework with which to work. The contents of this section of the paper are provided to help the student appreciate this transition and to give him guidance for use in case analysis.

In systems management programs, cases are used to give students an analytical framework for sifting and selecting the numerous elements involved in sensing a whole company and its environment [Ref 18:v]. This opens new doors to most students. They are not expected to work with sterile hypotheses or theories; they are provided facts and actual experiences which are used for extrapolation. Students are given open channels of communication for the first time [Ref 1:4].

Implicit in the use of cases is the assumption that students will accept the responsibility for participation and that they will exert themselves to think independently. However, not all students accept the strain of thinking actively or of voicing independent judgments which may be challenged vigorously. The temptation is to read cases through quickly, as a story, and then to conduct a dialogue so general and vague as to be of little value [Ref 17:15].

The detrimental effect of this vacillation is reduced when the student is shown that he typically passes through three discernible phases [Ref 1:9 and Ref 10:14].

1. The first phase is that of appreciating his inability to think of everything that his fellow students can think of. Disappointment, frustration and a sense of futility typify this phase. When the student accepts the fact that problems are perceived differently by individuals he proceeds to the next state of mind.
2. The second phase is that of easy and natural acceptance of the need for cooperative help. It is during this phase that the student recognizes the need for group pooling of intellectual efforts. The students learn to work cooperatively, to voice opinions, to draw each other out and to accept other points of view. This phase is of particular importance to systems management students because it is here that they begin to learn the importance of negotiation and persuasion.
3. The third, and most difficult, phase for the student to achieve is that of recognizing that the teacher does not always, or necessarily, know the 'best' answer. When this phase is reached, the student has matured to the point where he is capable of making independant progress through challenging situations; he now understands the complexities of management environments and the elusive nature of 'facts'. The student readily accepts cooperative help, analyzes data and makes independant decisions without fear of disapproval. While he seeks help from all quarters, he no longer looks for an authoritative 'crutch'. He recognizes that viewpoints are relative and is willing to constructively criticize a rationale with which he

disagrees [Ref 8:14]. In short, he acts as an adult member of a democratic group. Needless to say, attainment of this phase presumes a degree of teacher maturity as well.

Cases are beneficial when they elicit consistent patterns of search and decision resolution. Each student in a class differs from others in his sensitivity and perception of cases [Ref 88:15]. A working member of a case analysis group contributes his clarification, interpretation and evaluation based on his own perception. The case analyst acquires a stock of ideas and techniques suggested by other analysts which is integrated with his own [Ref 20:24]. If this group process is not guided by some procedure it degenerates to pandemonium.

Criteria. Case analysis is a goal directed activity which makes optimal use of time only when done in a systematic manner. Research and experience show that this manner, or process, consists of a series of discrete steps, each simple and direct in itself, but which, when considered together, lead to resolution of a case. The following criteria for case analysis precede discussion of this process in order to keep it in proper perspective [Ref 27: 18].

a. Case analysis is realistic. Case issues, like those of real-world management, appear complex in nature. The student calls upon experience and prior education to isolate them.

b. Case analysis is methodical. The systematic process used is applicable to all cases and to later, real-world, problem solving.

c. Case analysis is comprehensive. The student asks productive questions and is cognizant of other questions and answers. Creation of dichotomous alternatives is avoided.

d. Case analysis method is flexible. Pervasiveness of the method is achieved when it is not based on rigid preconceptions.

Case Analysis Model. The suggested process is no

panacea for case analysis. Problems, or issues of a case are seldom apparent; they are usually complex and hidden among the many vaiables of a situation. However, use of the following problem-solving model, suggested by the works of W. J. McLarney [Ref 20], and C. A. Cerami [Ref 4], provides the student with a systematic method for addressing any case.

1. Clearly define the problem or problems. Is there really a problem? Have similar problems been faced before? Who or what is responsible for the existence of the problem? How do personal attitudes relate to the problem? Answers to these questions provide for a more complete definition of the problem.
2. Gather the information. This may be quantitative or qualitative in form. In either case, the student separates the relevant from the irrelevant. He uses judgment and experience to develop assumptions as necessary in the absence of facts. This step actually pervades the entire process; elements of the problem will change in relative significance as new information is developed.
3. Develop alternative courses of action. This is based on interpretation of the information. The student does not select only the two most contrasting extremes. The alternative of doing nothing is always present. Therefore, the student draws on past courses and techniques to arrive at several options. Perhaps more than anywhere else, his judgment and perception are needed here.
4. Select the best practical alternative. Ranking of the alternatives is implicit in this step. This means assessing the advantages and disadvantages of each course of action and determining the liklihood of the occurrence of each. Here

again, the student brings to bear a variety of skills ranging from the esoteric to the subjective. This step requires more specificity than the preceding. The student previously determined 'what to do', now he must specify 'how to do it'.

5. Implement the decision. Since the results of case studies are voiced before peers and teacher, the student attempts to consider and evaluate all arguments, pro and con, *a priori*. The student's communication of the decision is concise, to the point, and reflects reasons for, and qualifications of, the decision. This develops the student's ability to articulate, and his courage to take a stand.
6. Evaluate the effectiveness of the decision. When a student's decision is presented to a class, he learns that there is no curcible more heated than that of peer-judgment. However, a logical, well developed presentation will gather support as well as logical criticism. It is here that the student learns most about the 'give and take' of participative decision making. He adds much to his resources by listening to and weighing the criticisms. Thus, he learns how effective his decision was without suffering the real-world consequences.

Although this model appears to be generic, it does cause the student to focus on the elements of a case and how they relate to each other. It also helps the student to cut away the superfluous and distracting bits of information in order to identify the real nature of a case. Most importantly, the model has meaning for the practitioner as well as the student.

The Executive

One author states that, *training executives in highly specific occupational skills is narrow and inadequate. The executive life is changing so rapidly that to train people for existing jobs is to teach them skills they may never use* [Ref 3;v]. This statement recognizes the obvious and important fact that the managerial task is becoming increasingly complex today [Ref 19:207]. Consequently, many companies attempt to put management development on a formal basis. These programs range from on-the-job training, to formal, academic education [Ref 18:544]. Research shows that the case method is an attempt to bridge the gap between academia and practice [Ref 26:iii].

Texts are replete with discussions of managerial or executive functions. Most authors agree, however, that much of a manager's work involves problem solving [Ref 19: 217]. The 'systems approach' directs the manager's judgment and intuition toward these aspects of problems which are best handled subjectively [Ref 5:12]. This approach recognizes that the increasing complexities and interdependencies of the systems manager's environment require him to rely on the judgment of others; he must obtain, analyze and evaluate these judgments. The use of cases in a training program is one means for developing an appreciation of this concept. As mentioned earlier, this provides the manager with an exercise in analytical problem-solving for practice only [Ref 14:7]. Also, cases are vehicles whereby the manager's understanding of his job is broadened and some of his preconceptions are challenged by interaction with others. This form of in-house training is important, not only as a stimulus to innovation, but as a means for adjustment to a rapidly changing world [Ref 19:210]. The primacy of relating one's job to the internal, competitive and external

systems is reinforced.

The participative and democratic nature of group case analysis is analogous to that of the systems manager's world. Through analysis of in-house developed cases, the trainee learns not only the intra-organizational relationships that exist, but also the necessity for persuasion, motivation and negotiation in decision-making [Ref 58:65]. Furthermore, one acting in the capacity of a manager must make choices among various plans, strategies and alternatives. Among other conditions, these decisions are made under varying degrees of information [Ref 41: 269]. Usage of the model developed earlier provides the trainee with a systematic process for acting in the face of varying degrees of complete information.

Some of practicing managers' main frustrations stem from their inability to communicate or present a decision. This is due to either inability or a lack of previous opportunity. In fact, the most common need expressed by managers is for help on how to present ideas, information, facts and programs to others [Ref 2:222]. The use of cases in developing internal management capabilities is a means to provide experience in this area. Feedback from peer criticism causes an active effort on the part of trainees to improve their presentations by being novel, original, and innovative.

It is insight and judgment of the manager that accounts for the variance in the quality of decisions despite his understanding of generally accepted theory [Ref 26: 8]. The group dynamics inherent in case analysis expands one's perception and development. Use of the process developed earlier gives practice in the application of these improved aptitudes which results in better decisions.

One author advises that, *Knowledge without the skill to use it is inert and surplus baggage to the practitioner. Skill without the continual infusion of new knowledge*

*leaves its possessor subject to boredom and certain of seeing all his skills outmoded* [Ref 16:6]. The use of case analysis sessions throughout the management spectrum of an organization precludes this dilemma. The value of the case method used in this fashion is that mental inertia is overcome, and the habit of analysis is re-emphasized [Ref 4:45].

# IV

# CONCLUSIONS AND RECOMMENDATIONS

## General

Harold F. Smiddy, while Vice President of General Electric said that,

> *...Perhaps the most provocative-and important-idea on which we are proceeding is that managing should be regarded as a distinct type of work, with its own disciplines, its own criteria for achievement; something which is both learnable and teachable* [Ref 28:510].

This idea is especially important to systems managers because of the increasing complexity of modern organizations. In the writers' judgment, the use of the case method, in the classroom and in the training program, is an excellent means for inculcating in the learner the knowledge, attitudes and skill required of a systems manager. However, while the literature consists of volumes devoted to cases used in policy, human relations and similar areas, not one source of material was found which provided a basis for the use of cases in systems management education. Consequently, the following conclusions are drawn from the writers' research and experience.

## Conclusions

The case method is a way of learning from experience indirectly by analyzing and reflecting on remote situations as reported by others; and directly by considering one's own experiences or by observing and studying the situation that develops in a case study group. Through participation in case analyses, the learner develops the habit of

clear, analytical reasoning; he also develops the use of good judgment when faced with different situations.

Case analyses are most successful when conducted in an atmosphere of cooperation and negotiation. This atmosphere is possible only when the teacher adopts a philosophy similar to that given in chapter III.

Use of cases provides a basis for the exchange of thoughts and a lesson in how to learn from others. The learner must integrate diverse information in order to arrive at a decision; he is encouraged to relate the information given in a case to the internal, competitive and environmental systems. When used in training programs, case analyses force the functional manager to consider the organization as a whole; he is given practice in the important task of developing salient relationships.

There are as many ways to perceive a case as there are people analyzing it. Methodical case analysis forces the learner to recognize and address conflicting viewpoints. More importantly, systematic analysis of cases provides operational experience in the resolution of conflict, an ability that is indispensible to the manager.

The student gains an appreciation of the importance of strategy by going through the rigor of case analysis. He sees objectives in more than one dimension and must develop a method of 'fire prevention' rather than simply 'fire fighting'. The student acquires breadth in exposure to diverse conventions and points of view.

In presenting the results of analysis, the learner gains practice in the articulation of effective transmission of his ideas. He learns the importance of communication of decisions based on logical analysis rather than emotion.

The model for case analysis consists of the following six steps:

1. clearly define the problem or problems
2. gather the information
3. develop alternative courses of action
4. select the best practical alternative
5. implement the decision
6. evaluate the effectiveness of the decision.

This model is not a panacea for case analysis. However, it provides a systematic and consistent method for addressing any case and arriving at a relevant course of action. The teacher whose students use this model will, in all probability, find it improved upon by each successive class.

The use of case analysis is particularly applicable to a course dealing with systems management. In the very act of participating in discussion, responding to one another's ideas (or ignoring them), the students gain a facility with the gamesmanship involved in any systems manager's job.

The case study of the TFX, presented in the following chapters, is an example of the complex and interrelated nature of management in action. The case is presented in such a manner that students can apply the model developed in chapter III in order to discuss the strategies of the participants in relation to the internal, competitive and external subsystems.

As mentioned earlier, the case method is student (as well as problem) oriented. The benefits of a case are definite but elusive. Some recommendations are suggested for the use of the case method in systems management courses or training programs.

Recommendations

The success of a case course demands motivation of the student. Assuming the teacher accepts the rationale of chapter III, this tells him 'what to do'; the following recommendations are offered as guidance in 'how to do it'.

a. Tell the students what the objectives of a case course are and provide them with written guidance on how to analyze a case. Reproduction and distribution of the 'student' portion of chapter III of this paper will accomplish this.

b. Coordinate the use of cases so that those used first are relatively straight-forward and less complex; succeeding cases should then progress up the spectrum of difficulty. As the complexity of cases is increased, offer students supplementary text material or background reading to aid their analysis.

c. Assign cases to small groups of students for analysis and presentation to the class. This takes the teacher out of the picture from the start. One warning: recognize the fact that the temptation will be for a group to sit back and relax once their case has been presented. The teacher has to exercise considerable ingenuity in order to preclude this. One method would be to assign cases well in advance; then require the analysts to present a brief abstract of their approach in the class prior to the period in which their presentation is to be made. This permits the remainder of the class to research and prepare other aspects of the case either in rebuttal or support. While this may appear to be a detailed process it should provide for greater participation and more lively discussion.

d. Require a balance of written and oral analysis. The model presented in chapter III can also be used as a format for written analyses. This promotes more careful analysis and reasoning by the student. It also provides a definitive basis for evaluation of student progress and ability.

e. Provide feedback to the students. A case course is meant to develop intellectual and social skills. Conduct a *post mortem* of the case and discuss the interactions of the class.

f. Solicit and evaluate student comments on how to improve a case course and presentation; tax their innovativeness and creativity. The process can not help but be improved by inputs such as these.

While the preceeding may appear obvious to some, they are often overlooked if not ignored. A poorly handled case is worse than no case at all.

Finally, it is recommended that the Graduate Systems Management curriculum at the Air Force Institute be changed to include a case analysis course. The diverse backgrounds and experiences of the participants in such a program are a source of information that should be tapped. The TFX case, which follows, would find good use in such a course. Other cases could possibly be obtained from Harbridge House (Cambridge, Massachusetts [Ref 8:8]), The Intercollegiate Bibliography [Ref 32:3-7], or by additional student research.

# PART TWO

# A STUDY OF THE TFX

# V

# INTRODUCTION AND BACKGROUND

## General

In the preceding four chapters, the writers have offered a rationale for the use of cases in systems management education. In this and succeeding chapters a case is provided on the acquisition of the TFX or Tactical Fighter, Expermental. This designation was later changed to F-111, the F-111A being the Air Force version and the F-111B, the Navy version. The essence of this case is such that it provides a basis for the student to relate the internal, competitive, and environmental subsystems of a major Department of Defense (DoD) decision.

As one Air Force General[1] said, *the TFX is probably the most publicized airplane ever built* [Ref 177:1014]. It is recognized that absolute objectivity is a myth; however, attempting to insure the writers' bias remaining at a minimum throughout the case, it has been endeavored to stick to the 'facts'. The major sources of information contained in this case were the following:

1. Senate Subcommittee on Department of Defense Appropriations Hearings for Fiscal Years 1960 through 1964.

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[1]General Holzapple, Deputy Chief of Staff for Air Force Research and Development, in 1968.

2. House of Representatives Subcommittee on Department of Defense Appropriations Hearings for Fiscal Years 1960 through 1964.

3. Senate Permanent Investigation Committee Hearings investigating the TFX, Parts 1 through 10.

4. Congressional Record for the period January 1, 1960 through December 31, 1963.

As mentioned earlier, no personal interviews, contracts, or questionnaires were used in the construction of this case. All information was obtained from public domain documents and copyright material.

Variable-Wing Geometry Aircraft[2]

Attempts to achieve variable wing geometry go all the way back to 1911. The chief problem: an undesirable relationship between the center of gravity and center of lift as the wings moved causes an airplane to nose up and down sharply, becoming longitudinally unstable. Until the mid-1930's there could be no real application of variable wing geometry because flight speeds had not yet approached the point at which compressibility effects became important and overcoming them became crucial. In 1942, the Messerschmitt engineering and research establishment began preliminary work on a design that incorporated a pivot wing that could be pre-set on the ground at any one of three selected sweep angles, but this design was never flown. Following the war, the National Advisory Committee for Aeronautics (NACA) Ames and Langley Laboratories, and the Bell Aircraft Company maintained at least a casual interest in the concept of variable flights.

[2]For more details concerning the history of variable wing geometry aircraft, see *Variable Sweep: A Case History of Multiple Re-Innovation*, by Robert L. Perry [Ref 184], The Rand Corporation, Santa Monica, California, October, 1966. (D.D.C. No. AD643136) Unless otherwise noted, history of variable-wing geometry came from this source.

In 1949, Bell Aircraft Company built two experimental aircraft, later designated the X-5, that would demonstrate the validity of the variable-sweep technique. The wings of the X-5 could be set at any angle of sweep between two extremes. The experience of the X-5 program showed that a reasonably satisfactory wing sweep mechanism could be designed, built and operated in flight.

Briefly, in 1951 there was hope that the appearance of an aircraft free of the design inhibitions of the X-5 might put variable sweep in a better light. Such optimism was based on the XF10F-1, a prototype of what was intended to be an operational carrier-based, variable sweep wing, fighter. It was designed by Grumman Aircraft Engineering Corporation against the Navy's need for a high speed aircraft that could operate effectively from the decks of in-service carriers. The XF10F-1 had only two wing angle settings; full forward and full rear. The wing sweep mechanism again proved almost trouble free and the effect of wing sweep was very nearly that predicted. However, owing to the general ineffectiveness of design, the aircraft was slow to respond at both extremes of its speed range, as was the X-5. Attempts to incorporate corrective features proved futile.

In addition to the design deficiencies, two factors contributed to the cancellation of the Grumman program in the summer of 1953. The first, reliable, high-performance steam catapult had been developed; second, angled landing decks were being installed on new and rebuilt aircraft carriers. In combination, these carrier features permitted the routine employment of swept-wing aircraft at sea and invalidated, in part, the original justification for a variable-sweep wing aircraft for the Navy.

No further important research in this area was undertaken in the United States until 1957. At that time, when it became clear that multi-mission aircraft capable of

operating effectively over a speed range from Mach 0.8 to something in excess of Mach 2.0 might well become the next essential requirement of the military services, NACA aerodynamicists at Langley again took up their investigation of variable-sweep aerodynamics. John Stack[3], director of Langley Research Center, held firmly to his early conviction that variable-sweep had promise only if a practical means of employing the technique could be found. The technology was finally perfected through the use of wind tunnel models [Ref 158:S5032].

In late 1958, at about that same time that NACA became part of the National Aeronautical and Space Administration (NASA), Langley began studies of specific aircraft configurations. One design conceived to eliminate instability involved simultaneously sweeping both wings around separate pivot points which were moved out of the wing root rather than having a single pivot in the center of the fuselage.

At the time these NASA findings were being reported, Headquarters, U. S. Air Force Tactical Air Command (TAC), was shaping a requirement so demanding that it could not be satisfied by any aircraft that lacked the performance flexibility provided by variable-sweep wings. TAC foresaw a near-term need for a fighter capable of flying across either the Atlantic or the Pacific unrefueled, able to operate effectively on a supersonic, low altitude assignment, capable of performing missions that required high altitude flight at speeds above Mach 2.0, and also able to take off and land on short, unimproved airfields. Industry responses to informal inquiries about the possibility of developing such an aircraft suggested that it would weigh around 100,000 pounds and would be limited to operation

[3]Now a vice-president of the Fairchild-Hiller Corporation.

from large, well equipped airfields. TAC was unwilling to accept either of these constraints [Ref 184:12]. (Studies at TAC Headquarters indicated only 44 airfields in the free world capable of accommodating such an aircraft [Ref 30:173]). Mr. John Stack briefed General F. K Everest, TAC Commander, concerning recent Langley findings concerning variable-sweep geometry [Ref 184:12]. Concurrently (July, 1959), Mr. Stack gave a presentation to the Navy Bureau of Aeronautics on the same subject [Ref 172:4-10]. At that time the Navy let two study contracts, one to Douglas and one to North American to study the variable geometry wing concept.

In late 1959, General Everest, Mr. Stack, members of their respective staffs, officers from Air Force headquarters, and senior officers of the Air Research and Development Command began working out the details of a formal requirement statement that might be passed on to industry. In early 1960, the System Operational Requirements (SOR) was refined and issued by the Department of Defense on July 14, 1960 [Ref 172:15]. In the summer of 1960, General Everest told the airplane companies that the TFX was the only aircraft likely to be built in operational numbers [Ref 30:175]. This announcement was made about the same time the B-70 bomber procurement had been drastically cut back. Earlier, the B-70 was billed as the only bomber to be built in any quantity during the 1960's. With the Democratic victory in November, outgoing President Eisenhower decided the project was neither so urgent nor so far along that it could not be delayed until the new Secretary of Defense took office in January of 1961.

In early 1960, the interest of the House Subcommittee on DoD Appropriations in the subject of development of a multi-service aircraft is evidenced by the following dialogue:

> Subcommittee Member: *...is there any thinking going on in the Defense Department of trying to get a common fighter, a common bomber, and then to modify that so as to make it adaptable for different services, like the Navy, Marine Corps, or the Air Force?*
>
> Secretary of Defense Gates: *Yes, there is a great deal of thinking and effort going on in this area. It has been accentuated quite a bit by the establishment of Dr. York's research and development office.* (Dr. Herbert F. York, Director of Defense Research and Engineering.)

Executive Office

President Dwight D. Eisenhower rankled under heavy criticism in his last years in the presidency. He caustically remarked that political and financial considerations were playing a part in causing his troubles, and added that something besides the strict military needs were involved in many military efforts to fight his decisions. The result was the so-called munitions lobby investigation by a House Armed Services Subcommittee headed by Representative F. Edward Hebert. These investigations established that a large number of retired senior military officers, including many admirals and generals, had taken high-paying jobs in defense industry[4] and that high ranking Air Force officers had been entertained lavishly at weekends in the Bahamas [Ref 24:239]. However, the Hebert investigation was unable to produce any evidence of misconduct [Ref 153:4850].

In his farewell address, President Eisenhower made reference to the forces behind what he believed was unwarranted criticism of his Administration. *In the Councils of Government we must guard against the acquisition of unwarranted influence--whether sought or unsought--by the*

[4]See Table XVI in Appendix A page 115 for the number of retired military officers employed by some defense contractors.

*military-industrial complex,* the retiring President warned [Ref 24:239]. Following are examples of the size of the military-industrial complex: there are one or more military installations in 282 of the country's 437 districts [Ref 153: 4850]; and approximately 16,000 firms do $10,000 or more of business with the Defense Department each year [Ref 172: 431].

As President-elect Kennedy prepared to take office, the following articles appeared:

> *Avowed intention of President-elect Kennedy to overhaul the Pentagon appears fairly high on the new year's priority list. In-house reforms should come first, with changes needing Congressional approval to follow* [Ref 131:13].
>
> *Reorganization is probably the most frequently heard single word in the Pentagon...and will probably continue to be so for a good while to come. What remains to be seen: how Kennedy will move on Defense. One so far unknown factor: what the new Defense Secretary will want to do, and how closely-on-detail he will work with Kennedy. The one sure factor seems to be that 'McNamara's Band' is in for a rapid rise on the Defense Department hit parade* [Ref 60:11].

## Department of Defense

Secretary of Defense. Robert S. McNamara agreed to serve as Secretary of Defense at the request of President-elect Kennedy on December 13, 1960 and took the oath of that office on January 21, 1961.

Mr. McNamara, who resigned his position as president of the Ford Motor Company to accept the appointment, was born in San Francisco, California, on June 9, 1916. He attended public schools at Piedmont, California. In 1937, he was graduated from the University of California where, at the end of his sophomore year, he had been elected to Phi Beta Kappa national scholastic honor society. Two years later he received a Master's Degree in Business Administration from the Harvard Graduate School of Business.

In 1955, he received an honorary Doctor of Laws Degree from the University of Alabama.

In 1939, Mr. McNamara joined the accounting firm of Price, Waterhouse & Company of San Francisco. In 1940, he returned to Harvard as an assistant professor of business administration. During part of his tenure there, he was consultant to the War Department in the establishment of a statistical control system for the Air Force. He took a leave of absence from Harvard in 1943 and went to England as a civilian consultant for the War Department. Subsequently, he was commissioned a captain in the U. S. Air Force, and served in England, India, China and the Pacific. He was awarded the Legion of Merit and promoted to lieutenant colonel prior to his return to inactive duty in April, 1946. Mr. McNamara is now a colonel, U. S. Air Force Reserve (indefinite).

Mr. McNamara, one of the ten so-called whiz kids who offered themselves as a team [Ref 106:33], joined the Ford Motor Company in 1946. He managed the company's planning and financial analysis office until 1949 when he was promoted to comptroller. In August 1953, he was appointed assistant general manager of Ford Division, and in January, 1955, was elected a vice president and named general manager of the division. He was appointed vice president and group executive--car and truck divisions--on May 23, 1957, and on August 8, 1957, was elected a director of the company. Appointed to the executive committee following his election as a director, he also was a member of the company's administration committee. Mr. McNamara was elected president of the Ford Motor Company on November 8, 1960.

The Secretary's Strategy. To provide an idea of how he intended to fulfill the duties of Secretary of Defense, the writers offer a short discussion of McNamara's strategy. McNamara had let it be known to all DoD and

service echelons that he wanted to hear conflicting ideas and viewpoints on issues of major significance (when in the interest of National Defense). He also let it be known that he wanted no bickering once an idea had passed the decision stage and reached the implementation stage. McNamara stated he would follow through with former Secretary Gates' idea of sitting in on Joint Chiefs of Staff (JCS) meetings and letting the Service Chiefs advise him directly on their viewpoints [Ref 114:15].

In 1961, Secretary McNamara restructured the entire work of the Defense Department so as to present alternatives to decision makers. This involved programming all manning and procurement around missions or objectives, cutting across the boundaries of the three services and extending beyond the confines of annual budgets [Ref 136: 94].

In April 1961, Secretary McNamara stated an aim of the Office, Secretary of Defense (OSD): *We are fully determined to continue our efforts to seek out and eliminate waste, duplication and unjustifiable expenditures.* This was to be achieved by carefully assessing all the elements of a program--analyzing the most significant alternative combinations of program elements in order to arrive at an optimum 'mix'; i.e. the combination that gives the kind and degree of defense needed at the least possible cost, recognizing that a large element of judgment enters into such decisions [Ref 163:1-10].

The November 1961 issue of Armed Forces Management contained the following remarks:

> *Barring unforseen events, the Secretary of Defense will stay in office four, and possibly eight years. What can be expected from him: ...not afraid to break with tradition or ignore accepted patterns of government operation ...places responsibility on individuals and not offices ...works himself and his subordinates hard ...sincere ...only apparent goal is a more efficient, more effective Department of Defense.*

*The McNamara team has accomplished more in its first nine months than has any other group in comparable Pentagon history. There now is absolutely no question in anybody's mind about where to go to get a decision in a hurry* [Ref 68:21].

Other members of the New Defense Team [Ref 106:33]:

*Roswell L. Gilpatric:* Deputy Secretary of Defense, 54 years old, expert in organization and Defense department contracting. No newcomer to the Pentagon, was Air Force Assistant Secretary in '51, Under Secretary in '53, on Rockefeller Studies Project for Defense Reorganization '56-'57, and on Symington's committee on the Defense Establishment in '60.

*Cyrus R. Vance:* General Councel, 43 years old, served two years ('57-'58) as Special Counsel to Preparedness Investigating Committee, Consulting Councel for special Committee on Space and Astronautics of the U. S. Senate.

*Paul H. Nitze:* Assistant Secretary of Defense (International Security Affairs), 54 years old, was instrumental in shaping Marshall Plan and later became Director of State Department's policy-planning staff.

*Dr. Harold Brown:* 33 years old, picked to relieve Dr. Herbert York as Director, Defense Research and Engineering. Brown is the youngest man on McNamara's immediate staff. Specialties include nuclear physics, nuclear reactor design, nuclear fissions and weapon systems. In new post, will choose among rival weapon systems advanced by services. Since '58 has been consultant and advisor on nuclear matters to government and large industries.

*Arthur Sylvestor:* Assistant Secretary of Defense (Public Affairs), 59 years old, will be valuable man to newcomer McNamara. Is considered 'old pro'

around Washington. Will work closely with White House Press Secretary Salinger. He was the Bureau Chief and correspondent for the Newark News, having joined the News in 1925. He enjoys the confidence of Secretary of Defense McNamara [Ref 65:26].

*Charles J. Hitch:* Assistant Secretary of Defense (Comptroller), 51 years old, author of The Economics of Defense in the Nuclear Age. Will supervise and direct preparation of DoD budget estimates. Rhodes Scholar in 1932. Once served as Chief, Controls Division, Office of War Mobilization and Reconversion.

*Eugene M. Zuckert:* Secretary of the Air Force, 49 years old, top-notch man in contracts and contract management, one time Assistant Secretary of the Air Force under Stuart Symington. Is an advocate of Defense Department unification. A man with a head for military contracts and management, served in Surplus Property Administration and, during Truman Administration, with the Atomic Energy Commission.

The Joint Chiefs of Staff. Composition of the Joint Chiefs of Staff remains unchanged: General Lyman L. Lemnitzer, U. S. Army, Chairman; General George H. Decker, U. S. Army; Admiral Arleigh Burke, U. S. Navy; General Thomas D. White, U. S. Air Force; and General David M. Shoup, U. S. Marine Corps.

Scope of DoD. The following prediction of OSD's operation was offered in the August 1961 issue of Armed Forces Management [Ref 87:18]:

> *With half a year under their belt, top OSD officials are beginning to make clear how they intend to run Defense. Among the rules:*
>
> *Item--Strong overall central direction from the*

*third floor (where most OSD assistant secretaries work). Top OSD staff will try to stay broad but make it clear they intend to dive into actual specific hardware decisions.*

*Item--Organization; made it clear that they intend to operate in fact as the laws on paper indicate they are supposed to operate.*

*Item--Launching penetrating inquiries into problems that have been swept under the rug for years.*

*Item--Getting decisions fast.*

In fiscal 1960, there were some 1.5 million military and almost 1.0 million civil service employees with a payroll totaling $11.4 billion. An additional $650 million was paid to more than 1.0 million National Guardsmen [Ref 153:4850]. DoD expenditures during the early 1960's were expected to stabilize between $35-40 billion per year. The DoD budget for fiscal years 1955 through 1961 is shown in the following table.

TABLE I

DoD Budget for Fiscal Years 1955-1961

| Year | Expenditure ($ billions) |
|---|---|
| 1955 | $ 35.59 |
| 1956 | 35.76 |
| 1957 | 38.46 |
| 1958 | 39.13 |
| 1959 | 41.08 |
| 1960 | 41.00 |
| 1961 | 43.09 |

[Ref 24:416]

The Aerospace Industry

In 1960, five companies accounted for 25 per cent of the dollar volume of defense contracts and 21 companies for 50 per cent [Ref 153:4850]. The top 100 military prime contractors received contracts totaling $15,410 million, or 73.4 per cent of the total $20,995 million awarded during fiscal year (FY) 1960. Table II lists the top four contractors for 1960 [Ref 51:42].

TABLE II

Top Four DoD Contractors for Fiscal Year 1960

| Company | Contract Value (millions of $) | % of total Defense Dollar |
|---|---|---|
| 1. General Dynamics | $1,260 | 6.0 |
| 2. Lockheed | 1,070 | 5.1 |
| 3. Boeing | 1,008 | 4.8 |
| 4. General Electric | 963 | 4.6 |

Trends in DoD Procurement. Soon after McNamara took office he authorized a study into the various methods of procurement. The findings of the study showed that at least 25 cents is saved on every dollar shifted to competitive procurement and 10 cents is saved on every dollar shifted to cost plus fixed fee procurement [Ref 63:59]. The increased use of incentive type government contracts, or fixed-price contracts, resulted in better selling prices for equipment bought by the government and are credited with the rise in profits by some aerospace companies. Fixed-price contracts[5] not only increase profits but, because of accounting treatments, tend to reduce sales totals.

[5]Cost-plus contracts' sales are recorded as costs are incurred, but fixed-price sales are not recorded until deliveries are made.

Trends in contract forms can be seen by examination of Figures 1 through 3. These figures indicate what percentage of Defense money has been expended under each of the contract types [Ref 118:83]. The current levels are approximately those which procurement officials would like to maintain in future months.

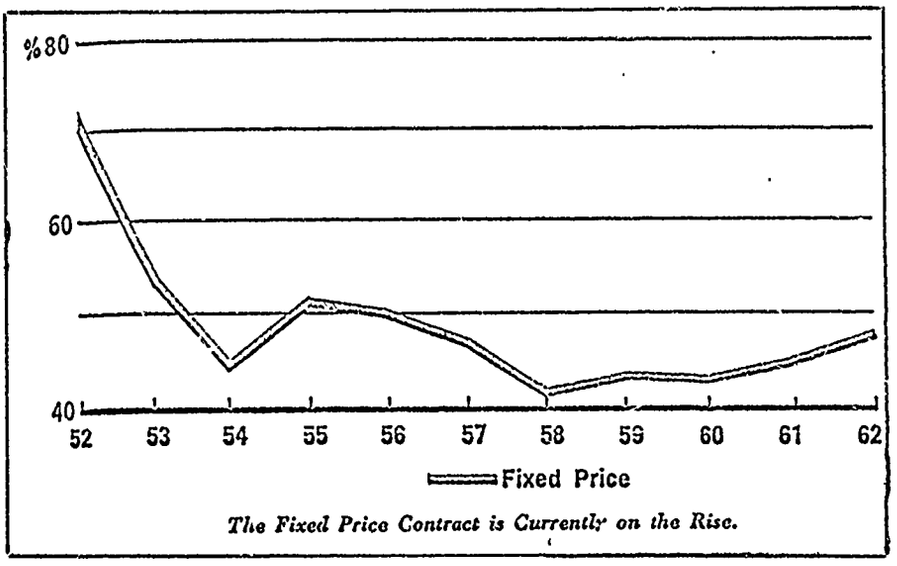


Figure 1.

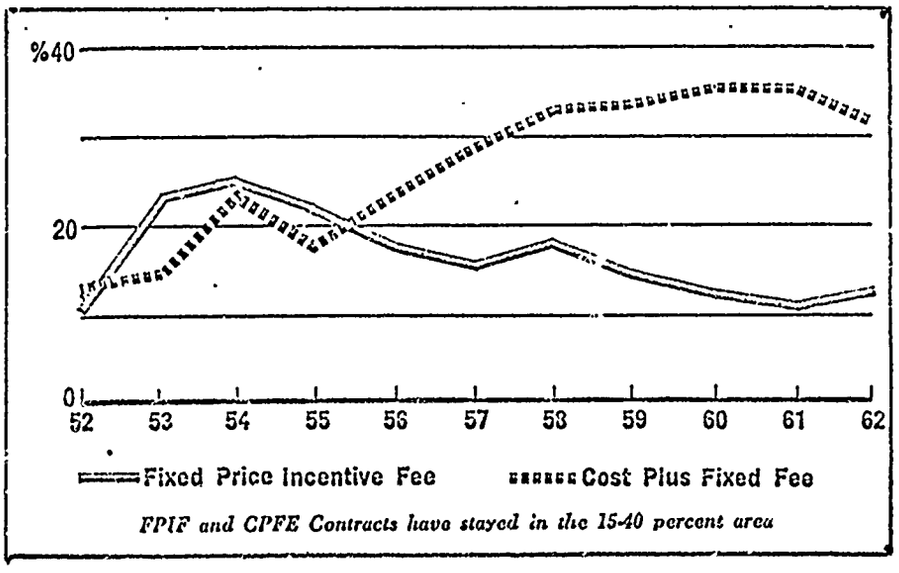


Figure 2.

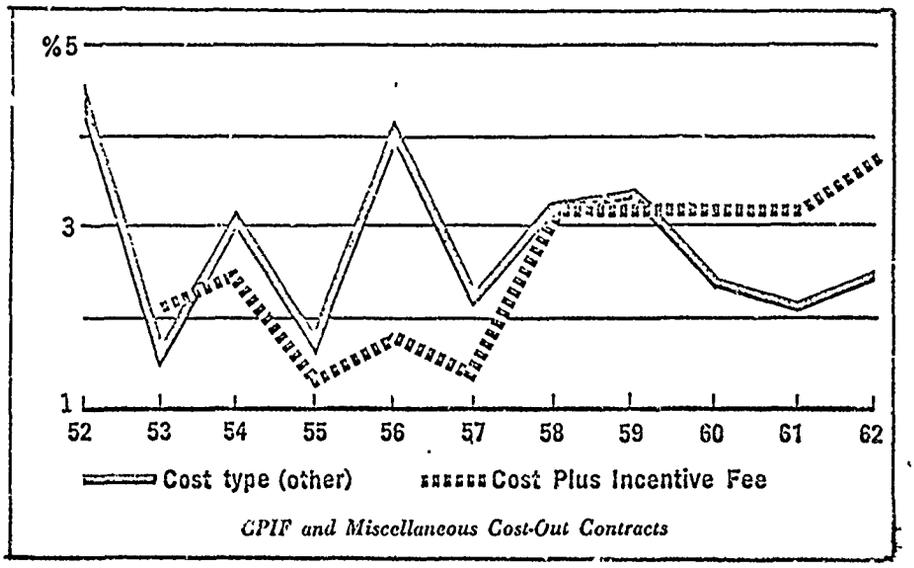


Figure 3.

Lead Times. To gain an insight into the time lapse from the letting of a development contract to the first squadron delivery, the relative lead time requirements of several complex systems are shown in Table III.

TABLE III

Fighter and Bomber Development Time

| Program | Number of aircraft on initial contract (1) | Initial commitment a basic aircraft only (millions)[a] (2) | Years to 1st squadron delivery[b] (3) |
|---|---|---|---|
| Fighter, prototype: | | | |
| F-80 | 3 | $2.6 | 2.0 |
| F-81 | 3 | 4.6 | 2.3 |
| F-86 | 3 | 4.7 | 3.5 |
| F-101A | 2 | 13.0 | 4.8 |
| Fighter, development-production: | | | |
| F-100A | 203 | 185.0 | [c] 4+ |
| F-101A | 31 | 117.0 | 5.3 |
| F-102A | 42 | 210.0 | 4.8 |
| F-105A/B | 15 | 195.0 | 6.0 |
| F-106A | 17 | 76.0 | 5 0 |
| F-107A | 9 | 85.0 | ---- |
| Bomber, prototype: | | | |
| Flying Wing | 15+4 | 83.0 | ---- |
| XB-45 | 3 | 13.1 | 5.0 |
| XB-47 | 2 | 12.0 | 6.0 |
| XB-48 | 2 | 11.0 | ---- |
| XB-51 | 2 | 13.3 | ---- |
| XB-52 | 2 | 70.0 | [d] 6.0 |
| Bomber, development-production: B-58 | 13 | 350.0 | 3+ |

Notes.--Not applicable.

[a] Shows the total financial commitment implied in the original contracts. In almost all cases the amounts shown are larger than the amounts of the initial versions of the contracts because they have been adjusted to take into account subsequent contract revisions. The data cover only the basic airplane, procurement of engines, and testing. They do not include the development of engines or the cost of major subsystems.

[b] In a number of the programs substantial development activity continued after the systems were put into operational use. Column (3) shows only the time required to make a 1st squadron delivery.

[c] Includes time contractor spent on preliminary development work, for which he was subsequently reimbursed.

[d] Excludes a period of over 2 years during which Boeing was working on a series of turboprop design very different from the swept-wing turbojet that finally emerged.

[Ref 172:1113]

Boeing [Ref 105:80-85+]

History. Boeing was founded in 1916 by William Edward Boeing, heir to a timber fortune who had learned to fly as a hobby, and G. Conrad Westervelt, a Navy officer who happened to be stationed in Seattle. Its first significant order was for fifty World War I trainers. At the end of the war, Boeing was forced into furniture manufacturing to stay in business. Hundreds of fighters and bombers were produced by Boeing during the 1920's and 1930's. These were followed by the famous B-17 *Flying Fortress* (12,731) and B-29 *Superfortress* (3,974) of World War II. Boeing's post-war B-47 was the nation's first jet bomber (2,040 were produced) and some 600 B-52's today compose a vital part of the nation's nuclear strike force--along with about 1,000 of Boeing's *Minuteman* intercontinental ballistic missiles.

Boeing's endeavor in commercial aviation started with the introduction of the *Monomail* in 1930, the first American commercial plane with stressed skin and cantilever wings. Its *Stratoliner*, introduced in 1939, had the first pressurized cabin in airline service. The retractable landing gear, air-to-ground radio communications, leading-edge de-icer boots, and low-wing design that have since become universal were all pioneered by Boeing. Its Model 314 flying boats provided the first scheduled service across the Atlantic.

In September of 1945, William McPherson Allen, then 45 years old, was named as president and chief executive officer succeeding Philip G. Johnson, who had died in 1944. Allen is a graduate of Harvard Law School and served for years as a Boeing director (since 1930) and chief legal counsel (since 1925). On his second day in command, amidst the turmoil of some 34,000 layoffs, Allen announced that Boeing would proceed immediately to production of a

civilian version of the C-97 transport to be called the *Stratocruiser*.

In 1952 he took the first of a series of spectacular gambles that have now become an Allen trademark--and scored the single biggest triumph in the history of the industry. The gamble was the *707*, the nation's first jet airliner. Boeing invested $16 million of its own funds (24 percent of its net worth at the time) in a prototype plane, and the first flight test was in mid-1954. It offered a tanker version of the plane, the KC-135, to the Air Force which eventually bought 775 of them. Its first commercial sale was twenty planes in October of 1955 to Pan American. Helicopters are the only new significant military aircraft business Boeing has had since the KC-135 in 1954.

Variable Wing Research. When Boeing was apprised of Langley Research Labs' apparent success with the variable geometry wing, they began to study possible applications of such a design. Late in 1959, Boeing submitted an informal,unsolicited, proposal to General Everest (Commanding General, TAC) for the development of a variable-sweep wing aircraft. This proposal generally conformed to General Everest's concept of a post-1965 TAC fighter [Ref 172:14]. This design is what became known as the TFX. By November of 1960, wind tunnel tests had been completed and Boeing was well on the way to finishing a full scale mock-up [Ref 30:175].

When they received an Air Force Request for Proposal in October, 1961, Boeing had accumulated about 3,000 hours of wind tunnel tests of a variable geometry wing aircraft; this was increased to more than 5,000 hours by May, 1963 [Ref 172:942,1030].

Financial Data. Table IV indicates financial data of Boeing Aircraft Company from 1958 through 1961.

TABLE IV

Boeing Aircraft Co. Financial Data*

| | 1958 | 1959 | 1960 | 1961 |
|---|---|---|---|---|
| Sales | 1,751.9 | 1,648.8 | 1,554.0 | 1,800.9 |
| Earnings | 30.2 | 12.7 | 24.4 | 35.6 |
| Backlog | 2,479.0 | 2,018.0 | 2,139.0 | 1,869.0 |

**All figures in millions of dollars.*

[Ref 37:115 & 34:67]

General Dynamics Corporation [Ref 30:63-93]

History. General Dynamics evolved from a series of mergers and acquisitions under the direction of Jay Hopkins and came into being under that name only in 1952. Hopkins was trained as a lawyer (Harvard Law '31) but was best known for his brilliance in finance. Sales in 1947, the year of the first key acquisition, were $174.5 million, increasing to $2,062 million in 1961, the year Hopkins died.

The 'air force' of General Dynamics was the Convair Division. Convair was a virtual empire within an empire: making *Terrier* missiles at its Pomona (California) plant; the *Atlas* missile, jet fighters, and propeller-driven transports at San Diego; B-58 bombers at Fort Worth. President of the Fort Worth plant was Frank Davis. He had been part of the aircraft production operation since 1940. In 1954, he was promoted to Chief Engineer and assumed the position of manager and president in 1959.

Commercial Jets. It was in 1955 that General Dynamics first considered going into the medium range jet transport program on an idea from the Convair Division. At this time, Convair was responsible for three out of every four dollars taken in by General Dynamics. The Division had already successfully dealt with a commercial transport

problem; the propeller-driven *240's, 340's* and *440's* were world famous. Between 1923 and 1953, Convair produced no less than 42 different aircraft models [Ref 172:1054].

During 1957, the cost figures for the commercial jet, the *880* program, began to emerge. When an engineer in Convair's purchasing division began adding up the sub-contractor components (representing 70% of the finished aircraft, the remaining 30% of the total materials cost being allocated to Convair), he discovered outlays for vendor-supplied components totaled more than the plane was being sold for (average price, $4.25 million). That same year Boeing introduced the Boeing *720*, a medium-range aircraft capable of carrying up to twenty-five more passengers, having lower operating costs and $200,000 cheaper than the *880*. The market potential for the *880* dropped from 110 to 80 planes.

To try to regain market sales, Convair decided to 'modify' the *880*. The *990*, in comparison to the *880*, had a bigger wing area, a fuselage ten and a half feet longer, weighed 50,000 pounds more, required enlarged empennage, a beefed-up landing gear, greater fuel capacity, stronger structural members, and was supposed to go twenty miles per hour faster. The *990* was to be built without a prototype, or advance model. The plane had been sold at a price of approximately $4.7 million. Yet nobody knew how much it would cost because the estimates were based on the costs of the *880*, which were still on the rise and unpredictable. In September of 1960, General Dynamics decided to write off all anticipated future losses on the *880* and *990* programs; an amount of $96.5 million, pretax.

In February, 1961, additional jet losses of $40 million were 'discovered'. Design deficiencies and competition by mid-January of 1962 resulted in only sixty-six *880's* and twenty-three *990's* being sold. The break-even point was calculated at sales of 200 of the *880's* and *990's*.

Consequently, General Dynamics wrote off $214.5 million in jet transport costs and ended 1961 with a $143.2 million deficit [Ref 83:29]. By the end of 1962, General Dynamics had to write off some $425 million of jet losses. Over the two-year period 1960-1962, General Dynamics incurred the biggest product loss ever sustained by any company, anywhere. The jet-transport program it built around the Convair *880* and *990* airliners cost the corporation far more than the $121 million loss Lockheed took on the *Electra* and even overshadowed Ford's $200 million disaster with the *Edsel*.

Experience. General Dynamics management experience includes the simultaneous production of five major weapon systems--*Atlas* missiles, nuclear submarines, B-58 bombers, F-102 and F-106 interceptor aircraft.

Financial Data. The table below is an abbreviated financial position of the General Dynamics Corporation.

TABLE V

General Dynamics Corp. Financial Data*

| | 1958 | 1959 | 1960 | 1961 |
|---|---|---|---|---|
| Sales | 1,626.0 | 1,811.8 | 1,987.7 | 2,062.3 |
| Earnings | 48.3 | 31.0 | (27.0) | (143.2) |
| Backlog | 2,095.0 | 2,555.0 | 2,555.0 | 1,700.0 |

**All figures in millions of dollars.*
() indicates loss.

[Ref 34:67,115]

Grumman Aircraft Engineering Corporation

History. Grumman Aircraft is not only a leading company in meeting U. S. Naval aviation requirements, particularly for carrier-based planes, but has also built and flown the only variable sweep aircraft designed for operational use (the XF10F mentioned earlier). Since 1930, Grumman has produced over 25,000 aircraft, of which 23,500 were carrier-based fighter or attack aircraft.

Among a number of Grumman 'firsts' for the Navy were: retractable landing gear, 1931; the folding wing (for carrier storage of planes), 1937; the swept-wing, 1951; the area rule ('coke bottle') fuselage; the carrier-based, supersonic, F11-F fighter, 1954; and the F11-F-1 carrier-based, Mach 2, fighter-bomber in 1956 [Ref 172:1058]. Mr. Towl became president and chief executive in 1960. Grumman was founded in 1930 with Mr. Towl as one of the founders. Grumman has its headquarters in Bethpage, Long Island, New York, and planned to build the F-111B at this location. When Grumman became interested in the TFX competition, they still retained in their employ a Mr. Meyer who was chief test pilot during the flight test of the XF10F variable sweep wing aircraft, *Jaguar*, in 1952-1953. He piloted the plane for 232 flights and had been with Grumman since 1942.

Financial Data. Table VI indicates financial trends for Grumman Aircraft Corporation; commercial business included.

TABLE VI

Grumman Aircraft Engineering Corp. Financial Data*

| | 1958 | 1959 | 1960 | 1961 |
|---|---|---|---|---|
| Sales | 225.0 | 288.9 | 325.5 | 316.7 |
| Earnings | 2.4 | 4.9 | 7.1 | 6.1 |
| Backlog | 175.0 | 260.0 | 327.5 | 295.0 |

**All figures in millions of dollars*

[Ref 34:67]

# VI

## DEFINING THE ULTIMATE AIRPLANE

### DoD Approach

On April 18, 1961, before the Senate Subcommittee for DoD Appropriations, Secretary of Defense McNamara requested funds for the development of a new tri-service tactical fighter.

> *...$45 million for the development of a new tri-service tactical fighter ...to meet the requirements of the Army, Navy, Air Force and Marine Corps ...to supplement and replace the Air Force's F-105 and the Navy's F4H. New development in the variable geometry wing concept now makes it possible to develop a tactical fighter which can operate from aircraft carriers as well as from much shorter and cruder runways ...carry conventional ordnance.*
>
> *...striving for one fighter to fill the needs of all services--fly without refueling across the ocean, thus greatly increasing its value for limited war purposes* [Ref 169:30-31].

This fighter aircraft was later given the designation of 'TFX'.

Supporting the DoD position, Lieutenant General R. G. Wilson, Deputy Chief of Staff of the Air Force (Development), made the following remarks before the same subcommittee:

> *Estimated cost of developing the TFX is $325.6 million. If planned inventory is acquired, average unit cost would be $2.7 million...capable of close support interdiction and air superiority tactical tasks. The desires of the Air Force will be primary and those of the other services will be secondary; in those cases where a decision is required on a controversial matter, it is the intent of the Air Force to fulfill the requirements of the other services to the greatest degree practicable* [Ref 163:120].

The Air Force Tactical Air Command (TAC) was looking for a single fighter-bomber that would be ready in the late 60's as the eventual replacement for the F-105 and F-100. Attention focussed on a variable geometry wing that could be swung forward to provide the large wing area required for short take-off and slow flight, or swept backward for supersonic flight. The Air Force decided to go for the concept in the form of a heavy fighter-bomber that could take off from 3,000-foot, unpaved, runways and fly for long distances at fuel saving high altitudes. Upon entry over enemy territory, the aircraft would be able to drop down to within a few hundred feet of the ground and make a 400 mile supersonic dash under defensive radar screens to deliver nuclear bombs. No other plane could then fly supersonically any substantial distance at very low altitudes.

At about the same time, the Navy was working on plans for a plane of its own. The Navy believed its fleets lacked the proper defense against bomb- or missile-carrying enemy aircraft. What the Navy needed was a combat air patrol of several highly computerized missile carrying airplanes to 'loiter' at high altitudes on a perimeter 150 or more miles from the fleet. These radar equipped planes would be used to detect enemy marauders miles away, and to launch sophisticated, computer guided missiles to destroy them. For a plane of this type, the primary requisites were long loiter times and, of course, the ability to take off from carriers. The Navy was busy working on an aircraft and missile combination that was to be called *Eagle/Missileer--Eagle* being the missile and *Missileer* being a subsonic aircraft.

In the Eisenhower Administration's last months the Navy's project was shelved in favor of a variable wing fighter to carry a projected new missile, the *Phoenix*,

and take over fleet defense missions being performed by F4B *Phantoms*. The Air Force project was held up for final clearance by the next Defense Secretary. By the time McNamara had been in office a few months, some of the systems analysts on his staff had noted similarities in the requirements for the Air Force and Navy planes; most notable among these was the requirement for each plane to make short take-offs and landings and the ability to stay aloft for long periods. When they suggested the two aircraft might be combined into one requirement, McNamara quickly agreed to what he then regarded as the embodiment of his ideas for trying to put 'cost effectiveness' into the military establishment. By injecting a sense of economy into the Defense Department, he also hoped to help break up some of the independence in the services that too often resulted in expensive weaponry duplication [Ref 40:89-90].

An economic study of how much might be saved if the two programs could be combined was made within the department's research and engineering office. Based purely on historical documentation of prior aircraft research and development (R&D) and production programs, the study showed a possible savings of roughly a billion dollars [Ref 40:90].

The military men were more interested in effectiveness than cost, especially when it seemed clear that the TFX was going to be the last new tactical airplane they would get for a long time. The most strenuous objections came from the Navy which knew the Air Force was interested in a slim but sturdy plane, weighing 85,000 pounds or more. Part of this weight would be in an airframe rugged enough to withstand the stresses imposed by the Air Force mission of terrain hugging flight at supersonic speeds. Part of it would be in large tanks and fuel to power the 400 mile, low level dash. The Navy objected, claiming

that an airplane of such characteristics would be impossible to fly from its carriers and to handle and store in sufficient numbers on its decks or to hoist up and down on carrier elevators. The Navy said it wanted a plane no more than fifty-six feet long and weighing no more than 55,000 pounds, fully loaded.

The Air Force was hardly happier. Slim, needle-nosed planes are the most efficient for high speed flight. The Air Force men did not like the drag-inducing chunkiness of typical Navy fighter aircraft, especially when the Navy was talking of a plane that could accommodate a five foot diameter, long range radar antenna in its nose.

After eight months of work, the majority of the aeronautical experts in both the Navy and the Air Force were in agreement that an effective common airplane for the two services was not technically feasible. McNamara then ordered the two services to get together with his own experts and to compromise their respective desires until they came up with a common design that could be built to satisfy both services' missions. As a result, the Air Force reduced its low-level supersonic dash capability requirement from 400 to 200 miles; the Navy settled for smaller radar and a 63,500 pound plane. The Navy also agreed to give up hope of landing the plane on the short decks of its Essex-class aircraft carriers, which were rapidly obsolescing anyway. In May of 1961, Secretary of the Navy John B. Connaly wrote McNamara objecting that the compromise design was *too large and expensive and we neither need nor want them on our carriers*. But if the plane had to be, Connaly added, *the Navy should be the service responsible for its development to ensure that the final design would be suitable for carrier operation.* McNamara found the argument unpersuasive and chose the Air Force to manage the program on the grounds that it would be procuring 86 per cent of the total production [Ref 40:90].

The military wanted the highest performance, most advanced aircraft available; the Defense Department wanted an aircraft which would meet the requirement without recourse to high risk technology and unpredictable costs [Ref 133:47]. In any event, the plane was intended to be the most important addition to the U. S. tactical air arm for the next 10-15 years [Ref 158:S5032]. The joint development of a single aircraft of genuine tactical utility to both services as ordered by Secretary McNamara resulted in a description of the TFX/F-111 aircraft as follows[6]:

> *The TFX/F-111 is designed as a versatile fighter-bomber aircraft ...variable sweep wing makes possible flight speeds from 100 to 1850 miles per hour. This two-man supersonic fighter bomber is to fulfill such roles as close support, interdiction, and counter air. Capabilities are enhanced by digital computer for navigation and weapons delivery, infrared search and detection systems, terrain-following radar, improved communications and advanced missiles.*
>
> *Wing can be varied from a 16° angle at take-off to a sharply swept 72.5° for supersonic strikes, or to any angle in between... land as slowly as 100 knots and come to a full stop in 2,000 feet...when loaded can take off in less than 3,000 feet.*
>
> *...is designed to employ a full range of serial weaponry--guns, missiles, rockets, bombs, or a combination of each for air-to-air, air-to-ground, or a combination of these missions* [Ref 183:331-332].

On October 1, 1961, the Request for Proposals (RFP's) were sent out to the following interested aerospace companies [Ref 47:28-29]:

---

[6]Secretary McNamara made the decision to proceed with the TFX weapon system with the Air Force acting as the executive agent for the procurement [Ref 172:1203]. See Appendix B, page 116, for the complete memorandum.

Boeing Northrop
Lockheed North American Aviation
and the following two-company teams:
General Dynamics-Grumman
McDonnell-Douglas
Republic-Chance-Vought

Boeing's Approach

As mentioned earlier, Boeing was independently advised of the apparent breakthrough by Langley Research Laboratory and began to study possible applications of the variable sweep technique. In December, 1959, they submitted to General Everest an informal proposal for the development of a variable sweep aircraft generally conforming to his conception of a post-1965 TAC fighter [Ref 184:12]. To learn more of the needs of TAC, Boeing sent representatives to TAC's field operations all over the world to get first-hand information. Boeing wrote a manual on how TAC operates which covered the whole system--maintenance, spares, even the skills required of the people who would do the maintenance work. (This manual was later adopted by the Air Force for its training programs [Ref 184:177]).

Boeing ignored partnership feelers put out by Grumman, deciding to go it alone. Since there would be tremendous technical difficulties in designing one plane to meet the divergent requirements of the Navy and the Air Force, Boeing surmised that there would eventually be two planes: an Air Force TFX and a Navy TFX. Consequently, since the Air Force would have the larger procurement, Boeing concentrated on meeting the Air Force requirements. (The Air Force would be buying 1500 TFX's versus only about 200 for the Navy [Ref 184:178]). Boeing assumed the Navy was powerful enough politically to defeat McNamara and get their own plane. The strategy of Boeing was not so much

to oppose McNamara as it was to give the Air Force and the Navy better planes than they asked for. This was based on the gamble that separate planes would be ordered.

Boeing desired to push the state-of-the-art by the use of thrust reversers and high air scoops to reduce engine damage when operating from unimproved airfields (NASA's John Stack supported both these innovations [Ref 172:26-29]). In regard to subcontracting, Boeing planned to let 50-60% to dependable suppliers with an eye to politically important distressed areas [Ref 115:181].

Boeing's prime appeal to the services was that it had designed for maximum specifications (i.e. capability) but they had to sacrifice commonality to get it [Ref 116:192]. They decided to build the TFX at Wichita, Kansas, as the B-52 program was scheduled to phase-out in the last quarter of 1962. Without the TFX, the work force in Wichita would be reduced from 22,000 to 12,000 workers [Ref 137:34].

The Power Plant. For two and one half years, Boeing had been designing their TFX around the Pratt & Whitney TF-30 engine. This was a Navy sponsored power plant on which that service had already spent $30 million (It was to have been used in the canceled Douglas *Missileer*) [Ref 184:179]. Four of the other teams had picked the TF-30: one team had chosen an Allison engine.

To get into the competition (a billion dollar contract awaited the winner) General Electric, in August, 1961, announced a new engine design, the MF 295. This engine would be superior to the current Pratt & Whitney and Allison designs, weighing several hundred pounds less, being smaller in diameter and length and having greater performance. This power plant was in the design stages only, but was declared eligible for the TFX competition (It was generally accepted in industry that the development time for an engine is twice the development time for

an airframe [Ref 172:1606]). However, the prospect for better performance eventually persuaded Boeing, Lockheed, McDonnell-Douglas and North American Aviation to switch to the MF 295.

General Dynamics' Approach

General Dynamics joined forces with Grumman, a company whose planes had made more than half of all the take-offs and landings on carriers. The Navy knew that with Grumman there would be a concerted effort to meet Naval requirements [Ref 184:178].

If the competition was close between contractors, subcontracting could play a decisive role. Recognizing this, General Dynamics-Grumman stayed flexible by having two or three runners up in each subcontracting category and postponing final selection until the last minute.

General Dynamics was more disposed toward commonality than Boeing. In building the B-58, General Dynamics went all out to please the generals and got little in return--instead of providing a basic airplane for the Strategic Air Command (SAC), the B-58's were limited to only two wings (116 B-58's were built) [Ref 115:182]. Moreover, General Dynamics had spent much time studying multipurpose weapons (in a vain attempt to interest TAC, SAC and Aerospace Defense Command [ADC] in the B-58), and thought the McNamara concept made a lot of sense [Ref 184: 182].

The two companies decided to stick to known and proven methods such as using stainless steel for structural members, employing a speed brake for deceleration and designing for side air intakes--all of these features were incorporated in various fighter aircraft then in the Defense inventory.

General Dynamics planned to build the Air Force version at Fort Worth and Grumman would build the Navy version at Bethpage, Long Island. At Fort Worth, both the B-58 *Hustler* and the F-106 interceptor were scheduled for phase-out by the fourth quarter of 1962. Seven thousand workers at Fort Worth faced layoff if General Dynamics-Grumman did not win the TFX contract [Ref 137:34].

# VII

# ROUND AND ROUND

## Round One

Six contractors submitted preliminary TFX designs in response to the Air Force's RFP by December 6, 1961 (Northrop had dropped out). Each of these contractors was then allocated one hour for oral presentations to the Air Force Evaluation Board on December 12 and 13. This evaluation team[7] was comprised of 235 men and was headed by Colonel Charles A. Gayle, USAF, the assistant program director for the F-111 system. Essentially one month was spent by this team analyzing each proposal.

These proposals responded to the following TFX specifications published by the Air Force Aeronautical Systems Division (ASD) [Ref 123:28]:

*General*

--A two engine aircraft; engines currently meeting requirements are the Pratt & Whitney TF-30, the Allison AR168, and the General Electric MF295.
--Variable geometry wing is probably necessary but not mandatory.
--All weather capability.
--Operate from pierced metal plank or sod fields.
--Deceleration provided by thrust reversal, drogue parachute or other developed method.

[7]See Appendix C for the model depicting the various stages of evaluation the TFX passed through before reaching the Office of the Secretary of Defense.

*Air Force*

--60,000 pound aircraft with length not specified (general belief is that it will be from 73 to 76 feet long).
--Takeoff and landing 3,000 feet or less.
--Combat radius for low-approach, high- altitude delivery and low-altitude escape is set as 800 nautical miles.
--Ferry range 3,300 nautical miles.
--Mach 2.2 at 60,000 feet and a high speed of Mach 2.5.
--Low level speed Mach 0.9 to Mach 1.2 for 100 nautical miles.

*Navy*

--Mach 1.0 at sea level and Mach 2.0 at altitude (which is conceded to be about 60,000 feet).
--Carry six 1,000 pound missiles for a combat radius of 150 nautical miles.
--Loiter on station for 3½ hours.
--Length, 56 feet; gross weight 55,000 pounds.
--Full carrier operation.

The Evaluation. The evaluation team considered the six contractor proposals for satisfying these specifications from three viewpoints:

1. Technical aspects--balancing preliminary engineering designs against military requirements.

2. Management plans--number and quality of corporate personnel to be assigned to the project and organization setups.

3. Procurement plans--covering contractor's need for new plant and equipment and subcontractors' proposals [Ref 137:34].

In order to accomplish an objective analysis, the evaluation team developed a set of standards against which each proposal was independently compared. The different designs were not compared with each other; the subsystems of each proposal were compared with the standard separately. These were then assigned a raw score without

weighing what the subsystem was valued at in relation to the entire aircraft. The results showed that none of the designs was acceptable without substantial change; however, two of the proposals were considered to be significantly better than the other four. Therefore, the evaluation team recommended that Boeing and General Dynamics be given further study contracts [Ref 172:54]. Based on the scores achieved, Boeing's was considered best of those submitted, with General Dynamics second. It was disclosed at this time that the General Electric MF295 engine, which was the foundation of Boeing's proposal, could not meet the TFX schedule. Consequently, the Air Force propulsion group removed it from the list of acceptable engines. Part of this reversal was due to TAC's determination to keep the plane strictly on schedule.

The Source Selection Board (SSB)[8] met on January 19, 1962, to consider the TFX proposals. It was composed of the following members: Admiral Ashworth, Navy; General Bennett, AFLC; General Culbertson, AFSC; General Moore, TAC. In addition to the evaluation team's analysis, the Source Selection Board considered two other matters. First, they considered the advice of John Stack; second, they considered the carrier compatibility evaluation, which was the Navy's separate evaluation of each of the six proposed aircraft. The carrier evaluation was conducted by the Bureau of Naval Weapons (BuWeps) and their report, dated January 8th, stated that *none of the designs, as presented, meet the minimum acceptable standards for Navy use. Two of the designs* [Boeing's and North American Aviation's] *can be categorized as capable of carrier*

[8]Source Selection Boards are *ad hoc* service groups convened to recommend a source (not the design) from among the competitors for a particular weapon system contract.

*operations without major re-design, but will require some changes. The other four designs are unacceptable for carrier operations without major change* [Ref 172:489]. The SSB's recommendation was that Boeing should be selected as the source for the TFX [Ref 172:57].

Subsequent to receiving the SSB report, the Navy made a further recommendation. The Navy felt that General Dynamics' proposal, while incorporating some desirable features, was so deficient in meeting carrier performance requirements specified in the work statement that the design could not be considered acceptable for Navy use.

On January 24, 1962, the Air Force Council met in joint session with Admiral Pirie, Deputy Chief of Naval Operations, Admiral Stroop, Chief of BuWeps and Admiral Haywood, Deputy Chief of BuWeps. The Air Force Council recommended that limited study contracts be awarded to both companies. They did state that, if a source was to be selected at this time, their recommendation was that Boeing be selected[9] [Ref 172:57].

The Chief of Staff of the Air Force, General LeMay, and the Chief of Naval Operations, Admiral Anderson-who had replaced Admiral Burke-concurred with the Air Force Council's recommendation.

On January 29, 1962, Air Force Secretary Zuckert and Navy Secretary Korth sent a memorandum[10] to the Secretary of Defense concurring with the recommendation of the Air Force Council. They attached an addendum on each of the companies involved. They said that *the Boeing design was the most readily adaptable to service requirements, and the most significant change required would be*

[9]For a copy of the Air Force Council's letter, see Appendix D.

[10] For the complete memorandum see Appendix E.

*incorporating a new engine*. As to General Dynamics, they said the most compelling change required was in the field of aerodynamics [Ref 172:57].

The Decision. The Secretary of Defense authorized a run-off between Boeing and General Dynamics, giving sixty days for the contractors to rework their design and allowing about thirty days for evaluation. Thus, Boeing was given a paid study contract to change its design to the TF-30 engine. General Dynamics was also given a paid study contract to rework their proposal. Both companies had 60 days from January 31, 1962, to complete their changes [Ref 47:28-29].

By ordering the restudy, McNamara had junked the time-honored service practice of awarding the contract to the top scorer in a competition and then giving the winner enough time to correct deficiencies. Instead, the Secretary had decided to gamble that protracted competition between two finalists would provide better results [Ref 116:110].

Impact. Both Fort Worth and Wichita plants were facing slowdowns in the airframe business and the possible economic impact on each community was receiving priority attention in both Congress and the Executive branch [Ref 47:29].

In March, 1962, it was reported that DoD was considering cost effectiveness studies between the TFX and the F4H-1 fighter aircraft built by McDonnell which was then being purchased in quantity by the Navy and the Air Force. This added more uncertainty to the future of the TFX [Ref 61:25].

Dr. H. Brown, then Director of Defense Research and Engineering, said that the Air Force is responsible for development of basic configuration with the Navy doing work on the avionics of its version. The emphasis was on

developing an aircraft having truly multimission capabilities for limited and general wars [Ref 164:238]. He said the TFX would cost *not as little as $2 million, but something less than $3-3.5 million per copy* [Ref 170:112]. The F-111 program over the succeeding eight years was expected to reach from four to five billion dollars with $800 million on engines [Ref 61:25].

On March 21, 1962, J. H. Wakelin, Assistant Secretary of the Navy (Research and Development), requesting $115.6 million for Fiscal Year 1963 to be used for the development of the Navy's TFX. He stated that the TFX effort represented the first time the services joined aircraft requirements before starting development [Ref 164:85].

During the first eight-week runoff, Boeing had to redesign around a new engine, the Pratt & Whitney TF-30. Their strategy apparently remained the same--satisfy the Air Force. They had long been a USAF-oriented firm but did their best to please the Navy. (The Navy was still skeptical as Boeing had never built a modern Navy fighter.) However, General Dynamics' apparent strategy was still to give the Secretary of Defense what he wanted. However, they still had a long way to go to overcome Boeing's technical lead. In spite of the interest surrounding the procurement, neither competitor had any indication of how he was being judged. In essence, all they knew was that both had to submit new proposals prior to April 1 [Ref 116: 110].

Round Two

The Evaluation. Both competitors submitted new proposals to the evaluation board on April 1, 1962. The SSB (same members as in Round One) received the evaluation board's recommendation in favor of Boeing on May 14, 1962.

The independent carrier compatibility study, conducted again by the Chief of the Bureau of Naval Weapons, was sent to Wright-Patterson Air Force Base on May 1, 1962. The study found that,

> *General Dynamics in many detailed areas now had an edge. However, in weight balance and carrier compatibility performance, it still was markedly deficient. Boeing improved its single engine performance despite the weight penalties assessed*[11], *but now had an unsatisfactory high wind over the deck required for carrier landings.*

The Navy concluded that *neither design is now acceptable from a carrier compatibility standpoint,* but Boeing retained its *substantial advantage over* General Dynamics [Ref 172:58].

The SSB made the determination that Boeing's proposal was superior for the following reasons: they had done substantially more preliminary engineering and wind tunnel testing; they had placed the air scoops over the wings; and General Dynamics' plane had an undesirable shift of the center of gravity during variation of wing-sweep. The three Air Force voting members voted unanimously to recommend Boeing. The Navy member agreed that Boeing's submission more nearly met the requirements of the work statement, but considered neither design acceptable to the Navy.

The Air Force Council met on May 24, 1962, to consider the matter, again with Admirals Pirie, Rayborn and Stroop joining the six lieutenant generals and one full general from the Air Force [12]. The Council unanimously determined that the Boeing proposal was superior to that of General Dynamics [Ref 172:59].

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[11]By redesigning around the Pratt & Whitney TF-30 engine, about 4,000 pounds was added to the gross weight of the Air Force version and the Navy version [Ref 172:326].

[12]General McKee, chairman; Lieutenant Generals Disoway, Bogart, Blanchard, Ferguson, Stone, and Gerrity.

The Decision. On June 1, 1962, Air Force Secretary Zuckert and Navy Secretary Korth sent a memorandum[13] to Defense Secretary McNamara stating that they had directed the Source Selection Board to examine the two contractors' possible courses of action, again to correct the design deficiencies. They gave the contractors three weeks to clear up the shortcomings, and there was to be another evaluation after what they called the 'short round'.

Impact. About this same time (May 16, 1962), Admiral Stroop wrote a memorandum to Admiral Anderson expressing his feelings that the chances of obtaining a successful bi-service plane were remote and recommending against any further efforts on the joint requirements. He was overruled by Admiral Anderson [Ref 172:59-60].

While the second round was undergoing evaluation, Aviation Week questioned the cost of the program in the May 7th issue [Ref 75:34].

> *On the basis of a program of 1,000 aircraft over a period of five years, and a target unit cost of $5 million, the cost of the weapon system would be $5 billion. Some military officers do not believe that the F-111A can be produced for $5 million. They point out that the McDonnell F4H-1 twin-jet fighter will cost the Navy $2.095 million each. A more realistic price tag, they say, would be closer to $10 million.*

McNamara, after examining the contractors' cost estimates and comparing them against Defense's own analysis, made the following comment:

> *I asked the Secretaries of the Navy and Air Force to tell the contractors that their costs are completely unreasonable. We aren't going to accept anything like that; they are without foundation. It appeared that they are following a practice that is evident elsewhere in our society of trying to entangle a customer*

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[13]The complete memorandum is contained in Appendix F, page 123.

*by a low initial bid, keeping the thought in the back of the mind that it can be raised later* [Ref 184:193].

Round Three

McNamara was concerned because a significant cost overrun on a $7 billion program like the TFX not only would have to be borne by the taxpayers, but it might raise the total price of the program to a level where it would have been wiser to put the money in a different weapons system--one that had previously been rejected on the basis of high cost [Ref 340:111].

The evaluation. The third round ended June 1, 1962. After oral presentations by the contractors[14] and evaluation[15] of the new proposals, Colonel Gayle presented the matter to the Source Selection Board for the third time. The Board reaffirmed, by unanimous vote, the selection of Boeing as the source. The Navy concurred in this finding, but could not commit itself to proceeding with the program until the design was settled[16] (the Navy traditionally fixes the design first and picks the source second while the Air Force typically works in reverse order).

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[14]See Appendix G for the instructions to Boeing concerning the presentations.

[15]The evaluation team did not perform a detailed analysis as they would have had only seven to ten days to do so.

[16]At the third round briefing by the contractors at Wright-Patterson Air Force Base, June 16, 1962, General Dynamics had no clear idea of a joint development solution to the TFX problem, while Boeing had offered, for the first time, an aircraft that answered the requirements of both services. General Dynamics presented six different variations, of which they recommended either one of two. One incorporated identical fuselages with different wings and the second employed identical wings with separate fuselages [Ref 172:1193].

The Air Force Council met for the third time on June 21, 1962. Again, with the Navy and Air Force representatives voting, the Council unanimously recommended Boeing to be the source. They agreed that the choice of the source was not an issue, and that the definition of the design of the airplane should follow the selection of the source [Ref 172:63].

The Air Force Council's recommendation was forwarded to General LeMay and Admiral Anderson, both of whom concurred with the findings without comment. However, neither USAF Secretary Eugene Zuckert nor Navy Secretary Fred Korth signed the board's recommendation.

Admiral Anderson, Chief of Naval Operations (CNO), indicated that the *Boeing design is acceptable to the Navy and gives every indication of being an acceptable weapon system.* He agreed that *the choice of the source is not an issue and the Navy representatives agreed that the Boeing design had improved whereas that of General Dynamics had slipped*[17].

The Decision. On June 29, 1962, Zuckert wrote the Source Selection Board directing them to go back for a fourth evaluation[18]. The purpose of this continuation was to:

1. provide the contractor with adequate time to establish their designs in sufficient detail to enable the services to assess more precisely the probability of the development of their respective versions into an effective weapon system.

2. reconcile the obvious disparity between the contractors' cost proposals with the Air Force standard [Ref 172:65].

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[17]For the complete memorandum see Appendix H.

[18]A copy of Zuckert's letter is contained in Appendix I.

Each contractor was given an additional $2.5 million to work on the fourth round. Sixty days were given for them to take corrective actions and submit revised proposals. During the sixty day period contractors would be given guidance in all areas as to appropriate corrective action, specific equipment, or similar guidance to insure maximum benefit from the contractors' efforts.

Impact. Heretofore, the competitors had been running blindfolded, not knowing precisely how short of meeting specifications they were. In early July 1962, the competitors were told of one more run off to be conducted with all the cards on the table; each contractor was going to be treated as if he had won. They were even told that the previously secret 'pay off points'--those given the most important weighting--were structural design, commonality and reliable costs[19]. [Ref 116:191]

The end of round three found the Navy still displeased with the design (there was still 6,500 pounds weight difference in Navy and Air Force versions). The contractors were becoming apprehensive about overhead expenses caused by keeping their teams together (this far exceeded what the firms were paid for re-doing the proposals) [Ref 100:29]. Investment of company funds in the proposals by the two finalists and the four losers has been estimated at $50 million. At the end of the third round, the evaluation team had spent an estimated 200,000 man-hours in analyzing the various proposals [Ref 172:70].

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[19]Appendix J contains a copy of the letter sent to General Dynamics' Roger Lewis (a similar letter was sent to Allen of Boeing).

Round Four

During the final stage, General Dynamics found a new way of making models for wind tunnel testing. The old process was to make the drawings, select the best set of drawings and make models for those designs which were most promising; this was followed by wind tunnel testing and selection of the design which performed best. The bottleneck was in the model building area. They had to be forged out of stainless steel which took six weeks to two months. Therefore, during the two previous competitions, no gross changes to the designs could be made. However, at the start of the final phase, it was discovered that fiberglass could be used to build the models. This cut the time requirement for models to ten days. This innovation permitted them to go back and look at the whole commonality problem again instead of just making small changes. As a result, General Dynamics built and tested more models in the July-September period than in the previous nine months combined [Ref 116:191]. More significantly, this permitted General Dynamics to negate Boeing's one-year lead in wind tunnel testing of variable sweep wing aircraft.

During this final stage of competition, Boeing combined a paragraph of the work statement[20] with a letter from Colonel Gayle[21] and decided to introduce titanium into their design in order to reduce the weight of the Air Force and Navy versions of the TFX.

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[20]See paragraph 4.3.1 of Addndum No. 1 (dated July 6, 1962) to the work statement in Chapter VIII.

[21]A copy of this letter is contained in Appendix K.

The Evaluation. On September 11, 1962, the fourth and final set of proposals were submitted. On November 2, 1962, Colonel Gayle[22] passed to the Source Selection Board the recommendation of the evaluation team[23]. The recommendation was that Boeing be selected as the source; it also stated that both weapons systems were acceptable and were very close to each other.

The Source Selection Board (on November 2nd) made the following statement[24]: *The Board unanimously recommends that Boeing be selected as the source.* According to the Board, the Boeing design offered superiority in operational capability, lower cost, a more flexible weapon system, thrust reversers, and over-the-wing air intakes [Ref 172: 1164].

Also on November 2nd, General Bradley, commander of AFLC, and General Sweeney--who replaced General Everett as commander of TAC (the using command for the F-111)--both concurred in the selection of Boeing.[25] On November 6th, Genral Schriever, commander of AFSC, and Admiral Masterson, Chief of BuWeps, also concurred in the recommendation of the Source Selection Board. The Navy announced on the same day that both designs satisfactorily met its requirements.

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[22]The Aeronautical Systems Division (ASD) commander's instructions to the evaluation team are shown in Appendix L.

[23]At least a half-dozen factors, other than cost, enter into the awarding of contracts. A company's past performance is considered; so are its physical location, technical approach, management structure and experience. Appendix M shows the evaluation team's rating of the contractors in this competition in these areas.

[24]Appendix N contains the SSB's complete letter.

[25]Appendix O contains General Sweeney's recommendation for the selection of Boeing as the weapons system source.

Table VII provides a comparison of the two TFX proposals as evaluated by the Air Force.

TABLE VII

Comparison of TFX Proposals

*Operational comparison of 2 TFX proposals, General Dynamics versus Boeing, as evaluated by U.S. Air Force. Only subcommittee selected items are shown*

| | General Dynamics | Boeing |
|---|---|---|
| Contractor's proposal (millions) [1] | $5,455.5 | $5,364.2. |
| Air Force program estimate (millions) | $7,023.2 | $6,983.0. |
| Air Force program estimate adjusted figures | $5,803.0 | $5,357.5. |
| Ferry rang (nautical miles) | X | X plus 1,100. |
| Reaction time at −65° F. (minutes) | 2 times X | X. |
| Landing distance over 50-foot obstacle | X plus 500 feet | X. |
| Deceleration device | Dive brakes and spoilers | Thrust reverser. |
| Air Force estimate of Navy weight (pounds) | X plus 2,208 pounds | X. |
| Air Force estimate of Navy mission A (loiter time in hours). | X | X plus 30 minutes. |
| Air Force estimate of Navy mission B (loiter time in minutes). | X | 5¼ times X. |
| Aircraft carrier spotting [2] | X plus 5 | X. |
| Avoidance of foreign object damage | Deflectors | High scoops. |
| Area intercept mission (radius in nautical miles) [1] | X | X plus 177 miles. |
| Ordnance carrying capability (pounds of demolition bombs): | | |
| Wings out | X | X plus 60 percent. |
| Wings in | X | X plus 11 percent. |
| Contractor's proposed ordnance loading: [1] | | |
| Nuclear bombs | X | X plus 50 percent. |
| Air to ground missile | X | X plus 50 percent. |
| Demolition bomb | X | X plus 105 percent. |
| Cluster dispenser | X | X plus 180 percent. |
| Fire bomb | X | X plus 250 percent. |
| Land mine | X | X plus 70 percent. |
| Rocket launcher | X | X plus 44 percent. |
| Air-to-air missile | X | X plus 100 percent. |

[1] Contractor data.
[2] Navy evaluation.

Note: The Air Force estimated Boeing's proposed F-111A would weigh 1,383 pounds more than that of General Dynamics [Ref 172:140].

The Air Force Council's November 8 report[26] indicated that Boeing's proposal had a *clear and substantial advantage* over that of General Dynamics. Consequently, the Air Force Council unanimously recommended selection of Boeing [Ref 172:761]. General LeMay and Admiral Anderson concurred.

The four evaluations had consumed approximately 292,000

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[26]See Appendix P for the affidavit of General McKee, procedures of system source selection and the Air Force Council's report.

man-hours [Ref 172:445]. Total industry investment was estimated at $75 million; Boeing alone had spent over $10 million [Ref 115:96].

The Decision. After having considered the proposals, comments, and concurrences, the civilian Secretaries announced that the contract would be awarded to General Dynamics-Grumman. The Secretary of Defense concurred in this finding. It was the first time anyone could recall that the advice of the Joint Chiefs of Staff or the expert Source Selection Board had been overruled on a major program [Ref 148:S-5033].

Impact. On November 21, 1962, a memorandum[27] was issued by Zuckert containing the justification for General Dynamics being chosen as the source for the TFX. The memorandum was concurred in by Secretary of the Navy Fred Korth[28] and by Secretary of Defense McNamara. The memorandum concluded: *in view of the fact that both aircraft proposed are acceptable and offer a capability far beyond present-day aircraft,* General Dynamics'proposal should be accepted

> *on the basis that it proposes the greater degree of commonness*[29]*, contemplates the use of conventional materials*[30]*, provides the higher confidence in structural design and offers the better possibility of obtaining the aircraft desired on schedule and within the dollars programmed.*

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[27]The complete memorandum is found in Appendix Q.

[28]Replaced Connally as Navy Secretary in Feb. 1962.

[29]Using Boeing's proposal, and building the two versions identical, would have still yielded a plane lighter than the one for which General Dynamics was selected [Ref 172:1199].

[30]In Rounds One and Two, Boeing used no titanium. In Round Three, Boeing had an alternate--a number of applications which showed how weight could be saved by the use of titanium, but it was not a part of the formal proposal [Ref 172:1348].

When he awarded the contract, the Secretary of Defense cautioned that Air Force cost estimates, which were based on General Dynamics' cost data, could not be considered reliable. However, he based the contract award on General Dynamics' *demonstrably credible understanding of costs*. He also cited lack of cost realism by the rival Boeing Company as a major reason for overturning the military leaders' nearly unanimous choice of Boeing [Ref 99:19510].

The contract for the TFX has never had an equal for general impact on the industry or the contractors involved and on the communities where the $5 to $7 billion would be spent[31] [Ref 137:34]. There were production orders worth $6.5 billion, 20,000 jobs, 1700 airplanes[32]. It was the largest tactical aircraft contract since World War II. The initial $28 million letter contract (December, 1962) involved 22 development planes for test to be delivered in two and a half years [Ref 150:1089].

The Victor. The TFX award of contract was a victory for a company whose debt of $322 million in early 1962 was 16 times bigger than its common equity. There was danger that the company would be forced to get rid of the Fort Worth plant.

General Dynamics made $42 million in prepayments on their long-term debt and had set aside nearly $4 million preferred stock payments during the year 1962.

General Dynamics/Fort Worth president F.W. Davis said "the TFX is more nearly within the existing technology than

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[31]For a detailed coverage of the impact that the TFX contract had on the Fort Worth area, see *An Economic Impact of the TFX Contract Award on the Fort Worth Trading Area*, a student thesis by R.W. Harrison et al, DDC No. 42438 [Ref 180].

[32]The total number of planes could go well above 1700. The Secretary of the Air Force told the House Subcommittee on DoD Appropriations in Feb. 1962, that *a reconnaissance version of the TFX is being planned* [Ref 170:289].

the B-58 *Hustler* was and management experience gained during work on the B-58 will be transferable to the F-111A [Ref 42:26].

General Dynamics has overall responsibility for the F-111 program[33]. The production of the forward fuselage sections and wings, the assembly of F-111A's and their flight test were the direct responsibility of General Dynamics. Grumman Aircraft Engineering Corporation is responsible for the aft fuselage sections and landing gear as well as final assembly and flight test of the F-111B [Ref 56:26]. General Dynamics was directed to funnel 50 per cent of the estimated $1.1 billion development effort to subcontractors[34].

The first contract is to cover the research, development, test and evaluation (RDT&E) phase which involved the building of eighteen aircraft as F-111A's (USAF version) and five aircraft as F-111B's (USN version). A listing of the major companies concerned with the TFX program can be found in Appendix S. Some of the original specifications, requirements and/or desires for the TFX are shown in Appendix T.

Shortly before the prime contract was announced, Hughes Aircraft received about a $200 million contract for the development of the *Phoenix* air-to-air missile fire and control systems for the F-111B (the original estimated cost of developing the *Phoenix* system was $137 million [Ref 158: 19527].

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[33]Appendix R shows the General Dynamics/Grumman relationship for work on the TFX.

[34]General Dynamics proposed to fabricate at Fort Worth 65.2 % by AMPR weight (weight of the basic airframe) and subcontract 34.8% by weight, including the work to be done by Grumman. Boeing proposed to fabricate at its own facility only 38.4% of the basic airframe by weight, and to subcontract 61.6 % [Ref 172:1570].

Prelude to Contoversy. When General Dynamics was declared the winner, not everyone agreed with DoD's choice. Forbes magazine commented that the TFX contract *represents General Dynamics' only real hope of recovery and it is a common industry assumption that their difficult straits helped them to get the contract.* Forbes stated that losing the contract would not mean disaster for Boeing because of their position in commercial and military jets and because they are prime contractor on the *Minuteman* missile, the *Dyna-Soar* space glider and the first stage of the *Saturn* rocket.

In early December, 1962, Senator Henry M. Jackson, Democrat from Washington, asked for an investigation into the awarding of the TFX contract. Senator John L. McClellan of Arkansas, Chairman of the Permanent Senate Subcommittee on Investigations[35] agreed to conduct such an investigation. Chairman McClellan then asked DoD to delay the signing of any contract until the investigation was completed. Disregarding this request, DoD signed a research and development letter-contract with General Dynamics on December 21, 1962. Thus, the fierce competition between these two companies which had begun in October, 1961, ended in December, 1962.

The Aerospace Industry. The aerospace industry ended calendar year 1962 showing profit increases of 20 to 25 per cent over those of 1961 and sales increases on the order of 8 per cent [Ref 35:29]. Table VIII represents an abbreviated financial statement, as of December 31st, 1962, of the three companies involved in the TFX competition.

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[35]The Permanent Subcommittee on Investigations is under the Committee on Government Operations. Names of the members of these committees in '62-'63 are shown in Appendix U.

TABLE VIII

Financial Statements (abbreviated) of TFX Competitors-1962

| Company | Sales* | % of Total[a] | Backlog* | Earnings* |
|---|---|---|---|---|
| Boeing[b] | $1,132.8 | 4.4 | $1,620 | $27.1 |
| General Dynamics[c] | 1,196.6 | 4.7 | 2,065 | 52.8 |
| Grumman | 303.6 | 1.2 | 700 | 6.2 |

* Figures in millions of dollars.
*a* Total U. S. amount: $25,588.4 million.
*b* Ranked third in 1962; fourth in 1961.
*c* Ranked second in 1962; first in 1961.

[Ref 165:82 & 89 and Ref 36:109]

# VIII

## 1963: THE YEAR OF THE INVESTIGATION

The January 1, 1963, issue of Armed Forces Management commented that the *procurement for the TFX aircraft captured public attention because it was the largest single military supply item in history* [Ref 157:5215]. As mentioned in Chapter VII, this procurement also aroused interest in Congress. On Tuesday, February 26, Senator McClellan formally opened the hearing into the TFX contract investigation.

In his opening remarks, Chairman McClellan said:

> *This subcommittee is to determine whether appropriated funds are being expended efficiently without waste or extravagance, and without favoritism. We have conducted a preliminary investigation into the procurement practices and into the award of a contract to General Dynamics Corporation for one of the largest tactical airplane programs ever contemplated by the U.S. Government.*
>
> *The aircraft is designed for use by the Air Force as a bomber or fighter, or as a reconnaissance plane, and for use by the Navy and Marine Corps for the off-carrier air-to-air combat fleet defense and reconnaissance in both limited or general war. The Defense Department's interest is in procuring a plane, of single design, which will meet the requirements of the Air Force and the Navy. The program calls for the production of over 1,700 planes, of which 235 will be for use of the Navy.*
>
> *The cost of these planes has been estimated by the Air Force and the Defense Department to be in the area of $6.5 billion.*
>
> *We anticipate the committee will be occupied with this investigation for some five or six days* [Ref 172: 3-4].

(The investigation was to last some 46 hearing days, produce 2740 pages of testimony, and, without reaching any conclusion or publishing any findings, was suspended

indefinitely at the time of the assassination of President Kennedy.)

John Stack

The first witness before the Subcommittee was John Stack who had resigned from NASA in May, 1962, to become a vice president and director of engineering and a member of the board of Republic Aviation Corporation.

Thrust Reverser. When asked by counsel if a thrust reverser is a desirable feature, Mr. Stack said he would certainly favor a thrust reverser and thought all future fighters would be so equipped. Although it is a difficult problem, Mr. Stack foresaw nothing insurmountable concerning the installation of a thrust reverser on the TFX as they are used every day on commercial jets [Ref 172:26-27].

Titanium. The subject then shifted to the use of titanium. Mr. Stack stated that titanium was a normal aircraft material used in many planes. In fact, Republic at the time was manufacturing the aft fuselage and tails of the F-4H. Of a total of 1,931 pounds, 515 pounds were titanium and 90 per cent of the titanium was stress (load)-bearing. (This Navy plane had recently been put into Air Force inventory as the F-4C).

Air Scoops. When asked his opinion as to the more desirable position of air-scoops, Mr. Stack replied the top mounted air-scoops would minimize foreign object damage (FOD) to the power plant when operating from primitive airfields. (Boeing's design offered top-mounted air-scoops versus General Dynamics' underwing air-scoops). Stack pointed out that the top-mounted air-scoops offered greater flexibility in the positioning of ordinance under the fuselage and wings. Republic Aviation in their F-107, a follow-on to the F-100, employed a top-mounted air intake located aft of the cockpit on the single engine fighter.

Mr. Stack could offer no great engineering problems associated with the mounting of air intakes on the top side of the aircraft [Ref 172:34].

Colonel Gayle.

On February 27, 1963, Colonel Gayle appeared before the board. Colonel Charles A. Gayle was the assistant program director of the F-111 program[36]. He was assigned to Wright Patterson Air Force Base in November, 1960, and had been the project officer or program director since that time for the F-111 or TFX program. His three duty assignments prior to that of program director for the F-111 were all with TAC. Colonel Gayle is a rated pilot and has an aeronautical degree. He had never held any job in the procurement field [Ref 172:49].

The Competitors. Colonel Gayle testified that the treating of two contractors as if they were both prime contractors (per instructions given after the third round) had never been done before [Ref 172:67]. In reply to Secretary Zuckert's reference to raw scores, Colonel Gayle said, *It is not the normal practice to add the raw scores because some features of the competitors' designs are entitled to more weight than others* [Ref 172:237].

Costs. After discussing some of the technical features of the plane, the questioning then turned to costs. The contract offered to the winning company was a fixed price incentive contract (ceiling price 120% of target) [Ref172: 207].

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[36]Appendix V contains the navy participation in the TFX program and an organization chart.

The following tables are based on the contractors' proposals at the end of round four and incorporate Air Force adjustments made prior, and subsequent, to the presentations at the secretarial level were made [Ref 172: 208-209].

## TABLE IX

### Boeing's Summary of TFX Cost Estimates (in millions)

| | The Boeing Co. | | | | Air Force estimating standards | |
|---|---|---|---|---|---|---|
| | Contractor's proposal | Air Force adjustments prior to presentation | After presentation | Final | Boeing | General Dynamics |
| R.D.T. & E. (22 aircraft): | | | | | | |
| Program management | $4.4 | | | $4.4 | $6.6 | $7.7 |
| Engineering | 153.9 | | | 153.9 | 175.7 | 177.5 |
| Tooling | 36.0 | | | 36.0 | 67.0 | 71.0 |
| Manufacturing | 146.6 | $5.5 | | 152.1 | 280.1 | 302.7 |
| Profit | 30.7 | .5 | | 31.2 | 47.7 | 50.9 |
| Total airframe | 371.6 | 6.0 | | 377.6 | 577.1 | 616.8 |
| Support items | 95.0 | 108.1 | $(3.9) | 199.2 | 295.8 | 301.3 |
| Total R.D.T. & E. | 466.6 | 114.1 | (3.9) | 576.8 | 872.9 | 918.1 |
| Cost presentation | | | 680.0 | | 873.0 | 918.0 |
| Production: | | | | | | |
| Program management | 2.1 | | | 2.1 | 10.2 | 11.7 |
| Engineering | 83.9 | | | 83.9 | 94.3 | 96.4 |
| Tooling | 33.7 | | | 33.7 | 115.3 | 111.4 |
| Manufacturing | 2,453.4 | | | 2,453.4 | 2,959.6 | 3,031.4 |
| Profit | 232.0 | | | 232.0 | 286.1 | 292.6 |
| Total airframe | 2,810.1 | | | 2,810.1 | 3,465.5 | 3,543.5 |
| Support items | 2,087.6 | (13.8) | (73.2) | 2,000.6 | 2,641.6 | 2,621.6 |
| Total production | 4,897.7 | (13.8) | (73.2) | 4,810.7 | 6,110.1 | 6,165.1 |
| Total program | 5,364.3 | (100.3) | (77.1) | 5,387.5 | 6,983.0 | 7,083.2 |
| Cost presentation | | | 5,465.0 | | 6,983.0 | 7,083.0 |

TABLE X

General Dynamics' Summary of TFX Cost Estimates
(in millions)

| | General Dynamics | | | | Air Force estimating standards | |
|---|---|---|---|---|---|---|
| | Contractors' proposal | Air Force adjustments | Adjusted proposal | Letter contract (ceiling 120 percent) | Boeing | General Dynamics |
| R.D.T. & E. (22 aircraft): | | | | | | |
| Program management | $4.9 | ---------- | $4.9 | | 26.6 | $7.7 |
| Engineering | 136.6 | $9.3 | 145.9 | $439.4 | 175.7 | 177.5 |
| Tooling | 76.3 | (3.9) | 72.4 | | 67.0 | 71.0 |
| Manufacturing | 239.2 | (50.1) | 209.1 | | 280.1 | 309.7 |
| Profit | 42.9 | (4.0) | 33.9 | 47.2 | 47.7 | 50.9 |
| Total airframe | 519.9 | (48.7) | 471.2 | 486.6 | 577.1 | 616.8 |
| Support items | 23.6 | 216.4 | 240.0 | 84.7 | 295.8 | 301.3 |
| Total R.D.T. & E. | 543.5 | 167.7 | 711.2 | 571.3 | 872.9 | 918.1 |
| Cost presentation | ---------- | ---------- | 711.0 | ---------- | 873.0 | 918.0 |
| Production: | | | | | | |
| Program management | 4.4 | ---------- | 4.4 | 131.5 | 10.2 | 11.7 |
| Engineering | 127.2 | (23.4) | 103.8 | ---------- | 91.3 | 96.4 |
| Tooling | 154.6 | (3.2) | 151.4 | ---------- | 115.3 | 111.4 |
| Manufacturing | 2,811.7 | (242.8) | 2,571.0 | ---------- | 2,959.6 | 3,031.4 |
| Profit | 270.1 | (24.2) | 254.9 | ---------- | 280.1 | 292.6 |
| Total airframe | 3,380.0 | (293.6) | 3,086.4 | ---------- | 3,465.5 | 3,543.5 |
| Support items | 1,532.0 | 473.9 | 2,005.0 | ---------- | 2,644.6 | 2,621.6 |
| Total production | 4,912.0 | 180.3 | 5,092.3 | ---------- | 6,110.1 | 6,165.1 |
| Total program | 5,455.5 | 348.0 | 5,803.5 | ---------- | 6,983.0 | 7,083.2 |
| Cost presentation | ---------- | ---------- | 5,503.0 | ---------- | 6,983.0 | 7,083.0 |

[1] Present amount.

SUBCOMMITTEE NOTE.—Parentheses in exhibit 34 appeared in red on original, except for those in "Adjusted proposal" and "Letter contract (ceiling 120 percent)" to indicate reductions from contractors proposal.

According to the cost standard briefings, the Air Force considered five items in arriving at its estimates of what the costs should be. These five items were: (1) the overall reasonableness of the cost proposals; (2) a comparison of the historical experience[37]; (3) a projection of reasonable improvement curves; (4) a determination of manpower levels, labor, overhead, and applications; (5) a consideration of the complexity density

[37] Appendix W contains a comparison of program performance vs contract estimates for Boeing and the winner.

factors. In the historical experience area, both the Air Force past history of procurement and company history were considered [Ref 172:225].

Commonality. When asked by the Subcommittee how the per cent of commonality[38] was determined, Colonel Gayle replied: *We did not go to, nor did we have the time to, sit down and from drawings and other things count parts ourselves. We did not do that. We accepted the information* (supplied by the contractors) *as being reasonably accurate information* [Ref 172:262].

The concept of the TFX aircraft is the savings that are expected to be realized by reason of supplying two services with one airplane. The three areas for potential savings are: one, in the cost of tooling; two, during the research, development, testing, manufacturing and production phase; three, in the area of replacement spares [Ref 172:266].

Table XI shows the comparison of commonality proposed by Boeing and General Dynamics [Ref 172:270].

TABLE XI

Commonality Comparison

| | General Dynamics | Boeing |
|---|---|---|
| AIR FORCE AIRCRAFT | | |
| 1. Total parts | 14,423 | 19,510 |
| 2. Identical parts | 12,086 | 11,245 |
| 2. Percentage of identical parts to total parts | 83.7 | 60.7 |
| 4. Similar parts | 202 | 3,675 |
| 5. Percentage of similar and identical parts to total parts | 85.2 | 80.6 |
| 6. Peculiar parts | 2,135 | 3,590 |
| 7. Percentage of peculiar parts | 14.8 | 19.4 |
| NAVY AIRCRAFT | | |
| 1. Total parts | 15,059 | 18,605 |
| 2. Identical parts | 12,086 | 11,245 |
| 3. Percentage of identical parts to total parts | 80.2 | 60.4 |
| 4. Similar parts | 202 | 3,675 |
| 5. Percentage of similar and identical parts to total parts | 81.6 | 80.1 |
| 6. Peculiar parts | 2,771 | 3,685 |
| 7. Percentage of peculiar parts | 18.4 | 19.9 |

[38] Appendix X is a sketch indicating the common and service-peculiar components on the F-111 aircraft.

Boeing, in reducing its commonality of identical parts to 60.7 per cent and increasing to 19.9 per cent its similar parts ratio, resulted in a removal of 2,534 pounds of weight from its Naval design; a reduction of 252 pounds on its Air Force version would also have resulted [Ref 172:268].

The commonality of parts affects the tooling that would be required to produce the TFX. Table XII compares the major toolings proposed by General Dynamics and Boeing [Ref 172:274].

TABLE XII

Production Tooling

| | General Dynamics | Boeing |
|---|---|---|
| 1. Major assembly tools and jigs | 3,051 | 3,110 |
| 2. Identical major assembly tools and jigs | 2,291 | 2,550 |
| 3. Percentage of identical major assembly tools and jigs to total | 75.2 | 81.9 |
| 4. Common major assembly tools and jigs | 147 | 240 |
| 5. Percentage of common and identical major assembly tools and jigs to total | 80 0 | 89.7 |

Standards. In the civilian secretaries' memorandum (November, 1962) reference was made to savings:

> *It is significant that General Dynamics' integrated program for the two versions of the aircraft showed a reduction of $623 million in comparison with their costs of developing two versions separately. The savings in the Boeing proposal was only $397 million, emphasizing the degree to which Boeing versions are less similar than General Dynamics* [Ref 172:351].

The last area in which Colonel Gayle was questioned dealt with the cost standard proposed by Boeing. Boeing justification for its man-hour estimates being in the neighborhood of 20 to 25 per cent below industry average was based on their experience in building jet bombers.

Figure 4. shows industry average versus Boeing average for bombers and industry average for Century series fighters versus Boeing's proposed cost of building the TFX.

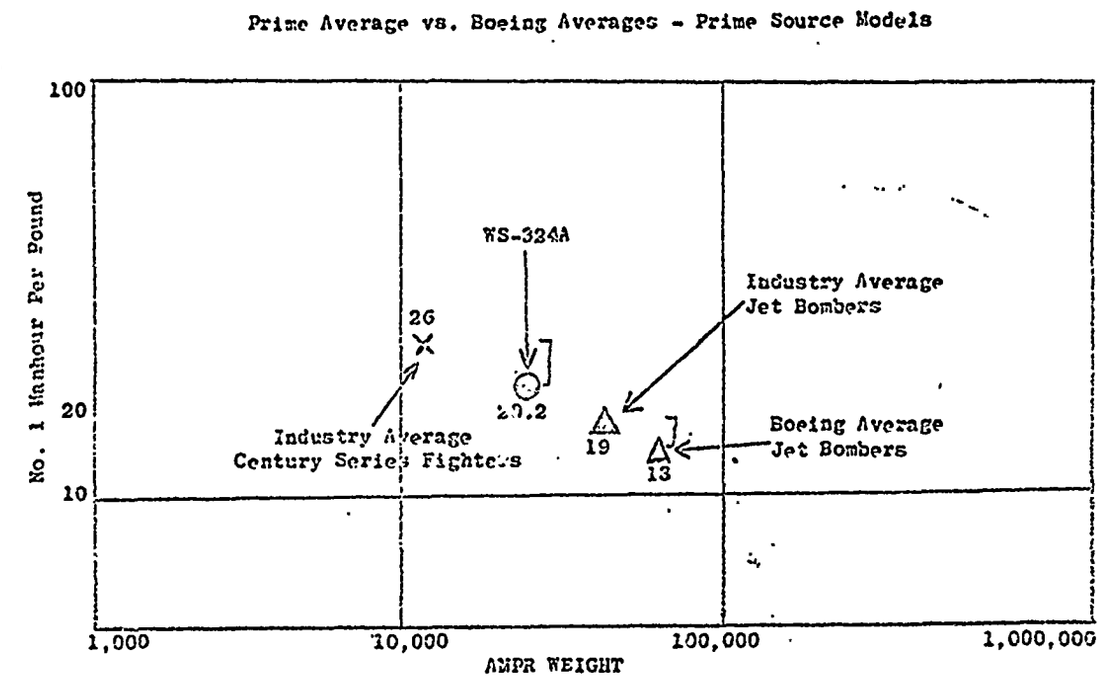


Figure 4. Production Manhours Per Pound vs. AMPR Weight* (*Basic Weight of the Aircraft, an Industry Standard for Aircraft Comparisons.)

George Spangenberg

At the afternoon session of March 12, 1962, Mr. George Spangenberg testified that in order to get one airplane for two services, the original requirements of each service would have to be compromised. Mr. Spangenberg is the Director (since 1957) of the Evaluation Division, Bureau of Naval Weapons. Since becoming associated with the Bureau in 1939, he has been involved with design, composition and selection of new naval aircraft [Ref 172:323].

Secretary of Defense

On March 13, 1963, (seventeen days after the opening of the investigation) Secretary McNamara had read into the record a 32-page statement in which he listed the justification for choosing General Dynamics as the source for the TFX, McNamara's reasons can be fitted into three main topics [Ref 172:374-388].

1. Least divergence from a common design. (Boeing proposed two different airplanes from a structural point of view.) [Ref 172:381]
2. A more realistic approach to costs, production and scheduling.
3. Least technical risk in the design.

Progress Report. To get an idea of how the TFX program was progressing, as of March 13, the 1963 fiscal year RDT&E funds for the TFX were obligated as follows:

| | |
|---|---|
| Air Force | $ 42.5 million |
| Navy (fire control) | $ 8.5 million |

[Ref 165:29]

When Secretary McNamara appeared before the committee on March 21, he stated his position thus, *It is my responsibility to make a decision such as this. I made it and I assume full responsibility for it.* [Ref 172:429] He then listed three objectives with respect to the TFX Program [Ref 172:429]:

1. To introduce into the Air Force and Navy inventories an advanced fighter aircraft with substantial performance advantages.
2. To maximize the dependability of the new aircraft.
3. To minimize its cost.

When asked if he had found anything which would induce him to change his judgment, McNamara replied that the contrary was true. *Re-examination of the entire decision...has simply further confirmed my view that the selection of*

*General Dynamics was the choice of the contractor who would provide both a militarily acceptable aircraft meeting the military requirements and do so with the highest dependability and the lowest possible cost* [Ref 172: 434].

Questioning the Decision. The questioning of McNamara then turned to the decision of the award of the contract. The dialogue went as follows:

SENATOR ERVIN: *I would like to ask you whether or not there was any connection between your decision, your selection of General Dynamics, and the fact that the Vice President of the United States happens to be a resident of the State in which that company has one of its principal offices, if not its principal office.*

SECRETARY McNAMARA: *Senator Ervin, absolutely none. I would like to believe that there are three grounds on the basis of which my decision might be questioned: first, that I yielded to political influence in such a way as to make the decision contrary to the national interest; or secondly, that I yielded to self-interest in some way, in such a way as to decide contrary to the national interest; or third, that through ignorance, stupidity or poor judgment I made the wrong decision.*

*Now, it seems to me that the committee would wish to question me on each one of those three possibilities. To the best of my knowledge, no one has submitted any evidence whatsoever indicating that I was influenced in the slightest degree by political matters. Specifically, the Vice President never discussed the matter with me, nor did Governor Connally of Texas, nor to the best of my knowledge did any other political figure in the country discuss the matter with me. They all learned long since that I pay no attention whatsoever to any such pressures.*

*Furthermore, I think that my own inventory of property submitted to you today will show that under no circumstances could self-interest have been a factor influencing the decision*[39] *and therefore I think we*

[39]At the beginning of his testimony, McNamara voluntarily submitted to the committee a complete list of all property owned by himself and his wife.

*are left with ignorance, stupidity or poor judgment. Those are the issues and in my opinion the only issues involved.*

SENATOR ERVIN: *You are convinced, or rather you can assure us, as far as any human being can assure another about his decision, that your decision in this particular instance was based solely upon your conclusion that the best interests of our country required the action you took.*

SECRETARY McNAMARA: *Yes sir, I am* [Ref 172:443].

The Source Selection Board

The members of the Source Selection Board who conducted the fourth evaluation were the next witnesses before the committee. The chairman, Major General Ruegg, stated that the TFX RDT&E program is so extensive that negotiations for the first production contract will commence several years in the future (circa 1965). The RDT&E program cost amounts to somewhere in the neighborhood of only 15 per cent of the total weapons system program cost, assuming that the production quantities remain at their current level [Ref 172:478].

Titanium. Admiral Ashworth, when questioned about the proposed use of titanium, quoted paragraph 4.3.1 of Addendum No. 1 (dated July 6, 1962) to the work statement:

> *Materials and components: The design and operational objectives stated in this work statement support the conclusion that the WS-324A* (the TFX) *air vehicle and subsystems can be successfully produced from readily available and economical-to-use raw materials and vendors' supplied component items. However, special consideration shall be given to the use of titanium with a view toward reducing the weight of the aircraft. This statement cannot be construed as an all-inclusive blanket authority to use titanium regardless of cost* [Ref 172:515-516].

Dr. Brown

*The intent of the Secretary of Defense to reduce weapon*

*systems cost by maximizing use of common or similar equipment, structures, and so forth, must be considered in all design and engineering decisions.* [Ref 172:591]. This appears in the work statement and was discussed when Dr. Brown appeared before the committee on March 28, 1963. Dr. Brown believed an aircraft using 100 per cent identical parts better met the objective of commonality when compared to an aircraft using 100 per cent similar parts [Ref 172: 591]. The Source Selection Board members and Dr. Brown agreed that there was no clear definition of *commonality*.

General McKee

General McKee, Chairman of the Air Force Council, viewed *that the operational factors should be the overriding consideration to all others in choosing between the two proposed systems because these aircraft are being procured for use in event of war* [Ref 172:958].

Mr. Jordan

Mr. Jordan, Chief Engineer of Pratt & Whitney Aircraft, testified that to develop and build thrust reversers for the TF-30 engines, usable on the ground and in the air, *is a pretty complicated device* costing approximately $447 million [Ref 172:813, 815]. These thrust reversers would add approximately 1,000 pounds to each aircraft [Ref 172:813]. To the best of his knowledge, Mr. Jordan said thrust reversers had never been used on operational fighter aircraft and had never been used on supersonic aircraft [Ref 172:819].

Subcommittee Testimony

In the area of cost, testimony on May 1 disclosed that Boeing estimated 20.2 man-hours per pound of aircraft; General Dynamics, 21.0; Air Force standard was 37.0 [Ref 172:867]. In regard to the entire area of cost,

McNamara stated that,

> *at the secretarial level the cost estimates prepared by the Air Force were considered so unreliable as an indication of the ultimate differential in research, development and production costs between the progress of the two contractors that they could not be used as a foundation for the source selection* [Ref 172:881].

When Mr. Newman, Director of Defense Accounting and Auditing Division, General Accounting Office, asked to examine the cost data, Secretary McNamara stated he had the figures in his head, indicating that he did not have them on paper [Ref 172:883].

Boeing

On May 2, and May 3, 1963, members[40] of the Boeing Company appeared before the subcommittee. In reference to the comment that Boeing proposed two different airplanes Mr. Allen stated, *a careful technical examination of their proposed design will in fact show there is no justification for these comments* [Ref 172:917].

Manufacturing Approach. The Boeing team then proceeded to cover the various areas for which Boeing was faulted. To keep design, tooling, and production costs at a minimum for the TFX, Boeing was going to use the procedures of a single production line as employed in the building of their commercial jets--the *707*, *727*, and *720*. Boeing knew of no other company producing different planes on the same tooling line [Ref 172:926].

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[40]William M. Allen, President and Chief Executive Officer; Edward C. Wells, Vice President and General Manager of the Military Aircraft Systems Division (MASD); Charles Keeton, Jr., Finance Manager of the TFX Organization; Ray Anderson, Management, Holden Withinton, Director of Engineering for MASD; William Lancaster, Pricing and Reporting Manager for the TFX.

Weight. Boeing was faulted for electing to reduce the weight of its Navy plane by substituting similarly shaped, but lighter, gauge parts. Boeing had claimed that no cost penalty would be incurred, since the parts would be made with the same basic tooling, a technique developed in building KC-135 tankers and *707* passenger planes [Ref 40: 90]. With no concession for this argument, Boeing's commonality factor was judged to be only 60 per cent and therefore inferior to the General Dynamics proposal.

Commonality. Three graphs were then introduced which Boeing considered to properly place in perspective the entire commonality issue. The first two graphs (Figures 5 and 6) reflect the percentage of uncommon and similar parts to the entire parts of 1700-odd airplanes to be built. Proposal 1 refers to round one or first evaluation; Proposal 2 refers to round two or second evaluation, etc. Figure 7 depicts the percentage of similar and uncommon spare parts to the total spare parts that would have to be stocked [Ref 172:972-973, 982].

Boeing claimed that although the guidance received by the contractors throughout the four rounds of the TFX competition was quite clear in stating that commonness was to be considered as an important factor in reducing total program costs, it was made equally clear that the true objective was performance compatible with the separate missions of the Air Force and Navy at minimum total program cost [Ref 172:927].

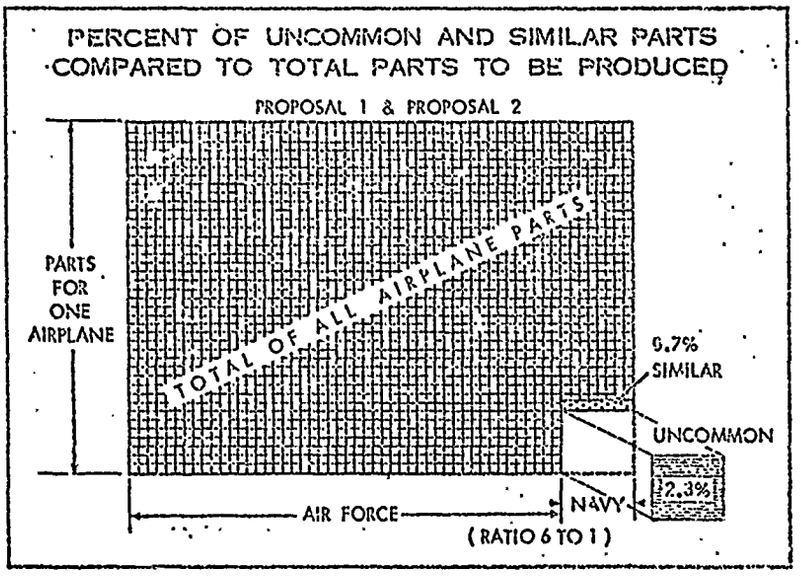



Figure 5. Boeing Commonality for First and Second Proposals.

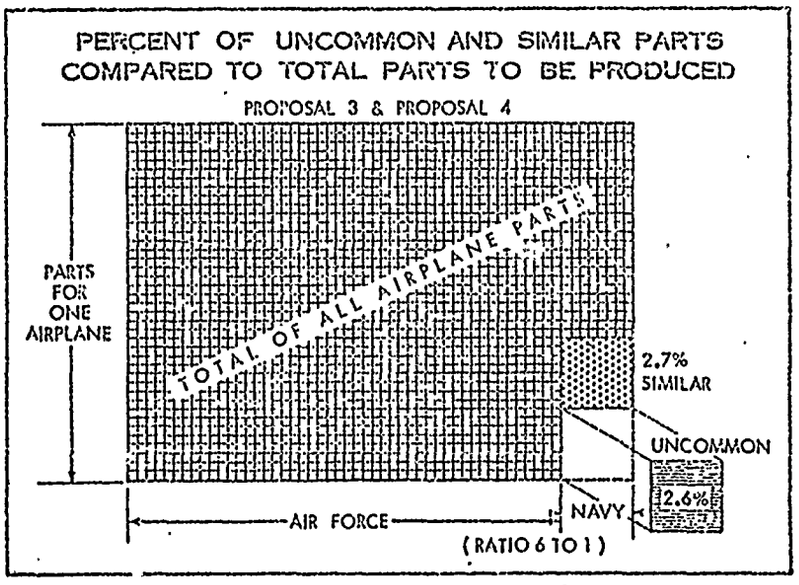



Figure 6. Boeing Commonality for Third and Fourth Proposals.

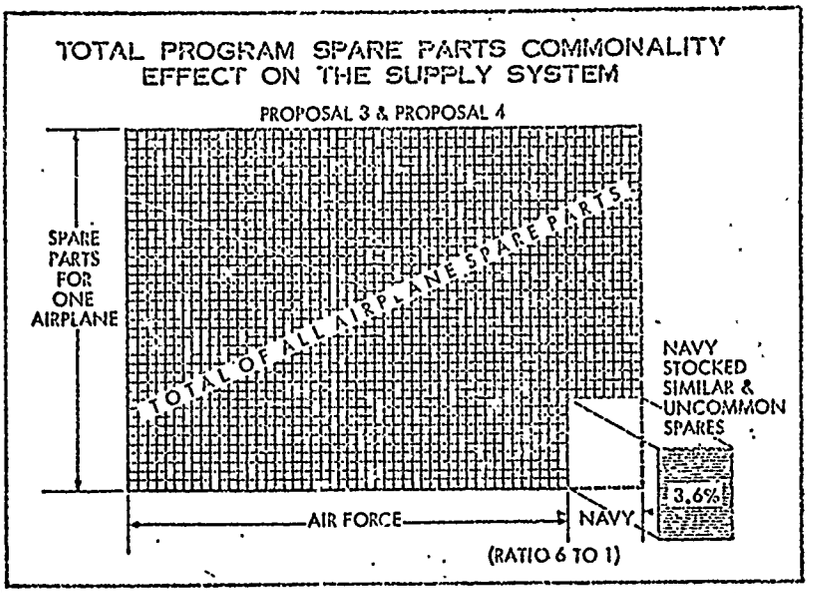



Figure 7. Boeing Commonality for Spare Parts

Titanium. Boeing was criticized for being optimistic for suggesting the use of titanium for structural members. DoD was of the opinion that titanium usage may introduce problems in manufacturing, structural integrity and fatigue. At this same time, the A-11, later known as the Mach 3, supersonic SR-71 aircraft was in the early stages of building. The SR-71 uses much titanium as this metal is resistant to the high temperatures encountered in supersonic flight.

Thrust Reversers. Another item for which Boeing was faulted was the use of thrust reversers; this allegedly required more research and development effort to perfect. The SR-71 also uses thrust reversers as a braking device. Boeing had spent over $17 million of its own coporate funds in developing successful thrust reversers for their own airplanes [Ref 172:916].

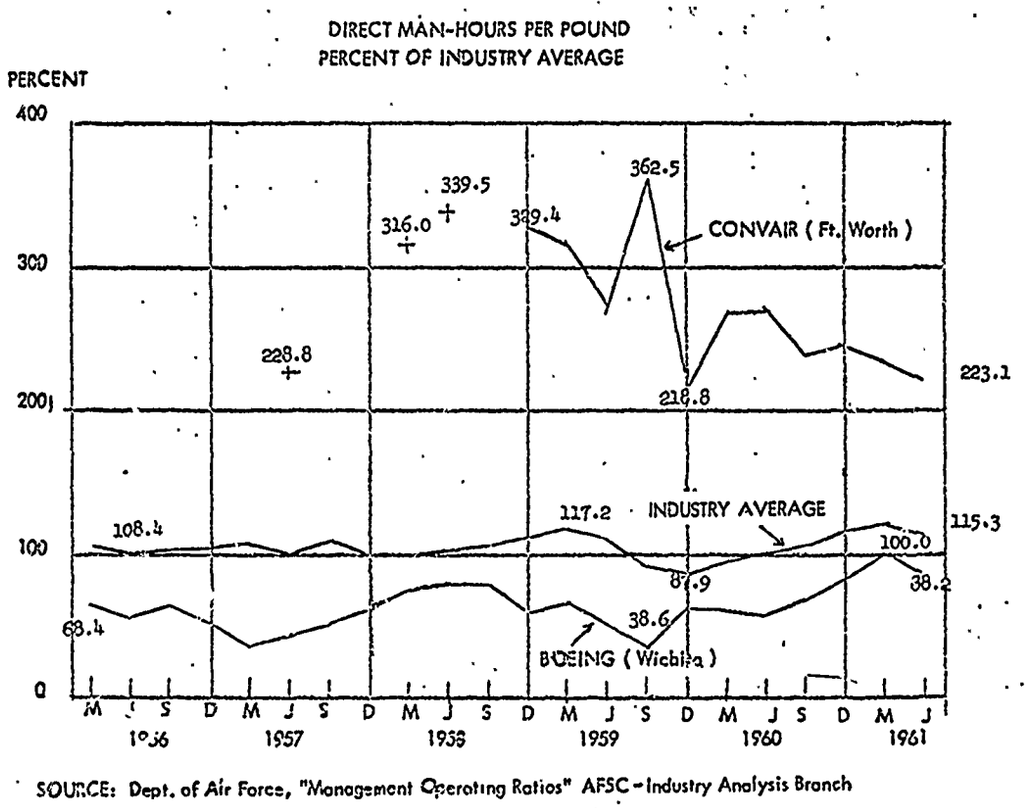
Cost. Probably the major item for which Boeing was penalized was that of cost. Boeing pointed to their past

record (covering more than 15 years) as an attestment to their ability to accurately cost out a weapon system (See again Appendix W). The Boeing Company expended approximately 71,000 man-hours, or an equivalent 458 man-months, in the preparation of its cost estimate. In addition, 33 airframe suppliers and 229 equipment suppliers throughout the industry expended proportionate amounts of effort in the preparation of their cost estimates for those items Boeing had planned to procure [Ref 172:1011]. To show the effort Boeing expended in arriving at realistic costs, they testified the weapon system was divided into 2,400 work packages. Each group was subdivided into five packages--design, develop, test, tool, and manufacture [Ref 172:994].

Meanwhile, before the House Subcommittee on DoD appropriations, Dr. Brown testified that the total estimated cost for the TFX development is on the order of $1 billion--$600 million for the airplane, $200 million for the engine, and $200 million for the fire control and radar system [Ref 65:71].

Mr. Nunnally

After Boeing's presentation, Mr. Thomas E. Nunnally, investigator for the Subcommittee, was called to give testimony concerning industry costs. He testified on May 8, 1963. Mr. Nunnally introduced a graph showing direct man-hours per pound of aircraft as a percent of the aerospace industry average. The chart depicts industry average, the Fort Worth plant of General Dynamics, and the Wichita plant of Boeing Company. Only three isolated values (228.8, 316.0, 339.5) for Convair (Fort Worth) were available before December, 1968, as afire had destroyed some of the source records at Wright-Patterson Air Force Base. This chart is included herein as Figure 8.




SOURCE: Dept. of Air Force, "Management Operating Ratios" AFSC - Industry Analysis Branch

Figure 8. Direct Man-Hours per Pound: Percent of Industry Average

The difference between the proposals of the General Dynamics and the Boeing Company with respect to labor, overhead, materials, other costs, support items, and profit is shown in the following table.

TABLE XIII

Comparison of TFX Contractor Costs

*Comparison of TFX contractor costs (as adjusted by the Air Force)*

[In thousands]

| | Labor | Overhead | Material and other costs | Support items | Profit * | Total |
|---|---|---|---|---|---|---|
| General Dynamics Corp., Fort Worth | $550,180 | $311,197 | $1,666,458 | $2,245,900 | $203,600 | $5,803,544 |
| The Boeing Co., Wichita | 324,107 | 459,748 | 2,140,494 | 2,199,800 | 263,200 | 6,387,439 |
| Difference | 261,992 | 351,449 | (274,036) | 46,100 | 30,000 | 416,105 |
| Attributable to: | | | | | | |
| High rate (138,000 times $.7276) | 100,413 | 122,300 | | | | |
| More hours (45,005 times $3.52) | 161,579 | 229,149 | | | | |
| Total | 261,992 | 351,449 | | | | |

*Contractors' proposals*

| | |
|---|---|
| General Dynamics | $5,455.5 |
| Boeing | 5,364.3 |
| Difference | 91.2 |

*Profit is based on 9% of costs.

Note: The average hourly direct labor rate and average overhead cost per direct labor hour are shown below for both the Wichita and Fort Worth areas.

| | (Wichita) Boeing | (Fort Worth) General Dynamics |
|---|---|---|
| Hour Labor Rate | $3.52 | $4.25 [Ref 172:1047] |
| Overhead Rate Per Hour | 4.99 | 5.88 [Ref 172:1048] |

About $100 million of the Boeing material cost is attributed to their use of titanium [Ref 172:1048].

General Dynamics-Grumman

On May 8 and 9, General Dynamics and Grumman personnel[41] appeared before the subcommittee. In rebuttal to the

[41] General Dynamics: Roger Lewis, president; Frank Davis Fort Worth Division; William Alvis, Fort Worth. Grumman: Clinton Towl, president; Roger Harris, vice president; Corwin Meyer, director of aircraft development.

Boeing statements, their arguments went as follows:

> EXPERIENCE: *General Dynamics has more experience than any other contractor in the design and manufacture of supersonic aircraft. The F-102, F-106, and B-58 programs have given General Dynamics over 50,000 hours of supersonic flying. Boeing has yet to build its first supersonic manned aircraft.*
>
> *Grumman has had carrier-based supersonic fighter experience with its F-11 F. Grumman airplanes have made more than one-half the carrier landings and takeoffs in the history of the U.S. Navy. Grumman has built and flown a variable sweep jet fighter, the XF10F.*
>
> *The General Dynamics-Grumman team has under its belt 4,330 hours of wind tunnel testing and full scale design and construction experience on the XF10F and 4,758 hours of wind tunnel testing on the TFX when the proposal was submitted.*
>
> COST: *There are many features of the General Dynamics-Grumman TFX program which will cost less than the program proposed by Boeing. Some of the most positive cost saving features are as follows: fewer total number of parts, fewer uncommon parts, less expensive materials, simpler engine installation, conventional speed brakes, less structural testing, fewer drawings, fewer instructions, fewer 'similar' parts which look alike but aren't, extensive and current manned supersonic aircraft experience, extensive and current carrier based experience, specific variable-sweep wing experience, better rating in the fourth evaluation in the area of production, management, and cost*[42] [Ref 172: 1073-4].

Mr. Blackburn

On May 22, Mr. Albert Blackburn, who from November, 1959, until March 25, 1963, worked in the office of the Secretary of Defense, in the office of the Director of Defense Research and Engineering, appeared before the

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[42]General Dynamics had a raw score of 150.2; Boeing, 135.3. For the evaluation group's raw scores in the fourth round, see Appendix Y.

Subcommittee. He testified that it was he, at Dr. Brown's request, who prepared a rough estimate of the savings that might result from the bi-service airplane. These savings were generally distributed evenly between development, procurement, and operations--with the clearest savings in the development area--and the most difficult to demonstrate in the operational area. He reported that the joint program should result in a savings of approximately $1 billion over the cost of permitting the Navy to select its own contractor, design and build its own airplane (assuming that it would employ the same engine) [Ref 172: 1189].

Sath Kantor

On May 24, Sath Kantor appeared before the Subcommittee. Kantor was a seventeen-year veteran newspaperman employed by the Fort Worth Press, a Scripps-Howard newspaper. He was their Washington, D. C. correspondent and wrote an article entitled *TFX Contract is Reported in Bag for General Dynamics--Fort Worth*, which appeared on October 24, 1962. The article begins,

> *General Dynamics of Fort Worth will get the multi-million dollar Defense Department contract to build the supersonic TFX Air Force and Navy fighter plane, the Press learned today from top government sources* [Ref 172:1252].

Mr. Kantor, under oath, then described 'top government sources' as two individuals at the decision-making level. Kantor's testimony was that the sources were not in the Defense Department, but were in a position to have information about the decision rather than influence the decision; and that the information was in the nature of fact rather than speculation. Further testimony revealed that Kantor had no reason whatever to doubt the sources and that the decision had been made to award the contract to General Dynamics. Kantor continually refused to reveal the identity of the sources.

Secretary of the Navy

On June 28, Secretary of the Navy, Fred Korth, first appeared before the Subcommittee. With so many boards and individuals recommending Boeing, he was asked why he approved the selection of General Dynamics. Korth stated that his approval was based on several dominant factors:

**The presentation by the Navy Evaluation group.*

** Statement in the Bureau of Weapons summary dated October 15, 1962. There is no significant preference between the Navy versions of the two designs as submitted.*

**Grumman was teamed with General Dynamics.*

**Commonality with regard to General Dynamics' design.*

**Complexity of the Boeing design* [Ref 172:1431].

Requirements. To enforce the Bureau of Weapons summary, Korth introduced the following comparison of the two designs versus the Navy Work Statement [Ref 172:1425].

*Comparison of Navy work statement requirements to Boeing and General Dynamics/Grumman designs*

| Items of comparison | Boeing | General Dynamics/ Grumman | Comment |
|---|---|---|---|
| Takeoff weight (Fleet air defense mission). | 12 percent greater than desired Navy weight. | 15 percent greater than desired Navy weight. | Desired weight was not to be exceeded without Navy concurrence. The Navy concurred. |
| Height | Satisfactory with folding tail. | Satisfactory with folding tail. More than ¾ foot lower than Boeing. | |
| Length | With folded nose, 3.1 feet longer than General Dynamics. | With folded nose, 3.1 feet shorter than Boeing. | The longer plane is more difficult to handle on a carrier. |
| Spotting factor and handling | ---------- | Betters Boeing by 5 aircraft. Superior in handling. | Spotting factor is the maximum number of aircraft than can be operated from a carrier. |
| Wind requirements for takeoff | Satisfactory. Bettered requirements by 10 knots. | Satisfactory. Betters requirements by 10 knots. | |
| Wind requirements for landing. | Satisfactory. Bettered requirements by 11 knots. | Satisfactory. Betters requirements by 6 knots. | |
| Hours on station: Fleet air defense mission | Satisfactory. Bettered requirement by 6 percent. | Satisfactory. Equals requirement. | |
| Beachhead support mission. | Could achieve only 60 percent of initial requirement with maximum internal fuel. | Betters initial requirement by 50 percent. | |
| Maximum speed: At sea level | Equaled requirement. | Betters requirement by 20 percent. | |
| At altitude | ----do---------- | Betters requirement by 25 percent. | |

Figure 9. Navy Work Statement vs Competitors' Designs

Production. Secretary of the Navy Korth stated he was so convinced of the General Dynamics-Grumman F-111 that he wanted to more than double the Navy's original buy--from 231 to 596 [Ref 172:1834]. On July 1st Secretary Korth testified he was *interested in getting the cheapest airplane for the Navy and the fastest airplane for the Navy,* yet he testified that he did not know what the arrangements for production were. That is, he did not know what subsystems of the two versions were going to be built at Fort Worth or what subsystems were going to be built at Grumman [Ref 172:1566].

Weight. One of the Subcommittee members inquired as to the progress of the TFX program, particularly in regard to weight. Testimony by the Navy Department's Dr. Wakelin (accompanying Mr. Korth) confirmed that the TFX had grown in weight by 3,911 pounds [Ref 172:1815].

Request For Appropriations. Meanwhile, before the Appropriations Subcommittee, the DoD was asking for $322 million for the TFX weapons system for fiscal 1964; $232.7 million was for the Air Force and $89.3 million for the Navy [Ref 171:1639].

## Secretary of the Air Force

Mr. Zuckert, Secretary of the Air Force, first appeared before the Subcommittee on July 25, 1963. In his prepared opening statement, he commented on the judgment he exercised in choosing General Dynamics:

> *I brought to bear on the choice between General Dynamics and Boeing no personal, political, or other extraneous considerations, but rather the following:*
> *First, many years of experience, in Government and out, with the analysis and assessment of R&D proposals.*
> *Second, close association with the TFX program that dates back to my return to the Pentagon in January of 1961.*

> *Third, active personal participation in all phases of the TFX source selection process, from beginning to end.*
> *Fourth, careful study of the final TFX evaluations, both as presented to the military staffs, and in their original uncondensed form.*
> *Fifth, extensive consultation with others who were familiar with the TFX evaluations, particularly during the period immediately prior to my final choice* [Ref 172:1899].

Raw and Weighted Scores. When questioned about the November 21st memorandum[43] in which he referred to raw scores, Zuckert replied that it did not matter which was used; raw scores or weighted scores, the results were the same. In the fourth evaluation, out of a possible total weighted score of 1,000 points, General Dynamics' score was 662.4 and Boeing's score was 654.2 [Ref 172:1912].[44] Zuckert concluded that *both contractors generally met the operational requirements* and that *both were weak in some areas*. Overall, he judged the Boeing plane the *more efficient plane at lower speeds*, while General Dynamics' was the *better supersonic plane* [Ref 172:1918]. In rebuttal to the argument that the extended competitive runoff permitted the General Dynamics proposal to 'catch up' to the Boeing proposal, Zuckert introduced the weighted scores in the technical area for the four evaluations.

TABLE XIV

Technical Evaluation Scores

| | First Round | Second Round | Final Round |
|---|---|---|---|
| General Dynamics | 172.2 | 199.1 | 209.3 |
| Boeing | 165.4 | 184.5 | 192.4 |

[43] See Appendix Q.

[44] See Appendix Y.

Zuckert stated, *In short, rather than 'catching up', General Dynamics gained an advantage in the technical area at the outset and maintained this advantage during the entire competition* [Ref 172:1975].

Experience. The questioning then turned to the past performance records of the two companies[45]. Zuckert contended that the figures were *interesting, but not significant* because the short production runs and larger steps in the state-of-the-art of General Dynamics' aircraft would tend to result in higher costs versus the relatively slow evolution and long production runs of the Boeing aircraft.

Cost. Zuckert testified that *cost realism was going to be a significant factor* in the appraisal of the proposals. He stated that both contractors submitted cost figures that were unrealistic and were not used in determining the winner of the competition. Zuckert attempted several times to make absolutely clear to the Subcommittee this point: the cost data submitted by the contractors was only a proposal, an estimate, and was not a bid, and therefore, neither contractor could be legally bound to produce the TFX program at the stated dollar value. Also, the specifications for the RDT&E aircraft were not finalized but were under negotiation. Further, the production contract for the TFX was scheduled to be negotiated in 1965, near the end of the development phase.

Two examples of Boeing's serious lack of cost realism were cited by Zuckert. The first dealt with the cost proposals of the two companies; Boeing's cost proposal from the first to the fourth evaluation increased about

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[45]See Appendix W.

50 per cent versus a 15 per cent increase in the General Dynamics' proposal. The second example was in the manufacturing hours; Boeing's manufacturing man-hours were less per pound of airframe than for any modern fighter[46] and even the P-38 and the P-47 of World War II fame [Ref 172:2218]. Zuckert Then introduced the following Cost Analysis (learning curve) as graphic illustration of the competing proposals' relation to the Air Force standard (note: Boeing's relation).

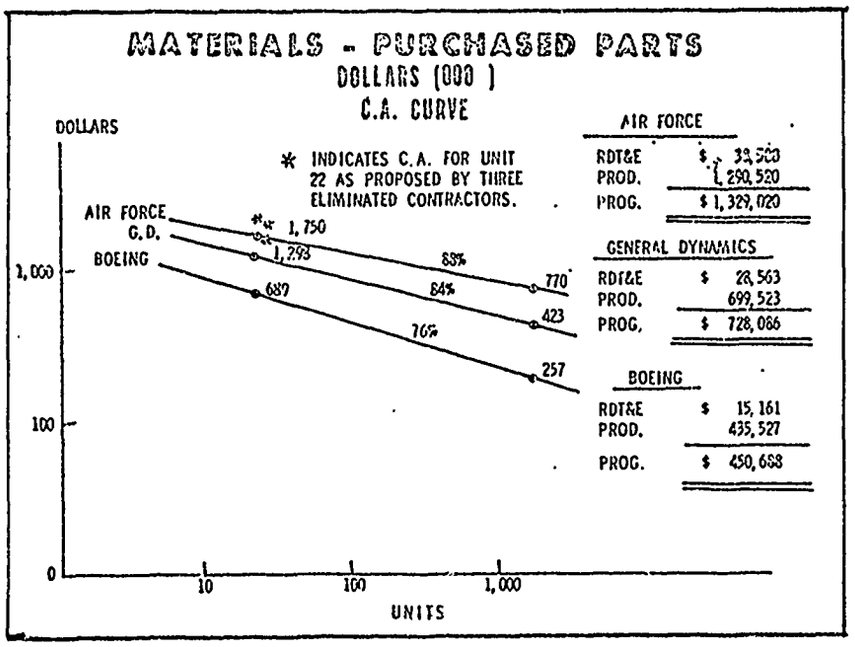


Figure 10. Cost Analysis Curve

Thrust Reversers. Another example cited by Zuckert concerning Boeing's lack of cost realism was the cost of thrust reversers per airplane at $8,300. This is

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[46] 61.3 per cent below the man-hours per pound for the F-4H; 44 per cent below the F-84; 61.3 per cent below the F-84F; 61.7 per cent below the F-86; 28.8 per cent below the F-101; 25.8 per cent below the F-104; 65.8 per cent below the F-105 [Ref 172:2224].

approximately 91 per cent lower than the Pratt & Whitney price[47]. It is 76 per cent lower than Rohr's price and 76 per cent lower than the General Electric price[48] [Ref 172: 2384].

Titanium. The Subcommittee questioned Zuckert concerning the development risks he associated with Boeing's use of titanium and over-wing air intakes. Zuckert replied that only Boeing of all the companies involved proposed a high use of titanium and then only in the third and fourth evaluations. Zuckert's testimony implied the following unanswered question: If there is little development risk associated with over-wing air intakes, why was Boeing the only company proposing high air intakes? Not even North American Aviation, the builder of the F-107, proposed over-wing air intakes.

Prototype Production. The Subcommittee suggested that Boeing and General Dynamics build prototypes and then conduct competitive flight testing, the results of which would determine which company should get the contract. Zuckert replied there had already been four evaluations and the disadvantages of prototype development far outweigh the advantages in this procurement[49].

## Deputy Secretary of Defense

Roswell Gilpatric followed Zuckert in testifying. He appeared before the Subcommittee not to be questioned about the technical aspects of the TFX but rather about possible conflicts of interest.

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[47]$8,300 is 25 to 50% the cost of thrust reversers on Boeing's 727 subsonic, commercial jet [Ref 172:2384].

[48]Pratt & Whitney estimated 44 months time to develop an effective thrust reverser.

[49]A further discussion of prototype development can be found in *The Role of Prototype Development* by Klein, *et al*, RAND memo RM-3467-PR, February 1963.

At the outset of his testimony, Mr. Gilpatric made the following voluntary statement concerning charges being brought against himself by the press:

> *When I took this office I stated that I would have no financial interest or any other interest in the firm*[50] *during my period in public office and after I left the Air Force in 1953, I made it a matter of my personal policy never to represent any client in any dealings with the Defense Department* [Ref 172:396].

Gilpatric worked for Cravath, Swaine & Moore since finishing law school in 1931, except for periods of time he was in Government service. When Mr. Gilpatric entered Government service in 1951[51] and again in 1961, he withdrew from his firm and had no connection with it during the period of his government service [Ref 172:420]. However, Gilpatric served as legal advisor to General Dynamics Corporation during 1959 and 1960, in connection with its acquisition of the business of Material Service Corporation [Ref 172:420].

When Gilpatric became Deputy Secretary of Defense in 1961, he turned over his various clients to the other partners in the law firm. Mr. Moore took over the General Dynamics account. Prior to the awarding of the TFX contract, the firm of Cravath, Swaine & Moore were one of several law firms retained by General Dynamics. Shortly after the winner of the TFX competition was announced, Mr. Moore was named a director of General Dynamics and his law firm was retained as the legal counsel for General Dynamics.

The Subcommittee introduced a letter from the Aetna Insurance Company stating the insurance policies on

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[50]Cravath, Swaine & Moore are partners in the New York City law firm by the same name.

[51]Gilpatric served as Assistant Air Force Secretary (Material) and Under Secretary in '51-'53 [Ref 172:419].

Mr. Gilpatric and his secretary, Anne Halfield, would continue in force during their 'leaves of absence to serve in the Defense Department [Ref 172:2683]. Gilpatric said the letter was in error and introduced a memorandum from the senior partner in the law firm corroborating this. This memorandum stated that Gilpatric *has withdrawn from the firm and his interest in the firm shall be liquidated as of January 20, 1961* [Ref 172:2679].

The Justice Department investigated Mr. Gilpatric's background to ascertain if conflict of interest did exist. In a letter of October 21, 1963, the Justice Department concluded that Mr. Gilpatric's work on the TFX contract did not constitute a conflict of interest [Ref 172:2597].

When Gilpatric left Government service, he returned to the law firm of Cravath, Swaine & Moore.

Secretary of the Navy

Further inquiry was made into Korth's activities before he became Secretary of the Navy. He was president of the Continental National Bank of Fort Worth, and still owned stock in the bank. The bank loaned money to General Dynamics with a loan limit of $600,000 [Ref 172: 1883]. The loan was part of $50 million borrowed by General Dynamics after its losses on commercial jets. Korth did testify that Mr. Pace and Mr. Davis, both of General Dynamics, were longtime friends of his [Ref 172: 1859].

Further testimony revealed that Korth used the Navy yacht, *Sequoia*, to entertain a bank customer; it was stated he used his official stationery for bank business and passed on to procurement officials letters from the bank expressing interest in contract proposals [Ref 154: 21839]. On November 1, 1963, Korth resigned as Secretary of the Navy and was replaced by Paul H. Nitze. There was

no specific censure of Mr. Korth.

Suspension of Hearings

Three days after the Subcommittee recessed, subject to call on November 20, 1963, President Kennedy was assassinated. Senator McClellan then suspended the hearings indefinitely.

Financial Statistics

Thus, 1963 ended with the financial statistics of the three participants in the competition as shown in Table XV.

TABLE XV

Financial Statement (abbreviated) of TFX Competitors-1963

| Rank | Company | Sales* | Earnings* | Backlog* |
|---|---|---|---|---|
| 3 | Boeing | $1,771.3 | $21.6 | $1,815.0 |
| 4 | General Dynamics | 1,415.0 | 49.7 | 1,159.0 |
| 10 | Grumman | 468.1 | 7.6 | 428.0 |

* Figures in million dollars

[Ref 62:22 & Ref 108:29]

# IX

# TEACHER'S AID

## General

The purpose of this chapter is to discuss what the writers feel are the salient features of the TFX case. This presentation is made to assist the teacher in his use of the case. Implicit in this discussion is the assumption that the instructor has accepted the philosophy of the case method offered in Chapter III of this paper.

## Comments on the Case

The TFX study is a difficult one and the teacher should not be disheartened if the class finds it hard to handle. It is a presentation of an actual situation in which much of the data is incomplete or obscured by irrelevancies. The case is so complex that extra care and attention on the part of the instructor are required. This case could be the nucleus of one term's work. Succinctly, this case is a study of the interrelatedness of the political, socio-economic and technical subsystems involved in a major weapons system acquisition. However, if the student had to take from the case only one appreciation, that would have to be for the importance and role of strategy.

## Use of the Model

The systematic model presented in Chapter III has application in analyzing the TFX case. The following resumè of the model could serve as a guide to classroom discussion. Undoubtedly, the students will bring out more features than presented here, but this should serve as a stimulus to the discussion.

1. Define the problem. The TFX case is an excellent example of what was alluded to in preceding chapters; i.e. there may be no central problem, *per se*. However, there is a multitude of issues throughout the case which had to be addressed by the participants. Specifically, these revolved about the strategies of Mr. McNamara, General Dynamics and Boeing. Student discussion should be guided toward analyzing these strategies, their elements and their effects.(e.g. what were the ramifications of Boeing's decision to 'go it alone'?). The economic contributions to the development of strategies should also be drawn out, e.g. the financial positions of the competitors and the aerospace industry in general and the status of Fort Worth and Wichita as employment areas.

2. Gather information. The case is replete with information, some explicitly stated and some clouded. The students should be guided to seek out the relevancies and their implications, e.g. comparison of competitors' scores after the four rounds. There are fiscal and subjective data for the class to organize and from which to extrapolate. Again, these data should be examined in the light of their contribution to the competitive strategies. The bibliography to this paper contains references dealing with the TFX which can be suggested as outside reading or research.

3. Develop alternatives. In this case it would be more precise to say 'analyze the alternatives'. This is where the students' insight and ingenuity are brought to bear. The results of steps one and two are the foundation of this effort. There should be diverse opinions and discussions of the various alternatives open to the three participants (DoD, General Dynamics and Boeing). The students should be encouraged to hypothesize

about the reasons underlying the strategies chosen (the concluding section of this chapter will cover some of these factors).

Steps 4, 5, and 6 of the model can be performed in concert. They are:

4. Select best alternative.
5. Implement the decision.
6. Evaluate the decision.

Essentially what is involved here is the *post facto* analysis of the decision to award the contract to General Dynamics. Student discussion can address the results of the four rounds of competition, the effects of these rounds on the competitors, the DoD philosophy of contractor selection and the criteria (and validity thereof) for award of the contract as discussed by the civilian secretaries.

In order to preserve the 'systems' aspect of the case, and to discuss some factors in more detail, the relationships of the participants' actions to the internal, competitive and environmental subsystems will now be discussed.

The Systems View

For the sake of brevity, the following comments relating to the three main subsystems are presented in an abbreviated manner.

Internal subsystem. General Dynamics, Fort Worth, and Boeing, Wichita, faced work phase-outs; however, the threat was more serious to General Dynamics. Boeing's management was stable, the company had a good financial base and a sizeable backlog of military and commercial orders. On the other hand, General Dynamics had recently changed top management personnel and structure. Due to the significant losses sustained in their commercial jet

enterprise, General Dynamics faced a large debt and the possibility of having to close down the Fort Worth plant altogether. This brings up a point which is not discussed in the literature but one which the writers think is valid; i.e. what is the Defense Department's responsibility in regard to keeping a major defense contractor in business? Does this affect the national security?

In their proposal, Boeing sought to advance the state-of-the-art and aimed their design at the primary users--Tactical Air Command. Even after the third round, when they were advised that the major scoring areas were cost realism and commonality, Boeing persisted in pleasing the Generals rather than the ultimate decision-maker. Conversely, General Dynamics strived from the outset to give the Secretary of Defense what he wanted; they teamed with Grumman and stressed commonality. The General Dynamics' design included conventional materials and methods, whereas Boeing stressed the use of titanium and over-the-wing air scoops.

Boeing's strategy of even entering the competition is subject to debate. Here is a company with no experience in the building of supersonic aircraft or naval aircraft and who had not built a fighter since 1930. Grumman's proposal of a joint venture was turned down by Boeing. One is tempted to wonder whether or not Boeing asked, 'what business are we in?'

An appreciation of DoD's strategy can be gleaned by examination of Mr. McNamara's stated philosophy, his emphasis on cost-effectiveness analysis and his desire for one aircraft for the three services. These factors combined to change the DoD process of weapons acquisition, a fact that had to be assessed by the competitors.

Competitive subsystem. General Dynamics' discovery of how to make and use fiberglass models allowed them to virtually negate Boeing's one-year lead in wind tunnel testing. Possibly one reason why the military boards continued to prefer Boeing was their early start in variable geometry research and their unsolicited proposal to General Everett in late 1959.

Environmental subsystem. The economic outlook of the aerospace industry for the 1960's was not encouraging for the following reasons:

a. recent cancellation of the F-108 fighter.

b. cutback of the B-70 program to only three prototypes.

c. General Everest's statement indicating that the TFX would probably be the only fighter built during the 60's.

d. proposed stabilization of the Defense budget at $38-40 billion.

e. an apparent lessening of tension in the cold war.

These factors, combined with the production capability of the industry, were probably responsible to a large degree for the low bids submitted by General Dynamics and Boeing.

McNamara's cost effectiveness and detailed analysis procedures also impacted on the environment. Additionally, the trends in DoD contracts for weapons caused an environmental change; proposals were now gone over in great detail before award of a contract and contractors were being held more responsible for controlling costs.

## Conclusion

In conclusion, the writers would agree with the assessment in Armed Forces Management [Ref 138:50]:

> *The TFX controversy arose from bad judgments on the part of all concerned. Navy and Air Force miscalculated the depth of commitment of Secretary*

*McNamara to the concept of a single aircraft for both services. McNamara misjudged the degree of resistance to the idea of the TFX within the services and failed to impress the selection criteria which he was using on the evaluation board. Boeing misjudged the power of the Defense Department and backed the wrong side. General Dynamics, even though the winner, has a tough road with the fixed price incentive contract which they accepted to build the TFX.*

*Who was right in the TFX? A defense expert summed it up very well: 'We're never going to know because the Boeing machine is not being built', and this is probably the best and only answer.*

# APPENDIXES

## Appendix A: Retired Military Officers Employed by Defense Contractors

TABLE XVI

Retired Military Officers Employed by Defense Contractors

| Company | Defense Position | No. of Retired Military Officers | No. of Retired Flag Officers |
|---|---|---|---|
| Boeing | 1 | 61 | 5 |
| General Dynamics | 2 | 186 | 27 |
| Lockheed | 4 | 171 | 27 |
| Martin Co. | 9 | 63 | 9 |
| RCA | 15 | 35 | 15 |
| General Tire | 26 | 66 | 11 |
| ITT | 30 | 44 | 14 |

[Ref 153:7465]

# Appendix B: Memorandum to the Civilian Secretaries (September 1, 1961)

THE SECRETARY OF DEFENSE,
*Washington, September 1, 1961.*

Memorandum for: The Secretary of the Air Force.
The Secretary of the Navy.

Subject: TFX.

Reference: Secretary of the Air Force memo to Secretary of Defense dated August 22, 1961, same subject.
Secretary of the Navy memo to Secretary of Defense dated August 22, 1961, same subject.

My office has reviewed the most recent positions of the Air Force and the Navy with regard to joint development of a tactical fighter for both services. I believe that the development of a single aircraft of genuine tactical utility to both services in the projected time frame is technically feasible.

A single aircraft for both the Air Force tactical mission and the Navy fleet air defense mission will be undertaken. The Air Force shall proceed with the development of such an aircraft.

The Air Force tactical version of this aircraft shall be developed to meet as nearly as possible the minimum required performance as specified in SOR 183, dated July 14, 1960, within the following constraints:

1. The mold line of the aircraft shall be configured so that a radar dish of [deleted] diameter minimum size may be accommodated in the nose.
2. The maximum length of the aircraft shall not exceed in the Air Force tactical version.
3. The weight of the aircraft in the Air Force tactical version with full internal fuel and [deleted] of internal stories should be approximately [deleted].
5. The basic design provisions for stories shall allow for the carrying of conventional ordnance.
5. The basic design provisions for stories shall allow for the carrying of at least [deleted] air-to-air missiles [deleted] and [deleted] air-to-air missiles.
6. The basic structure of the airframe must be able to accommodate the loads associated with carrier operations.

The Navy version of the basic aircraft to be developed under this program shall be capable of performing the Navy fleet air defense mission, carrying [deleted] air-to-air missiles at a radius of [deleted] with [deleted] hours of loiter time. Takeoff gross weight for this mission shall not exceed [deleted] without the concurrence of the Navy.

Changes to the Air Force tactical version of the basic aircraft to achieve the Navy mission shall be held to a minimum. There will be provisions for shortening the length of the aircraft for Navy use, at least for purposes of stowage and handling. The Navy will evaluate these provisions for maximum operational carrier effectiveness in the time frame of [deleted] and later. In this regard, it would be considered desirable if the minimum Air Force requirements can be met by a basic aircraft of less than the specified [deleted] maximum.

For the present, the Navy and the Air Force are to continue the currently programed development of their respective all-weather intercept systems [deleted]. The basic airplane should be configured so that either system may be accommodated.

Representatives of the Air Force and Navy should convene as soon as possible to resolve differences in the pertinent detail specifications that govern the design, fabrication, performance, and testing of their respective combat aircraft. If the expeditious resolution of differences in specifications cannot be achieved, these differences shall be delineated and presented to the Director of Defense, Research and Engineering, for solution.

The Air Force, in collaboration with the Navy, should develop plans for the management and funding of this program, which shall include Navy participation on the source selection board. These plans should be submitted to my office by September 15, and should include the following major milestones:

1. Submission of request for proposal to industry by October 1, 1961.
2. Signing of weapons system contract by February 1, 1962.

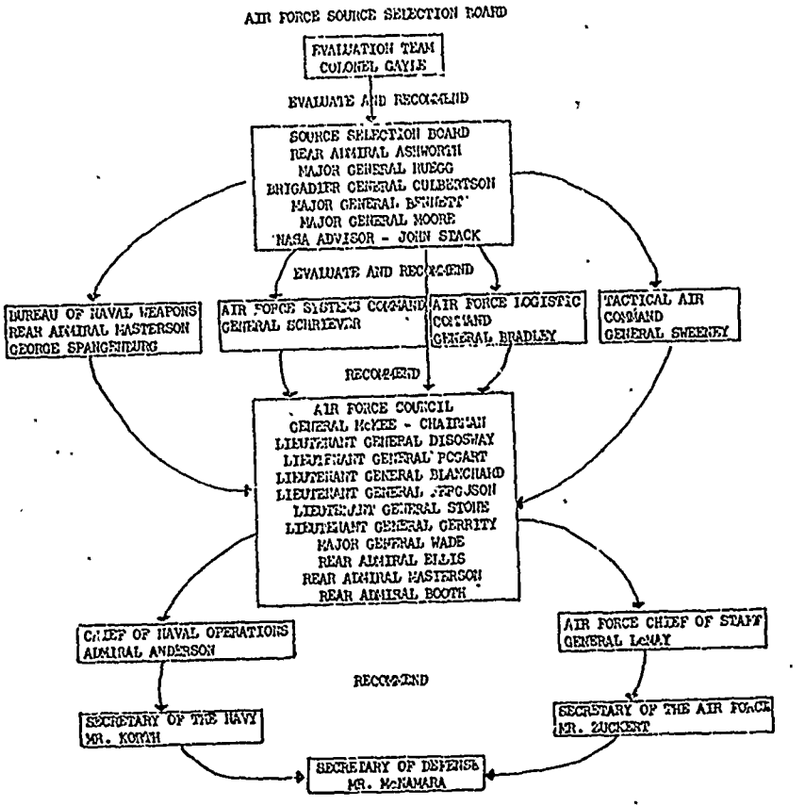
(Signed) ROBERT S. MCNAMARA,
*Secretary of Defense.*

Signature authenticated by:

REID C. BUSH.

[Ref 172:333-34]

# Appendix C: The TFX Evaluation Sequence




[Ref 172:43]

# Appendix D: Letter From the Air Force Council (24Jan62)

DEPARTMENT OF THE AIR FORCE,
OFFICE OF THE CHIEF OF STAFF,
U.S. AIR FORCE,
*Washington, D.C., January 24, 1962.*

Reply to attention of: AFCCS.
Subject: Selection of source for WS-324A (the TFX).
To: Chief of Naval Operations, Chief of Staff, U.S. Air Force.

1. On January 24, 1962, the Air Force Council, in joint session with Admirals Pirie, Hayward, and Stroop of the U.S. Navy, considered a presentation on the above subject by the System Source Selection Board and its Evaluation Group, and recommends that you approve:

(*a*) Awarding of limited study contracts to Boeing and General Dynamics to determine the effect of required changes on their proposed designs before selecting a single source.

(*b*) Exclusion of the General Electric MF-295 engine from consideration for the TFX, and the substitution of the Pratt & Whitney JTF-10A20.

2. The joint Air Force Council/Naval Staff session noted that:

(*a*) No contractor had submitted a design that would not require substantial redesign to meet the established requirements.

(*b*) There was unanimity between the Navy conferees, the Air Force Council, and the using and supporting commands that if a source is selected at this time it should be Boeing.

(*c*) The Evaluation Group had recommended contracting with two sources to evolve detail specifications incorporating corrections of deficiencies identified by the Evaluation Group. (While the period required to accomplish this work has not been firmly determined, it is estimated at 6 to 8 weeks for the contractors' redesigning, and 2 to 4 weeks for services' evaluation.)

3. The Council and Navy participants agreed that:

(*a*) Competition should be continued between the two contractors for a period of 60 to 90 days.

(*b*) Although this procedure will be time consuming, it is considered to be the more prudent approach, in that the interests of management and economy will be better served by forestalling uninhibited design effort and materials procurement until the essential details of the design have been resolved to the satisfaction of both the Navy and Air Force. Time and dollars are thereby more apt to be saved than lost in the long run. Continued competition can be expected to aid in achieving a final design earlier, while at the same time expediting critical contractual agreements.

(*c*) Boeing is expected to be the ultimate source, but the additional design period suggested above will provide further assurance of the validity of this choice. It will also enable the Air Force to obtain needed commitments from Boeing regarding management, costing, and data submittal details.

(*d*) More realistic cost estimates should be developed during the redesign period.

(*e*) Specific determination should be made as to the availability of sufficient and competent management and engineering personnel for the job.

(*f*) Company responsiveness to the establishment of a management structure adequate for the job should be determined.

(*g*) There are political dangers in the course of action proposed, but they should be accepted.

(*h*) The Secretaries of the Navy and Air Force should hear the Source Selection Board's presentation.

(*i*) The character of the joint deliberations and the unanimity of the findings constitute a milepost in interservice cooperation.

(*j*) The efforts of the Source Selection Board and its Evaluation Group were highly commendable, particularly in view of the stringent time limitation within which they were required to complete their actions.

(S) R. B. Pirie,
R. B. PIRIE,
*Vice Admiral, U.S. Navy.*

Approved January 1962.

GEORGE ANDERSON,
*Chief of Naval Operations.*

(S) D. C. Strother,
D. C. STROTHER,
*Lieutenant General, U.S. Air Force,*
*Acting Chairman, Air Force Council.*

Approved January 1962.

FREDERIC H. SMITH, Jr.,
*General, U.S. Air Force,*
*Vice Chief of Staff.*

[Ref 172:641-142]

# Appendix E: Memorandum to Secretary of Defense (29 Jan 62)

DEPARTMENT OF THE AIR FORCE,
OFFICE OF THE SECRETARY,
*Washington, January 29, 1962.*

MEMORANDUM FOR THE SECRETARY OF DEFENSE

Subject: Selection of source for WS-324A (the TFX).

1. The undersigned have reviewed the data supplied by the Air Force TFX Source Selection Team, together with the recommendations of the senior Navy and Air Force officers involved in the selection process. As a result, it is recommended that—

(*a*) All competitors except Boeing and General Dynamics be eliminated from further consideration;

(*b*) That these two companies be awarded 90-day study contracts to provide the opportunity for each to bring their respective designs within Navy and Air Force requirements; and finally

(*c*) Based upon design resubmissions, a final source selection will be made using the same procedures as were employed in the original elimination.

2. The following notes are pertinent to our recommendation.

(*a*) The prescribed source selection process of the Air Force was supplemented not only by inclusion of senior Navy personnel at higher levels, but also by substantial engineering inputs from BuWeps and NASA. No substantive disagreement developed at any point of the selection process.

(*b*) Requests for proposal were sent to 10 contractors; resulting in the receipt of 6 designs for source selection evaluation (three combined; one withdrew).

(*c*) Every design submitted requires major change to meet Navy and Air Force requirements. Those of Boeing and General Dynamics, however, are markedly superior to the other four and present the best opportunity for being brought up to the stated service requirements.

(*d*) In the case of the Boeing design, the most significant changes would be substitution of a completely different engine. With respect to General Dynamics, the most compelling improvement must be in the area of drag reduction. There are other refinements of somewhat lesser import that must be achieved to both designs. It is anticipated that each company would be informed of their respective deficiencies in order that the proposed follow-on study contracts are more meaningful.

(*e*) It should be noted that there was unanimous agreement among the Air Force, Navy, and NASA personnel involved that the Boeing design was the most suitable of the six presented. This in terms of being the more readily adaptable toward service requirements and possessing the greatest growth potential. Due primarily to the limited time allowed for evaluation, however, it would be advisable to extend the competition between the two most promising sources in order to permit complete exploitation of the two designs. Such a course would also provide the incentive for sharper competition from a business standpoint.

(*f*) It should also be noted that extension of the competition will cost an additional $2 to $3 million. Further, an extra load will be placed upon the already overburdened service evaluators. Despite this, exercise of such an option is desirable for it will provide not only additional design and evaluation time, but also enable the utilization of the best possible design talent, refinement of cost data, and resolution of legal points. Taking this route should make for the best possible contracting arrangements for the development and production phases of the venture.

(*g*) Finally, extension of competition will allow for reaffirmation of the judgments leading to engine selection. The services were unanimous in rejecting the General Electric engine because of its "paper status" and the low probability that it would be available in the time required. Similarly, all the competitors rejected the Allison-Rolls engine because of the estimated penalties to their designs occasioned by weight and performance. As a result, the Pratt & Whitney engine is indicated. In the extended competition, a complete reevaluation of the engine problem would be demanded.

3. A series of enclosures are attached which discuss, in summary form, the design proposal of each of the competitors as well as each of the engines involved.

EUGENE M. ZUCKERT,
*Secretary of the Air Force.*
FRED KORTH,
*Secretary of the Navy.*

# Appendix E (Continued)

ENGINE SUMMARY

The following three engines were considered in proposals, although no contractor proposed the Allison engine in his primary proposal.

| Engine | Thrust | Turbine inlet temperature | Weight | Approximate test hours to date |
|---|---|---|---|---|
| General Electric | Deleted by Department of Defense | | | None |
| Pratt & Whitney | | | | 909 |
| Allison | | | | 1,300 |

*Pratt & Whitney.*—This design is well along in development. The air-cooled turbine design is conservative, having relatively low turbine inlet temperatures and good growth potential. The basic design concepts for the afterburner and propulsion exit nozzle were investigated under U.S. Air Force contract and are considered desirable and well within the state of the art.

*Allison.*—The Allison design is based on the Rolls-Royce RB–168 design presently undergoing full-scale test in England. It has a cooled turbine design that is well along in development. The [deleted] proposed is a new approach and therefore constitutes a development risk. The AR–168 nozzle design caused generally higher boattail drag. Contractors using this engine had much heavier designs. For example, Boeing estimated that at mach [deleted] aft body drag using this design was 610 pounds greater than for configurations incorporating the other two engines. The resulting air vehicle weighed in excess of [deleted] pounds. For the reason of weight penalty, and because of the added development risk expected of an engine being developed in two continents, none of the bidders chose the AR–168 for their primary proposals.

*General Electric.*—The MF 295–A design was started after the initiation of the TFX program; consequently, it was sized for the TFX. The design is based on XJ–93 (B–70) technology; however, it is today only a "paper" engine. Turbine blade cooling is employed. The design has a unique [deleted] nozzle. New techniques and materials are used; development risks are therefore high. It is the considered judgment of both the U.S. Air Force and the U.S. Navy that the performance and weights claimed by the contractor cannot be achieved within the time frame required for operational delivery of the TFX.

ALLISON

The AR–168–23 design is based on the Rolls-Royce RB–168 being developed in England. The Air Force investigated the Allison/Rolls-Royce agreement, with the resulting opinion that Allison could produce this design; however, there is inherent risk in developing an engine in two geographically separated countries. Design parameters are:

Weight
Thrust
Turbine inlet temperature
Afterburner
Nozzle
} [Deleted.]

*Discussion.*—The AR–168 design is technically sound. The exhaust nozzle design is workable, although mechanically complex. This nozzle is the heaviest of the designs considered. Development risk is associated with the proposed [deleted] feature. The AR–168 nozzle design caused high boattail drag. Bidders evaluating this engine in their designs found that to meet mission requirements additional fuel had to be carried because of the higher thrust and resulting higher SFC required to compensate for the higher total drag. For example, Boeing's design with this engine weighed over [deleted] pounds, as compared to the Pratt & Whitney design which weighed [deleted] pounds (these are contractor weights).

Although the design is feasible, there remains the basic question of whether Allison can produce this Rolls-Royce design in time to meet the required schedule.

# Appendix E (Continued)

GENERAL ELECTRIC MF 295-A

The MF 295-A design was commenced subsequent to initiation of TFX studies. It was sized specifically to meet TFX requirements. It is entirely new—existing only on paper at this time. Its technology is based on that of the [deleted] used in the [deleted]. The contractor has no extensive "twin spool" or "forward fan" experience. It is extremely doubtful that his design could be developed, and proven, in time to meet the TFX schedule. Design parameters are as follows:

Weight
Thrust
Turbine inlet temperature
Afterburner
Nozzle
} [Deleted.]

The development risk associated with the MF 295-A is very high. The average pressure rise in the compressor, per stage, is high with respect to the present state of the art. Because of high operating temperatures, a new experimental alloy is proposed for the high pressure compressor. The [deleted] will require considerable development. In summary, development risks are substantially greater than those associated with either the Pratt & Whitney or Allison engines. There is, therefore, a clear and present danger that reliance on the GE engine would cause schedule slippage.

PRATT & WHITNEY

The JTF-10A design is similar to present inservice Pratt & Whitney fan engines. A nonafterburning version has been under development for the Navy for several years. Afterburner and exhaust nozzle have been investigated under Air Force contract. Design parameters are:

Weight
Thrust
Turbine inlet temperature
Afterburner
Nozzle
} [Deleted.]

*Discussion.*—Based upon purely technical assessment, the JTF-10A appears to be the best choice. Development risk appears low due to its advanced state of development. This engine was the first choice of both the Air Force and the Navy.

BOEING

Of all six proposals, it was unanimously agreed by the three agencies participating in the source selection process (U.S. Air Force, U.S. Navy, NASA), that the Boeing design was the most readily adaptable to service requirements and possessed the greatest growth potential.

The most significant change in this design involves the substitution of a completely different engine (vice the GE MF 295-A, proposed) because of the development risks associated with the General Electric engine.

The following is a tabulation of the significant "favorable" and "unfavorable" points of the Boeing proposal, as determined by the U.S. Air Force evaluation:

*Favorable*

1. Ability to meet ferry range [deleted] and supersonic dash requirements.
2. Excellent weapon delivery flexibility, including a "wing positioning" feature with great selectivity.
3. [Deleted] radar.
4. Engine air inlets are located on top—good for missile firing and protection of engine from ingestion of foreign objects.
5. Desirably low radar reflectivity.
6. Engine thrust reverser permits rapid deceleration during offensive maneuvering.
7. Well-conceived support program with high degree of mobility and self-test features.

## Appendix E (Continued)

*Unfavorable*

1. Choice of GE engine.
2. Wheel loading slightly high for unprepared surfaces.
3. Weight distribution, when close to empty, requires reengineering.
4. Offensive system must be improved.
5. Wing pylons must be made to aline with aircraft centerline, vice the airstream.

*Navy evaluation of carrier compatibility*

This design, as presented, is acceptable to the Navy, with changes. The contractor's choice of the GE engine is covered above:

1. Meets catapulting, arresting, and single-engine rate-of-climb requirements.
2. Folded wingspan of [deleted] makes aircraft relatively difficult to handle aboard ship.
3. Good powerplant removal features, good fuel system.
4. Good lateral control power for carrier approach.
5. Missile arrangement must be reworked to improve firing and loading selectivity.

GENERAL DYNAMICS

The most compelling change required in this proposal lies in the field of aerodynamics, which in its present posture indicates a design completely unacceptable to the Navy because of the high operational wind requirements for catapulting and arresting, and the poor single engine rate of climb for waveoff.

The following is a tabulation of the significant "favorable" and "unfavorable" features, as determined by the U.S. Air Force evaluation.

*Favorable*

1. Weapons delivery capability.
2. Wing positioning has desirably high selectivity.
3. [Deleted] radar.
4. Well-conceived support program; good ground accessibility, self-sufficiency, and maintainability.
5. Ferry range. [Deleted.]
6. Engine choice (P/W JTF-10A-20).

*Unfavorable*

1. High wheel loading for unprepared surfaces.
2. Relatively high radar reflectivity.
3. Location of ventral fin interferes with location of drag chute.
4. Flight control system.
5. Offensive system must be improved.

*Navy evaluation of carrier compatibility*

This design, as presented, is unacceptable to the Navy because of the following:

1. Catapulting wind is [deleted].
2. Arresting wind is [deleted].
3. Single engine rate of climb is so low that aircraft cannot maintain level flight [deleted].

The following favorable design features are noted:

1. Missile installation considered most workable of all proposals.
2. Excellent fuel and vent system.
3. Good engine removal arrangements.

[Ref 172:1496-1500]

# Appendix F: Memorandum to Secretary of Defense (1 Jun 62)

DEPARTMENT OF THE AIR FORCE,
OFFICE OF THE SECRETARY,
*Washington, June 1, 1962.*

MEMORANDUM FOR THE SECRETARY OF DEFENSE

Subject: Source selection F-111A (TFX).

On May 28, the results of the final evaluation of the F-111A (TFX) proposals submitted by Boeing Airplane Co. and General Dynamics Corp. were reviewed by the Secretary of the Navy and the Secretary of the Air Force. This review revealed that the Air Force is prepared to recommend a source, but neither competitor's design is satisfactory to the Navy.

The principal design deficiencies for the Navy are due primarily to the high gross weights and wing loadings and are judged by the Navy to be correctible only by a significant design change.

While there are also deficiencies in meeting Air Force requirements, these are judged by the Air Force to be correctible in the best proposal.

Recognizing your desire to proceed with the joint service program, we have directed the Source Selection Board to again examine with the two contractors possible courses of action to correct the deficiencies which make the present designs unsatisfactory. These have been specified by the Navy and the two contractors are being requested to analyze the minimum design changes and determine the resulting divergence between the Navy and the Air Force versions of such an aircraft that would be necessary in order to eliminate these deficiencies.

Although a refined analysis would require considerable design effort, it is felt that an estimate of the magnitude of the divergence required can be reached in about 3 weeks.

EUGENE M. ZUCKERT.
FRED KORTH.

[Ref 172:1399]

GSM/SM/68-07,14

# Appendix G: Correction to Proposal Deficiencies (5 Jun 62)

AERONAUTICAL SYSTEMS DIVISION,
*Wright-Patterson Air Force Base, Ohio, June 5, 1962.*

Subject: Request for correction to proposal deficiencies—WS-324A.

To: The Boeing Co., Military Aircraft Systems Division, Post Office Box 3999, Seattle, Wash.

Attention: R. H. Anderson 3-1000, 41-84 interplant.

1. This letter confirms verbal instructions briefed to representatives of your company by the F-111 system program director with regard to deficient items resulting from evaluation of your revised proposal. Further, this letter formalizes the request for additional information to be submitted, as contained in this letter and as briefed to your representatives on June 5, 1962, at Wright-Patterson Air Force Base.

2. The actions that you are to take will be oriented to correction of identified deficiencies in the Navy version of your aircraft, to more fully meet the requirements of the Navy as identified in the work statement. The primary deficiencies to which you should devote your efforts at this time are identified as follows:

(*a*) Maneuver capability at Navy loiter altitude and airspeed for best fuel economy.

(*b*) Recovery wind over the deck capability.

(*c*) Loiter time on station at [deleted] nautical miles. (Mission B.)

(*d*) Study required based on the following:

(1) What can be done to reduce the weight of the Navy version, at the expense of similarity?

(2) What can be done to reduce the weight of the Navy version to [deleted] pounds, at the expense of similarity?

3. You are requested to give a presentation at Wright-Patterson Air Force Base on June 15, 1962, with regard to your proposed method of correcting these deficiencies. A total time of 4 hours will be allotted for your presentation including questions and answers. Additional time can be allowed if necessary. You will be notified of the exact time and place for this briefing at a later date. You will be allowed 15 minutes to set up your briefing material. Your charts and the printed briefing words must be retained at WPAFB as data to assist in establishing complete understanding of the contractors corrective action.

4. Information in your briefing should clearly show how the deficiencies can be corrected and the resulting technical, production, schedule, and cost effects. A tabulation should be included to show where the Air Force and Navy versions of the aircraft differ and where they are alike. Funding requirements per fiscal year in accordance with this version should also be submitted. These corrections will then be submitted as official changes to your proposal under established ground rules for submitting proposal changes. More concise instructions are included in attachment No. 1 to this letter.

5. Because of the limited time available for you to prepare this briefing, it is hoped that complete understanding of actions required can be reached by the end of the June 5, 1962, session. If, however, you need additional information or clarification after June 5, you should contact the F-111 system program director.

6. Your interest in the results of this evaluation is fully appreciated; however, pending official announcement, you will not make any public release of any information pertaining to this weapon system and will instruct your representatives to refrain from making inquiries concerning status from the various elements of the Government.

W. A. DAVIS,
*Major General, U.S. Air Force,*
*Commander, Aeronautical Systems Division,*
*Air Force Systems Command.*

1. Discussion summary (s) 62ASZB-377.
2. Viewgraph instructions (U).

[Ref 172:496-498

# Appendix G (Continued)

DISCUSSION SUMMARY

Summary of information discussed with Boeing and General Dynamics on Saturday June 2, 1932:

1. There is a requirement for further study effort and submission of information by the contractors.

2. Study required will be based on the following:

(*a*) That can be done to reduce the weight of the Navy version, at the expense of similarity.

(*b*) That can be done to reduce the weight of the Navy version to [deleted] pounds, at the expense of similarity.

3. Information required will include:

(*a*) How it will be accomplished from a technical and production viewpoint.

(*b*) Effect in all areas—program schedules, cost, etc.

4. How submitted:

(*a*) Contractors will submit as change to proposal, under established ground rules for submitting proposal material. Will include a firm fixed price cost of changes.

(*b*) Will prepare a briefing on viewgraphs and printed. Will be required to brief in detail to the system program director and selected personnel.

(*c*) Will submit a list that will indicate where the versions differ and where they are alike.

(*d*) Will submit fund requirements by fiscal year, assuming a July 1 go-ahead.

5. Initial guidelines on deficiencies:

(*a*) Weight was increased.

(*b*) As a result did not meet wind over deck for landing.

(*c*) Did not meet [deleted] MM mission requirements. (Mission B.)

(*d*) Buffet—each contractor will submit individual buffet graph (format will be furnished by SPO) for five altitudes, 10,000, 20,000, 30,000, and 35,000 feet, plus best loiter altitude. Buffet will be based on 1.20 intensity level.

(*e*) Contractors will also consider using Navy design criteria of 60 percent fuel instead of Air Force (Tork statement) requirements of 80 percent fuel.

(*f*) Repackaging of standard equipments to reduce weight.

VIEWGRAPH INSTRUCTIONS

Contractors viewgraph reproducibles to be in accordance with the following specifications if possible:

Overall image area, 10 x 8 inches; overall paper size, 11 x 8½ inches; translucent paper (for ozalid use); black image (for photographic reproduction).

# Appendix H: Recommended Source for TFX

Subject: (U) Recommended source for WS-324A (TFX/F-111).

1. On June 22, 1962, in joint session, the Secretaries of the Air Force and Navy continued consideration of the Source Selection Board report on the above subject. Considered was a summary by the evaluation team of its addendum to the final TFX source selection report. Evaluation team had explored with Boeing and General Dynamics the Navy deficiencies and methods of meeting these by holding design changes and model divergencies to a minimum.

2. Secretary Zuckert was particularly concerned with the degree of certainty that the Navy would firmly commit itself to this program. During the executive session, Admiral Pirie indicated there would be at least a 90-percent chance that the Navy will be able to accept the program and remain with it.

3. Admiral Anderson and Admiral Pirie indicated that the Boeing design is acceptable to the Navy and gives every indication of being an acceptable weapon system.

4. The choice of source is not an issue. The Navy representatives agreed that the Boeing design has improved, whereas that of General Dynamics has slipped.

D. C. STROTHER,
*Lieutenant General, USAF, DOS/Operation, Hq. USAF.*

[Ref 172:1401]

# Appendix I: Memorandum to Source Selection Board (29 Jun 62)

DEPARTMENT OF THE AIR FORCE,
*Washington, June 29, 1962.*

Memorandum to: Chairman, Source Selection Board, WS-324-A.
Through: Chief of Staff, U.S. Air Force.

1. After review of the presentation of your board findings, and recommendations concerning source selection of the F-111A, it has been determined that additional work with the two contractors will be necessary. The purpose of this continuation is to:

(*a*) Provide the contractors with adequate time to establish their designs in sufficient detail to enable the services to assess more precisely the probability of the development of their respective versions into an effective weapon system.

(*b*) Reconcile the obvious disparity between the contractors' cost proposal with the Air Force standard.

2. Confirming Mr. Korth's and my verbal instructions to you, the following actions will be taken:

(*a*) The present letter contracts will be amended to require each contractor to accomplish that work necessary to take corrective action on the deficiencies identified to him by the system program director.

(*b*) Two and one-half million dollars will be authorized each contractor as reimbursement for his efforts.

(*c*) Each contractor will be allowed 60 days in which to take corrective action, and to prepare and submit a revised proposal and substantiating data.

(*d*) The results of this follow-on effort will be presented to the Secretaries of the Navy and Air Force on or about October 22, 1962.

3. Additional guidelines are:

(*a*) The Source Selection Board presentation will be oriented primarily toward the technical and cost aspects. Where time is available to determine the effect on the total weapon system program, the results may be presented in brief summary form.

(*b*) During the 60-day period, approval to work directly with each contractor as though he were a prime source is granted. Contractors may be given guidance in all areas, as to appropriate corrective actions, specific equipments, or similar guidance to insure maximum benefit from the contractor's efforts.

(*c*) The intent of the Secretary of Defense to reduce weapon system cost by maximizing similarities of Air Force and Navy versions, and by maximum use of common equipments and structures, etc., must continue to guide the efforts of the contractors in their design considerations. The degree of divergence between the two versions and the cost implications thereof must be identified.

(*d*) TFX weapon system program requirements identified to the contractors in the RFP work statement, and the June 1962 review, will be the guidelines used in identifying deficiencies and implementing corrective actions.

(*e*) Source selection procedures now established remain in effect, except that intermediate level briefings are waived.

EUGENE M. ZUCKERT.

[Ref 172:1400]

# Appendix J: Letter to Lewis of General Dynamics (13 Jul 62)

DEPUTY SECRETARY OF DEFENSE,
*July 13, 1962.*

Mr. ROGER LEWIS,
*President, General Dynamics Corp.,*
*New York, N.Y.*

DEAR ROGER: As you know, the Fort Worth division of your company has been engaged for some time in a competition for the TFX aircraft weapon system development program. Representing as it does, a joint Air Force-Navy development to yield important improvements to our total tactical capabilities, the TFX could well be one of the most complex and largest programs to be undertaken by the Defense Department over the next several years—complex because of the biservice use and multimission capabilities required of a single basic airframe design, large because of the potentially extensive buy of this new aircraft by both the Navy and the Air Force. Attesting to the competence of its initial proposal, General Dynamics, with Grumman as an associate, was selected in February of this year as one of two from the six competing companies to continue on a funded basis advanced studies leading toward more detailed definition of this new tactical aircraft.

Subsequent to submission of the second proposals in April, both finalists were asked to amend their designs to show how certain Navy deficiencies could be remedied. Though the time allotted for accomplishing this was very short, some imaginative concepts were brought to bear on the problem and promising solutions were offered. Unfortunately, because the time was short, detailed validation of the new proposals from both technical and cost viewpoints was not possible. The new modifications appear to offer improved tactical utility for this new weapon system but better substantiation is required to warrant final program approval for that design which may be judged superior. Additional funded work for both competitors has been approved to realize such substantiation.

Before final go-ahead on the program can be given by my office, three conditions must be met:

(1) Satisfaction of both Navy and Air Force that a significant improvement to their tactical air capabilities is represented by the winning design.

(2) Minimum divergence from a common design compatible with the separate missions of the Air Force and Navy to protect the inherent savings of a joint program.

(3) Demonstrably credible understanding of costs both for development and procurement of the complete TFX weapon system, which costs must be acceptable in view of the capability added to our military strength by the weapon system.

Retention of the competitive nature of the source-selection exercise on a funded basis is felt to be the best method for accomplishing the above outlined tasks. This will mean continued intensive work by two competing teams that have already extended themselves exhaustively in the three foregoing exercises. I write therefore to express my appreciation of the effort already expended and to emphasize the importance of the work remaining. I sincerely hope that the above noted conditions will be met as a result of this final effort and the culmination will be initiation of a full scale weapon system development program—the first of such magnitude to be biservice in character from its inception.

Please convey these thoughts along with my best wishes to those of General Dynamics involved in the TFX program.

Sincerely,

(Signed) ROSWELL L. GILPATRIC.

[Ref 172:1195]

# Appendix K: Letter to Boeing Concerning Titanium (9 Aug 62)

HEADQUARTERS, AERONAUTICAL SYSTEMS DIVISION,
AIR FORCE SYSTEMS COMMAND, U.S. AIR FORCE,
*Wright-Patterson Air Force Base, Ohio, August 9, 1962.*

Attention of: ASZB/ASNST.
Subject: Use of titanium alloys.
To: The Boeing Co., Military Aircraft Systems Division, Post Office Box 3999, 3-1000, 4184 Interplant, Seattle, Wash.

1. Since your company may desire to use titanium alloys as a part of the airplane structure as a weight-saving measure, the F-111 System Program Office is issuing the instructions below concerning the use of titanium.

2. The requirements of the work statement with respect to titanium still applies. Justification must be presented for each structural application of titanium. It is the judgment of ASD that—

(*a*) It is not advisable for use in fittings subjected to motion or wear under heavy load, such as the wing pivot and the stabilator pivot. The fact that it does not lend itself to plating is pertinent in this case because of poor protection against wear.

(*b*) It is not advisable for applications in heavy section areas because of lack of data on titanium alloys in heavy sections.

(*c*) Titanium has to have certain steps taken to protect against dissimilar metal corrosive action (tapes, sealants, etc.), which, in turn would increase weight.

3. It is emphasized that as a part of each proposed application, justification will be required for the use of titanium in preference to other materials, and further, that corrosion protection and structural integrity provisions have been properly considered.

(Signed) CHARLES A. GAYLE,
*Colonel, USAF, System Program Director,*
*Deputy Commander/Systems Management.*

[Ref 172:1347]

# Appendix L: Instructions to Evaluation Team (13 Sep 62)

AERONAUTICAL SYSTEMS DIVISION,
OFFICE OF THE COMMANDER,
*Wright-Patterson Air Force Base, Ohio, September 13, 1962.*

Subject: Instructions to Chairman.
To: Chairman, Evaluation Group, weapon system 324A.

1. The Secretary of the Air Force has directed that additional work be accomplished with Boeing and General Dynamics, to be followed by submission of revised proposals on or about September 10, 1962. In turn, evaluation of these proposals will be accomplished and presented by the Source Selection Board to the Secretaries of the Air Force and Navy, on or about October 22, 1962.

2. Procedures and criteria to be utilized in this evaluation, will be in accordance with original letter from the Chairman, Source Selection Board, to the Chairman, Evaluation Group, as modified by supplemental letters.

3. The Evaluation Group is responsible for all areas except "carrier compatibility" and the Navy AMCS fire control system, which will be accomplished by BuWeps. The briefing to the Source Selection Board and subsequent presentations will be oriented toward the technical and cost aspects; other areas will be presented in brief summary form. "Carrier compatibility" and the Navy fire control system portion will be prepared by BuWeps and submitted to the Chairman of the Evaluation Group in sufficient time for timely review and integration into Evaluation Group briefings and reports.

4. The schedule proposed for performance of the evaluation and presentation to the Secretaries Air Force/Navy is approved. Proposed schedule is as follows:
Source Selection Board, October 23, 1962.
Commanders, October 24, 1962.
Air Council, October 25, 1962.
Secretaries Air Force/Navy, October 25, 1962.
Chairman, Evaluation Group, will be prepared to brief D.D.R. & E. and Secretary of Defense following briefings to Secretaries Air Force/Navy. Briefing to Source Selection Board will be accomplished at Wright-Patterson AFB, briefings to commanders at Andrews AFB, and all other briefings in the Pentagon.

5. A written report of this evaluation is required. Format and content as established by the Chairman, Evaluation Group. Briefing materials and requirements will take priority in Evaluation Group actions. Written report will be submitted at the time of the Source Selection Board briefing, if possible.

6. Contractors have been instructed to submit complete new proposal material. Evaluation results will be based on this material.

7. Concurrent with evaluation of proposals, Evaluation Group personnel will identify deficient or problem items, as determined by their review of contractor-submitted information. Items will be documented for each contractor, to be used during contract negotiations after announcement of single source.

8. During the performance of the evaluation, Chairman of the Evaluation Group will establish a format and content of "debriefing" to be given to the losing contractor. Debriefing will emphasize those items necessary to reasonably identify to the contractor where his weapon system was deficient. Source selection procedures will not be compromised in this "debriefing." It is emphasized that this action is to establish the format and type of information that will be included in a "debriefing."

Appendix L (Continued)

9. During the evaluation period, Chairman of the Evaluation Group is authorized to make verbal or written request to the two contractors concerned, hold such meetings or request such information deemed necessary for clarification of any of the data submitted by Boeing and General Dynamics. The intent of this authority is to insure maximum benefit from the efforts that the two contractors have expended. Meetings or discussions will be monitored by the Chairman or an area cochairman. For the purpose of evaluating "carrier compatibility" and the AMCS evaluation, the head, Evaluation Branch in the Navy BuWeps will be delegated similar authority.

10. Weapon system specifications will be utilized in accordance with provisions of letter dated April 6, 1962, from the Chairman, Source Selection Board, to Chairman, Evaluation Group. Provisions of paragraph 1.b.(2) same letter do not apply.

11. Chairman, Evaluation Group, will be prepared to brief the TFX/F-4H presentation as previously presented to the Air Council, to Secretary of Defense when this source selection briefing is presented.

12. Contractors have been requested to present a study of improved air-to-air capability for the tactical version, based on proposed changes to SOR requirements. Evaluation Group will perform an analysis of these studies and present results to the Source Selection Board as a summarized briefing. Presentation of this briefing will also be required up to and including D.D.R. & E. Briefing format and content will be as established by Chairman, Evaluation Group.

13. All participating agencies have been notified that the Evaluation Group will be reconvened on September 10, 1962. Personnel assigned to the Evaluation Group have been identified, and will be available on the date specified. Final release of Evaluation Group personnel will be determined by the Chairman.

14. Evaluation will be accomplished to carry out full intent and directions of Secretary of Air Force memo dated June 29, 1962, copy furnished to Chairman, Evaluation Group.

15. Provisions of all previous letters from Chairman, Source Selection Board, to Chairman, Evaluation Group, are applicable. Instructions in this letter supersede previous instructions where conflict may occur.

R. G. Ruegg,
*Major General, U.S. Air Force, Commander.*

[Ref 172:2078-2079]

# Appendix M: Rating of Contractor Proposals

| | BAC | G/D |
|---|---|---|
| **TECHNICAL** [1] | | |
| Systems analysis integration, and growth potential | Good | Good. |
| Air vehicle | Good | Good. |
| Propulsion subsystem | Good | Good. |
| Flight control | Good | Good. |
| Secondary power and environmental control | Very good | Very good. |
| Offensive systems | Good | Good. |
| Mission and traffic control | Very good | Very good. |
| Aerospace ground equipment (AGE) | Fair | Good. |
| Reconnaissance | Good | Good. |
| Penetration aids | Very good | Good. |
| Crew provisions | Good | Good. |
| Test concept | Very good | Very good. |
| Reliability | Good | Fair. |
| Electromagnetic compatability (EMC) | Good | Good. |
| Personnel subsystem | Good | Very good. |
| **LOGISTICS** | | |
| Maintenance | Good | Good. |
| Supply | Good | Good. |
| Transportation | Good | Good. |
| Procurement | Good | Good. |
| **MANAGEMENT** | | |
| Program planning | Good | Very good. |
| Production | Very good | Very good. |
| Management and organization | Excellent | Excellent. |
| Cost realism | Fair | Fair. |
| **OPERATIONAL** [1] | | |
| Operational utility | Very good | Good. |
| Support requirements | Good | Good. |
| Weapons delivery capability | Good | Good. |
| Reconnaissance | Very good | Good. |

[1] Subsequently cleared for release by Department of Defense by letter of Mar. 5, 1963, to the General Counsel.

General conclusions are:

(1) Both contractors have the capability to successfully design and produce this weapon system.

(2) Both designs are acceptable as initial development design configurations to the using agencies involved—TAC and the Navy.

(3) Both designs will require further design refinement and changes can be expected during the development period.

(4) When fully developed, the operational tactical aircraft will markedly improve the capability of the Tactical Air Command in carrying out its assigned missions, especially in limited war.

(5) Similarly, the Navy version, when fully developed, and when configured with the new long-range, air-to-air missile, will markedly improve existing fleet air defense capability.

[Ref 101:147]

# Appendix N: Letter From Source Selection Board (2 Nov 62)

AERONAUTICAL SYSTEMS DIVISION,
WRIGHT-PATTERSON AIR FORCE BASE,
*November 2, 1962.*

Subject: WS 324A (TFX/F-111) Source Selection.
To: Commander, AFLC, Wright-Patterson AFB, Ohio.

1. The WS 324A System Source Selection Board met on November 2, 1962, to review the fourth submission of source data from Boeing and General Dynamics, in response to letter of instructions from the Secretary of Air Force dated June 20, 1962. Voting members of the Board were: BUWEPS, Rear Adm. F. L. Ashworth; AFLC, Maj. Gen. T. A. Bennett; TAC, Maj. Gen. J.H. Moore; AFSC, Brig. Gen. A. T. Culbertson.

2. The latest data submissions by the two contractors have corrected previously identified deficiencies, and result in two designs that approach equality in size, weight, performance, and Air Force estimated cost. However both contractors presented more optimistic cost quotations than Air Force standards.

3. The Board unanimously recommends that X be selected as the source. Some considerations bearing on this decision are—

(*a*) Superiority in all major aspects of operational capability.
(*b*) Lower quoted cost.
(*c*) Positive ground deceleration mechanism.
(*d*) Greater weapons selectivity and carrying ability.
(*e*) Less risk of foreign object damage and missile exhaust degradation of engine performance.

4. It is the unanimous opinion of the Board that competitions between the two contractors has achieved its purpose and any further refinement of competitive designs is unjustified. It is recommended that company X be confirmed as the WS 324A source.

(S) R. G. Ruegg,
R. G. RUEGG,
*Major General, U.S. Air Force,*
*Commander, ASD, Chairman, SSSB.*

[Ref 172:1164]

# Appendix O: Letter from General Sweeney

HEADQUARTERS TACTICAL AIR COMMAND,
U.S. AIR FORCE,
OFFICE OF THE COMMANDER,
*Langley Air Force Base, Va.*

To: Headquarters, USAF (AFCVC) Washington, D.C.
Subject: WS324A (TFX/F111) Source Selection.

1. I have reviewed the findings of the WS324A System Source Selection Board and have carefully considered the factors evaluated. I concur with the unanimous recommendations of the Board that company X be confirmed as the WS324A Source.

2. There may be little to choose from between the two proposals as far as the Navy role is concerned. However, in my opinion there is considerable difference between the two proposals as far as the TAC role is concerned. I believe that company X has a much better aircraft with the following advantages which make it far superior for the TAC role:

(*a*) Airscoops above the wings will reduce the risk of foreign object damage and the possibility of engine flame out when missiles are fired.

(*b*) A thrust reverser which will provide better deceleration both in air maneuvering and on landing. The latter is especially important on wet or icy runways.

(*c*) A much greater ordnance carrying ability which will provide a broad range of weapons selectivity and capability.

(*d*) A ferry range of over [deleted] miles, which is substantially greater than for company Y's proposal.

(*e*) Dual wheels which weigh less and are more easily changed in the field without heavy AGE.

(*f*) A better air ground fire control system.

3. I firmly believe that company X's proposal will produce a superior weapon system that will provide a substantial improvement in TAC capabilities. I believe just as firmly that company Y's proposal will not provide the same increased capabilities. I urge that company X be confirmed as the WS324A Source.

(s) W. C. Sweeney, Jr.,
W. C. SWEENEY, Jr.,
*General, USAF, Commander.*

[Ref 172:743]

# Appendix P: Affidavit of General McKee

AFFIDAVIT OF GEN. WILLIAM F. MCKEE

COMMONWEALTH OF VIRGINIA, *ss:*
COUNTY OF ARLINGTON, *ss:*

William F. McKee, having been first duly sworn, deposes and says:

1. I am a general in the U.S. Air Force and am Vice Chief of Staff under my immediate superior, Gen. Curtis E. LeMay, the Chief of Staff.

2. I assumed this duty July 1, 1962, and for 9 years prior thereto, 1953 through 1962, I was vice commander of the Air Materiel Command, and thereafter, commander of the Air Force Logistics Command

3. For a number of years the Air Force has utilized a thorough selection system for the purpose of determining the source, or producer of certain of its major weapon systems. The source selection system is designed to minimize any bias in the decision and also to assure that the Air Force gets what it needs.

4. My duties at Air Materiel Command, Air Force Logistics Command and as Vice Chief of Staff have brought me into close contact with several major source selections including the B-70, Minuteman, Titan, Atlas, Skybolt, Hound Dog, Dyna-Soar and the F-108.

5. The recommendation of the Source Selection Board is made available to the three Air Force commanders concerned and to the Air Force Council. The Council comprises the six Deputy Chiefs of Staff of the Air Force, of lieutenant general rank, and the inspector general. I am Chairman of the Air Force Council. The Air Force Council, after receiving the recommendations of a Source Selection Board, makes appropriate comment and forwards the recommendation to the Chief of Staff. The Chief of Staff then approves or disapproves the Council recommendation, and forwards it, with appropriate comments, to the Secretary of the Air Force for action.

6. To the best of my knowledge and belief the recommendation of a Source Selection Board on a major weapon system which was thereafter confirmed by the Air Force Council, has never been overruled at the secretarial level until November 1962 in the source selection involving the TFX/F-111.

7. In that case, the Air Force Council received a recommendation from the Source Selection Board which in this case, because of the biservice nature of the aircraft, had an additional Navy admiral as a member. The Board unanimously recommended the selection of Boeing as source. The Board was assisted in its deliberation by recommendations forwarded from—

Gen. W. C. Sweeney, Jr., commander, Tactical Air Command.
Gen. Mark E. Bradley, Jr., commander, Air Force Logistics Command.
Gen. B. A. Schriever, commander, Air Force Systems Command.

Each of these separate recommendations recommended the selection of Boeing as the producing source for the TFX.

## Appendix P (Continued)

8. On November 8, 1962, the Air Force Council met. I acted as Chairman. Other members were—

Lt. Gen. Frank A. Bogart, Comptroller of the Air Force.
Lt. Gen. G. P. Disosway, Deputy Chief of Staff, Operations.
Lt. Gen. W. H. Blanchard, the inspector general.
Lt. Gen. James Ferguson, Deputy Chief of Staff, Research and Technology.
Lt. Gen. W. S. Stone, Deputy Chief of Staff, Personnel.
Lt. Gen. T. P. Gerrity, Deputy Chief of Staff, Systems and Logistics.
Maj. Gen. H. M. Wade, Assistant Deputy Chief of Staff, Plans and Programs.

Also voting with the Council that day were—

Rear Adm. W. E. Willis, Acting Deputy Chief of Naval Operations for Air.
Rear Adm. K. S. Masterson, Chief, Bureau of Naval Weapons.
Rear Adm. C. T. Booth, II, Director, Programs Division, Office of Chief of Naval Operations.

9. Because of the clear operational superiority of the Boeing aircraft and other factors, the Air Force Council, with Navy members, voted unanimously to recommend Boeing as a source to the Service Secretaries. There was no dissent within the Air Force Council, including the Navy members mentioned above, on the "clear and substantial advantage in the Boeing proposal over the General Dynamics proposal which is magnified by the environment found under the austere conditions usually inherent in limited war actions."

10. On November 23, 1962, the Air Force Secretary, Eugene M. Zuckert, informed me that on the following day an announcement would be made that General Dynamics had been selected as a source. General LeMay and I immediately visited Mr. Zuckert and attempted to dissuade him from this decision. We were unsuccessful.

11. There are many reasons for the strong preference for the Boeing design, which are set forth in the Air Force Council action of November 8, 1962. One of these is the clear advantage that the Boeing design has by reason of the location of its airscoops at a high level, in minimizing the ingestion of foreign objects into the air intake scoops. In my estimation, the General Dynamics airplane, with its low airscoops, could cost us a significant amount of money in maintenance and repairs and would increase the danger of engine failure.

12. Boeing proposed the utilization of a thrust reverser. I see no serious technical problems in adapting this excellent device to fighter aircraft. Boeing has pioneered in this field and is designing, manufacturing, and using thrust reversers on all of their commercial aircraft throughout the world.

13. It is my view that the operational factors should be the overriding considerations to all others in choosing between the two proposed systems because these aircraft are being procured for use in event of war.

14. In June 1962, prior to my assumption of duty of Vice Chief of Staff, when it was decided at the secretarial level to return the recommendations of the Board for a fourth evaluation, Air Force Secretary Zuckert and Navy Secretary Korth directed the Source Selection Board to work with both competitors as if they had been chosen as prime contractors. To the best of my knowledge there has never before been, in a competition, this type of instruction issued.

15. In producing the B-58, General Dynamics did a creditable job but the aircraft was a lot more expensive than originally planned. Part of this increase was the fault of the Government. It is my view that, all things being considered, Boeing is a better producer.

16. During the entire source selection procedure there were no political pressures brought to bear on me or, as far as I know, any of the uniformed personnel within the Air Force.

17. Attached hereto is a statement regarding workings of the SSB which is made a part hereof.

WILLIAM F. MCKEE.

Subscribed and sworn to before me this 13th day of February 1963 in the County of Arlington, Commonwealth of Virginia.

[SEAL]

KARL J. BILEK,
*Notary Public, Arlington County, Va.*

My commission expires September 4, 1964.

## Appendix P (Continued)

FEBRUARY 13, 1963.

STATEMENT REGARDING PROCEDURES OF SYSTEM SOURCE SELECTION

In order to explain the rationale behind the Air Force Council recommendation to the Chief of Staff in the selection of a contractor for production of the TFX, I believe it would prove worthwhile for the subcommittee to have a thorough understanding of the Council functions and participation with respect to what we call system source selection procedures.

The Air Force Council was formed by the first Chief of Staff, Gen. Hoyt S. Vandenberg, in April of 1951, as an agency of the Chief of Staff. It was charged quite simply with formulating Air Force objectives and policies and reviewing programs for their implementation. It was also charged with dissemination of program and policy guidance to the Air Staff. Chairmanship of the Council at that time was given as an added duty to the Vice Chief of Staff of the U.S. Air Force, and membership confined to the Deputy Chiefs of Staff, the Comptroller, and the Inspector General. Under its first Chairman, General Twining, the Council became the senior deliberative and advisory body for the Chief of Staff. Over the years the original concept of the Council and its system of operation have not varied, and one Chief of Staff after another has found the considered advice of his senior responsible Deputies most useful in arriving at the kinds of decisions which confront the military chief of so large and complex an organization. The Council has also become the appropriate agency for resolving divergent staff views which did not prove susceptible to resolution through normal staff procedures.

After a period of long trial, the Council became a fixture in Air Staff organization and was formalized by the publication of a suitable Air Force regulation (No. 21–6, currently dated September 10, 1951) and a Headquarters office instruction for use within the Pentagon (HOI 21–18, currently dated November 30, 1959). Throughout this time the Council has always been chaired by the Vice Chief of Staff and has always consisted of the lieutenant generals serving on the Air Staff. There is a small secretariat of three officers which provides the usual services of writing the papers and disseminating the decisions and guidance.

It can be easily seen that so important a problem as the selection of a major weapon system would fall naturally within the purview of the Council before a final decision was made by the Chief of Staff or the Secretary of the Air Force. For some time the Council has participated in this way in reviewing the recommendations of the major commands as to the selection of a contractor to produce a weapon system in response to a specific operational requirement of the Air Force. As an example, there have been 18 basic Air Force Council actions on source selection since January of 1959. In early 1959 the Air Force regulation governing source selection procedures (AFR 80–3, April 28, 1959), among other things, specified the particular role of the Air Force Council in these procedures. Prior to that time the Council was operating on an internal instruction at the direction of the Vice Chief of Staff. The regulation published in 1959 was superseded in April of 1962 by an updated version published during the normal periodic review of Air Force regulations (AFR 70–15).

Generally, it is our policy that the source of selected Air Force systems and major subsystems will be determined by system source selection procedures. Since the function of Air Force Systems Command is to develop and/or produce a new system or subsystem, our headquarters usually directs General Schriever's Headquarters to utilize the source selection procedures to select a new system or subsystem. The normal procedure is to set up a System Source Selection Board as an instrument of the Systems Command, of the Logistics Command, of the proposed using combat command, and others who have a direct interest. This Board investigates, evaluates and makes recommendations on a preferred source or sources for the development and/or production of a system. Only well qualified personnel, generally with experience in the procedures, are assigned to the SSSB, and the senior member from each Command is usually a general officer.

According to our procedures, when the objective of the SSSB is to evaluate specific proposals, the Board designates an evaluation group to perform duties specified by the Board. The evaluation group may be subdivided into several teams for the purpose of covering specific areas of consideration, such as tactical feasibility, logistics, operational utility, production, manufacturing and management. When the Board has finished considering the recommendation of the evaluation group, it makes its own evaluation, which, in turn, is indorsed by each of the major commanders concerned, over his personal signature, and forwarded separately to headquarters, USAF, to the Secretary of the Air Force Council.

## Appendix P (Continued)

At an appropriate time the Council listens to the final presentation of the evaluation group, reads the recommendation of the SSSB and consults the written recommendations of the major commanders concerned. At that time, the Council makes its own recommendation over the signature of the Chairman to the Chief of Staff of the Air Force. The final source selection is made by the Chief of Staff and the Secretary of the Air Force, as appropriate.

This is precisely the course that was followed in the case of the TFX. As is already known, we added to the procedures in this case by incorporating U.S. Navy participation as members of the evaluation group and voting members of the SSSB. Further, in all of the meetings of the Council relative to the TFX from January 24 onward, there was naval flag officer participation. Thus, the senior naval flag officer joined with the Chairman of the Air Force Council in signing the recommendation of the Council to the Chief of Staff, and, in this case, to the Chief of Naval Operations.

With this background in mind, may I add that the only Council meeting on the TFX in which I personally participated since becoming the Vice Chief of Staff on July 1, 1962, and hence, Chairman of the Air Force Council, was on November 8.

This statement is a part of affidavit signed by Gen. William F. McKee on February 13, 1963.

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DEPARTMENT OF THE AIR FORCE,
OFFICE OF THE CHIEF OF STAFF,
U.S. AIR FORCE,
*Washington, D.C.*

Reply to attention of: AFCCS.
Subject: (U) Recommended source for WS-821A (TFX/F-111).
To: Chief of Naval Operations.
Chief of Staff, USAF.

1. On November 8, 1962, in joint session Admirals Ellis, Masterson, and Booth, and the Air Force Council continued consideration of the Source Selection Board report on the above subject and unanimously recommend that you approve the Boeing Aircraft Co. as the single contractor for development and production of the TFX.

2. It was noted that:

(*a*) Continuing deliberations by the Source Selection Board were responsive to:

(1) Original instructions from this headquarters.
(2) Results of the three previous evaluations.
(3) Secretary McNamara's instructions to the Secretaries of the Air Force and the Navy which provided additional time for refinement.
(4) Letter from Deputy Secretary of Defense Gilpatric, dated July 13, 1962, to the contractors; and
(5) Secretary of the Air Force letter of June 29, 1962, incorporating the verbal instructions of the Secretary of the Navy.

(*b*) Procedures of the Source Selection Board have been basically the same as those heretofore identified in previous evaluations. Most pertinent parts of the Secretary of Defense instructions concern:

(1) Satisfaction of both Navy and Air Force that a significant improvement to their tactical air capabilities is represented by the winning design.
(2) Operational flexibility.
(3) Maximum divergence from a common design compatible with the separate missions of the Air Force and Navy to protect the inherent savings of a joint program.
(4) Demonstrably credible understanding of costs both for development and procurement of the complete TFX weapon system, which costs must be acceptable in view of the capability added to our military strength by the weapon system.

(*c*) With regard to significant milestones, even if a decision is immediately forthcoming, there will be a slippage of approximately 6 months in the IOC of the 1st Tactical Wing.

(*d*) It should be noted that until actual work has begun with a single contractor, all items cannot completely be corrected to the satisfaction of the military. Costs, particularly, will continue to reflect contractor analysis of the program until further refinements are made. Nonetheless, the evaluation at this time is the result of a much more thorough and searching study and has produced as comprehensive a design analysis as is now possible.

## Appendix P (Continued)

(*c*) Navy participation in this phase of the evaluation has been considerably broadened over the three preceding phases, particularly in the performance area. Although numbers were calculated independently in Washington, they represent a high degree of corroboration and interchange of procedures among the Air Force and Navy engineers. In general, the level of carrier suitability and mission performance favors Boeing as in the previous submission, but General Dynamics is now acceptable. There are no major changes foreseen in either of the Navy versions and no clear-cut choice in the naval configuration between contractors.

(*f*) Both contractors are overly optimistic as regards cost figures. Boeing estimates the lower cost figure. Overall, Source Selection Board figures after readjustment also give Boeing a slight edge.

(*g*) The System Source Selection Board with naval flag officer representation, unanimously recommended that Boeing be selected on the basis of:

(1) Superiority in all major aspects of operational capability.
(2) Lower quoted costs.
(3) Positive ground deceleration mechanism.
(4) Greater weapons selectivity and carrying capability; and
(5) Less risk of foreign object damage and military loss degradation of engine performance.

(*h*) For varying reasons, in addition to those cited above, the commander, TAC (Using Command); Chief, BuWeps; commander, AF Logistics Command; commander, AF Systems Command, endorsed the selection of the single Source Selection Board. Commander, TAC emphasized that the Boeing proposal will provide a substantial improvement in TAC capabilities, while the General Dynamics proposal will not provide the same capabilities. Chief, BuWeps emphasized the thoroughness of the evaluation in BuWeps which assures that the naval requirement has been met. In addition, he emphasizes that there is margin for growth in both proposals, but he cautioned against major changes which could invalidate the response to the requirement. Chief, BuWeps also notes the interdependence in the long range air-to-air naval role of the funding for missile systems as well as for this manned system.

3. It was agreed:

(*a*) Both contractors have the capability successfully to design and produce this weapon system.

(*b*) Both designs are acceptable as initial development design configurations to the Using Agencies involved, TAC and Navy.

(*c*) Both designs will require further design refinement and changes can be expected during the development period.

(*d*) When fully developed, the operational tactical aircraft will markedly improve the capability of the Tactical Air Command in carrying out its assigned missions, especially in limited war.

(*e*) Similarly, the Navy version, when fully developed and when configured with the new long range air-to-air missile, will markedly improve existing Fleet Air Defense capability.

(*f*) The competition between the two contractors has achieved its purpose and any further requirement of competitive designs is unjustified.

(*g*) Extremely close management coordination between the Navy and the Air Force will be required to keep a ~~COST PLUS~~ (sic) Fixed Price Plus Incentive Fee contract meaningful and within stated limits.

(*h*) There is a clear and substantial advantage in the Boeing proposal over the General Dynamics proposal which is magnified by the environment found under the austere conditions usually inherent in limited war actions.

[s] WILLIAM J. MCKEE,
*General, U.S. Air Force,*
*Chairman, Air Force Council.*
[s] W. E. ELLIS,
*Rear Admiral, USN, Acting DCNO (Air).*

Approved November 8, 1962.

CURTIS E. LEMAY,
*Chief of Staff.*
EUGENE M. ZUCKERT,
*Secretary of the Air Force.*

Approved November 8, 1962.

[s] GEORGE W. ANDERSON, Jr.,
*Chief of Naval Operations.*
FRED KORTH,
*Secretary of the Navy.*

[Ref 172:760-761]

# Appendix Q: Korth and Zuckert Memorandum (21 Nov 62)

DEPARTMENT OF THE AIR FORCE,
OFFICE OF THE SECRETARY,
*Washington, November 21, 1963.*

MEMORANDUM FOR THE RECORD

We have reviewed the source selection evaluation for the TFX (F-111) most carefully.

This evaluation is by far the most comprehensive source selection evaluation in our experience, and we have great confidence in the details as well as the general conclusions. The magnitude of completed work provides a reliable indication of the quality of both the proposals and the evaluation. Requirements of the work statement have been met in practically all areas by both contractors; where any deficiencies exist, adequate provision has been made to comply with the work statement. All the necessary information is available for selecting a contractor.

The evaluation has produced an advanced aircraft operationally acceptable to both the Navy and Air Force users. It will be a true biservice aircraft, providing for both the Air Force tactical fighter mission and the Navy carrier-based fighter mission.

As both services agree, the TFX design represents a significant advance in the state of the art and results in a weapon system superior to those now in the inventory or in production for either service. The TFX can provide target coverage at a higher mach number than present aircraft and approximately five times the range in performing a typical mission profile. The following is a comparison of the TFX and the F-4C, using the General Dynamics version of the TFX as an example.

| | TFX | F-4C |
|---|---|---|
| Ferry range<br>Takeoff distance<br>Landing distance<br>Range at altitude (supersonic)<br>Range at sea level (supersonic)<br>UCI | Deleted | Deleted |
| Airframe R. & D. costs | $503,000,000 | $168,000,000 |

In its design the TFX has unusual flexibility and growth potential. Improvements in powerplants, weapons, and special equipment can be anticipated, followed by new techniques and new missions. Growth potential is an important consideration, because the life of the aircraft should be long to justify the high cost.

It is apparent from the evaluation that the Boeing and General Dynamics proposals, although possessing strong dissimilarities, are rated equally. In the raw score comparison, General Dynamics received 175.6 points and Boeing 172.1, a difference of less than 2 percent.

## Appendix Q (Continued)

The Air Force gives a significant edge to the operational characteristics of the Boeing aircraft, because of its longer ferrying range, greater firepower, and the provision of thrust reversers for increased maneuverability. The Navy also favors Boeing's operational features but to a lesser degree, attributable in part to the lower number of Boeing aircraft which could be accommodated aboard a carrier [deleted]. In the Navy version the Boeing proposal has a speed restriction which would require additional weight to be added. The General Dynamics aircraft is slightly inferior in weapon selectivity and carrying capability; however, its superior supersonic performance and lack of a speed limitation are considered to be basic advantages which can overcome the deficiencies.

Inasmuch as either of the proposed aircraft can perform the mission required by both services, and the evaluation of the proposals provides no overriding margin between the competitors, it is necessary to consider other factors in evaluating these aircraft.

The first of these is the degree of commonness. A high degree of commonness will initially provide a larger number of identical parts and their required tooling, and a future higher rate of common maintenance and operating spares. General Dynamics has a distinct edge in this area, and more closely adheres to the Secretary of Defense guidelines to "reduce weapons system costs by maximizing similarities of Air Force and Navy versions and by maximum use of common equipment and structures."

On a reasonably comparable basis, 85 percent of the parts in the General Dynamics version are identical, contrasted with 60 percent in the Boeing proposal. This factor, we believe, will become increasingly important as the development program of the aircraft evolves. Furthermore, it is doubtful that, in the normal course of development, Boeing can maintain their degree of commonness. This conclusion is reinforced by the fact that Boeing contemplates separate static test programs for their two versions. As stated in the evaluation, Boeing "is, in effect, proposing two different airplanes from the structural point of view."

It is significant that General Dynamics' integrated program for the two versions of the aircraft showed a reduction of $623 million, in comparison with their cost of developing the two versions separately. The saving in the Boeing proposal was only $397 million, emphasizing the degree to which Boeing's version are less similar than General Dynamics'.

Another factor concerns the reservations expressed by the Navy regarding the structural aspects of the Boeing proposal.

It is believed by Boeing that components used in the Air Force aircraft can be manufactured by the same tooling and reduced for the Navy aircraft by machining. It seems reasonable that if the Navy reservations as to the adequacy of the Boeing design turn out to be sound, necessary modifications of the structural design will further reduce the degree to which the Boeing versions will be common. In addition, if the Navy's reservations as to the structural integrity, the fatigue problem, and the introduction of titanium in structural members are well founded, further manufacturing problems may be introduced which are not envisioned by Boeing at this time.

Another factor to which we gave consideration was the cost proposal of the two manufacturers. It is hard to understand the optimism of the Boeing estimates for engineering, tooling, and manufacturing. With respect to tooling costs, it appears from the estimates and the rationale used by Boeing that they are approaching the development of this aircraft on a very simple basis. Boeing has reduced its man-hour estimates for manufacturing by as much as 30 percent below the industry average and has based much of its estimating on experience with B-52, KC-135, B-47, and BOMARC costs. It is not believed that this experience is directly applicable to a high-density, complex fighter aircraft. Boeing provided for acquisition of duplicate tooling in the production program, which reduces the R.D.T. & E. cost estimate. Sustaining tooling man-hours have been reduced to a most unrealistic level and sustaining engineering has again, through bookkeeping, been costed in the production program rather than in the R.D.T. & E. program. This implies that there would be no manufacturing difficulties due to engineering change proposals during the research and development program.

## Appendix Q (Continued)

We conclude that the Boeing formula for estimating the cost of the aircraft resulted from an overoptimistic impression of the complexity of the TFX in relation to Boeing-produced bombers. Boeing's estimates for the total research and development program are so low that, in our opinion, they have seriously misjudged the difficulties to be expected in this aircraft of new concept.

There are additional examples of excessive optimism in the Boeing proposal—the apparent belief that thrust reversers can be developed without major problems and engineering changes; the view that the variable sweep wing can be quite easily applied to the TFX concept; the use of titanium in structural members; and the unique design for the propulsion installation. These examples suggest, if our experience is any guide, that much redesign and testing would be necessary, contrary to the reduced engineering estimates and cost indicated in the Boeing proposal.

Conversely, it is noted that the General Dynamics proposal applies extensive engineering and test effort to the development program and could be considered as being conservative. It is felt that this approach is more likely to meet the development milestones and cost goals than the Boeing proposal.

In analyzing the summary of ratings in the evaluation, it is pertinent to note that the General Dynamics evaluation exceeds Boeing's in the technical areas of air vehicle, propulsion, flight control, secondary power and environment control, mission and traffic control, aerospace ground equipment, crew provisions, and personnel subsystems. These favorable areas, in our opinion, outweigh the deficiencies in offensive systems, reconnaissance, and penetration aids.

Further, the favorable rating in production program planning and cost realism provides much credibility to General Dynamics in areas with which we are particularly concerned.

The final consideration stemmed from the fact that the General Dynamics/Grumman team has extensive experience in the development and production of high performance, tactical, and carrier-based aircraft. It is thoroughly familiar with all the problems of stability augmentation and supersonic operation. This experience is not obtained in developing and producing bombers and subsonic jet transports, which have been the major portion of Boeing's experience in recent years.

It is our opinion, therefore, in view of the fact that both aircraft proposed are acceptable and offer a capability far beyond present-day aircraft, we should accept General Dynamics' proposal on the basis that it proposes the greater degree of commonness, contemplates the use of conventional materials, provides the higher confidence in structural design, and offers the better possibility of obtaining the aircraft desired on schedule and within the dollars programed.

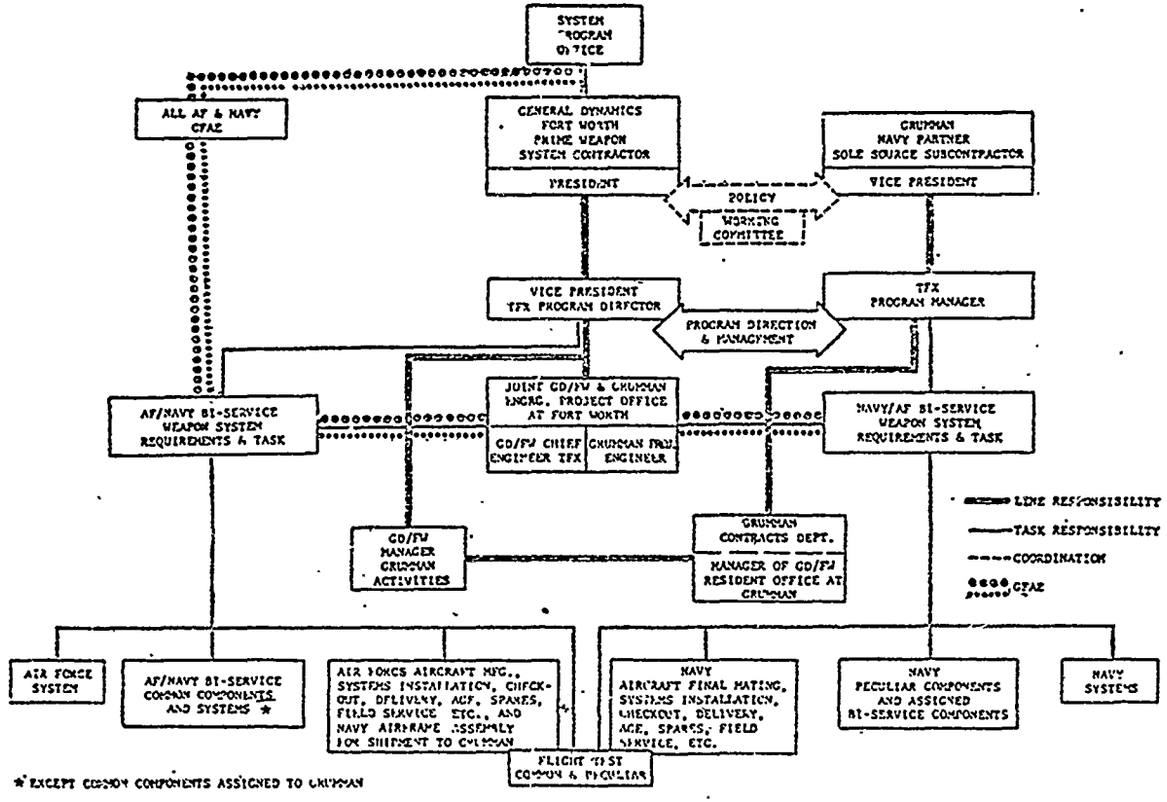
FRED KORTH,
*Secretary of the Navy.*
EUGENE M. ZUCKERT,
*Secretary of the Air Force.*

Approved:

ROBERT S. MCNAMARA,
*Secretary of Defense.*

[Ref 172:350-353]

# Appendix R; General Dynamics-Grumman Relationship




[Ref 172:1600]

# Appendix S: The F-111 Industry Team

## Prime Contractor

General Dynamics Corp.
Fort Worth Div.
Fort Worth, Tex.

## Associate Contractor

Hughes Aircraft Co.
Culver City, Calif.
Phoenix missile system

## Associate Contractor

United Aircraft Corp.
Pratt & Whitney Aircraft Div.
East Hartford, Conn.
Engines

## Subcontractor: Principal and Associate

Grumman Aircraft Engineering Corp.
Bethpage, N. Y.
Aft fuselage sections and F-111B assembly

## Subcontractors: Major Subsystems

AVCO Corp.
Electronics Div.
Cincinnati, Ohio
Countermeasures receiving systems

The Bendix Corp.
Electrodynamics Div.
North Hollywood, Calif.
Servo actuator for horizontal tail, rudder, and spoilers
Navigation and Control Div.
Teterboro, N. J.
Air data computer

Collins Radio Co.
Cedar Rapids Div.
Cedar Rapids, Iowa
Antenna coupler

The Garrett Corp.
AiResearch Manufacturing Co.
Los Angeles, Calif.
Air-conditioning system, engine starter (pneumatic)

General Precision, Inc.
Link Group
Binghamton, N. Y.
Mission simulator
GPL Div.
Pleasantville, N. Y.
Doppler radar

General Electric Co.
Defense Electronics Div.
Aerospace Electronics Dept.
Utica N. Y.
Attack radar
Defense Electronics Div.
Avionics Controls Dept.
Johnson City, N. Y.
Flight control, load computing optical sight set, and the optical display sight set
Missile and Space Div.
Armament Dept.
Burlington, Vt.
Ammunition handling system

Honeywell, Inc.
Aeronautical Div.
Minneapolis Minn.
Low-altitude radar altimeter

Litton Industries, Inc.
Guidance and Controls Systems Div.
Woodland Hills, Calif.
Navigation and attack system, astrocompass

McDonnell Douglas Corp.
St. Louis, Mo.
Crew module and escape system

Motorola, Inc.
Aerospace Center
Scottsdale, Ariz.
X-Band transponder

North American Aviation, Inc.
Autonetics Div.
Anaheim, Calif.
Mark II and Mark IIB avionics

Sanders Associates, Inc.
Nashua, N. H.
ECM group

Sundstrand Corp.
Sundstrand Aviation Div.
Rockford, Ill.
Constant speed drive engine starter (cartridge), emergency power unit

Texas Instruments, Inc.
Apparatus Div.
Dallas, Tex.
Terrain-following radar

Textron, Inc.
Dalmo Victor Co.
Belmont, Calif.
Radar homing and warning

United Aircraft Corp.
Hamilton Standard Div.
Windsor Locks, Conn.
Air inlet and cabin pressure equipment

Westinghouse Electric Corp.
Aerospace Electrical Div.
Lima, Ohio
AC power system

Extracted from the December 1967 issue of Air Force and Space Digest, pg 55.

Appendix T: Specifications and Requirements for the TFX

Demonstrate a capability of flying 30 hours a month, maintaining 75% operational readiness rate and achieve a maintenance rate of only 35 maintenance man-hours per flight hour during test [Ref 56:26].

No ailerons; pitch and roll controlled by horizontal foil.

Pilot can select an infinite number of wing sweep angles (Wing sweep is 16 degrees to 72.5 degrees).

Ability to carry 48 bombs externally (Ref 66:53).

Identical and interchangeable engines (Ref 149:53).

Specifications (F-111A)--span, wings extended, 63 feet; wings fully swept, 32 feet; height, 17 feet; length, 73 feet; weight, approximately 60,000 pounds.

Performance (F-111A)--speed, supersonic at sea level and up to Mach 2.5 at 60,000 feet; range, transoceanic without refueling in flight; refueling capability and landing capability under 3,000 feet.

Specifications (F-111B)--span, wings extended, 70 feet; wings fully swept, 34 feet; height 16 feet, 8 inches; length, 66 feet, 9 inches.

Performance (F-111B)--same as that of the F-111A [Ref 185: R-4B.

GSM/SM/68-07,14

# Appendix U: Committee on Government Operations

COMMITTEE ON GOVERNMENT OPERATIONS

JOHN L. McCLELLAN, Arkansas, *Chairman*

HENRY M. JACKSON, Washington
SAM J. ERVIN, Jr., North Carolina
HUBERT H. HUMPHREY, Minnesota
ERNEST GRUENING, Alaska
EDMUND S. MUSKIE, Maine
CLAIBORNE PELL, Rhode Island
THOMAS J. McINTYRE, New Hampshire
ABRAHAM A. RIBICOFF, Connecticut
DANIEL B. BREWSTER, Maryland

KARL E. MUNDT, South Dakota
CARL T. CURTIS, Nebraska
JACOB K. JAVITS, New York
JACK MILLER, Iowa
JAMES B. PEARSON, Kansas

WALTER L. REYNOLDS, *Chief Clerk*

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PERMANENT SUBCOMMITTEE ON INVESTIGATIONS

JOHN L. McCLELLAN, Arkansas, *Chairman*

HENRY M. JACKSON, Washington
SAM J. ERVIN, Jr., North Carolina
EDMUND S. MUSKIE, Maine
THOMAS J. McINTYRE, New Hampshire
DANIEL B. BREWSTER, Maryland

KARL E. MUNDT, South Dakota
CARL T. CURTIS, Nebraska
JACOB K. JAVITS, New York

JEROME S. ADLERMAN, *General Counsel*
DONALD F. O'DONNELL, *Chief Counsel*
PHILIP W. MC[illegible]AN, *Chief Counsel to the Minority*
RUTH YOUNG WATT, *Chief Clerk*

[Ref 172:ii]

# Appendix V: Navy Participation in TFX Program

DEPARTMENT OF THE NAVY,
BUREAU OF NAVAL WEAPONS,
*Washington, D.C., March 20, 1963.*

From: Chief, Bureau of Naval Weapons.
To: Secretary of the Navy.
Via: Assistant Secretary of the Navy (Research and Development).
Subject: Navy participation in management of F-111 (TFX) program.
Enclosure: (1) Additional functions of the Assistant Director for Navy Program.
(2) F-111 System Program Office organization.
(3) Rules for computing Navy R.D.T. & E. funding.
(4) Contractor liaison clause.

1. A joint Air Force-Navy agreement for the management and funding of the F-111(TFX) was approved by the Assistant Secretaries (Research and Development) of the Air Force and Navy in September 1961. This agreement provides that the F-111A/B weapons system program will be managed under the Air Force weapons system concept; i.e.: The complete system will be planned, organized and controlled as an integrated single program by the Air Force System Program Office (SPO) located at Wright-Patterson Air Force Base, Ohio. The program will be directed by an Air Force System Program Director who is responsible for procuring the weapon system to satisfy both Air Force and Navy requirements.

2. The System Program Director (SPD), currently Col. C. A. Gayle, has the management responsibility for integrating, coordinating, and monitoring the system-oriented activities of all participating users and all Air Force field agencies, and for directing procurement in consonance with the approved plan. This plan, called the system package program plan, is a planning and programing document which will be periodically updated and will describe the overall biservice program. This plan will be prepared by the SPO in collaboration with Navy and Air Force participating agencies. Upon its approval by higher Navy and Air Force headquarters, it will be a directive for all users of the aircraft and other participating agencies. This system package program plan will be the major management tool of the System Program Director.

3. The F-111 System Program Office (SPO) will include appropriate naval personnel, under the direction of a senior naval officer, to assist the SPD in his management of the program and to represent the Chief, Bureau of Naval Weapons in the SPO. At the present time there are two naval officers on duty in the SPO; a third has been ordered; and it is planned to order four more within the next few months. Of the seven naval officers assigned to the SPO, it is anticipated that five will have post graduate engineering education and/or previous duty in BuWeps. The senior naval officer in the SPO is designated Assistant Director for Navy Program (ADN)—currently he is Capt. D. C. Davis, USN. As direct representative of the Chief, BuWeps, the ADN is organizationally oriented within the SPO subordinate to the Director but with adequate organizational posture to enable him to fulfill the Chief, BuWeps responsibility for the Navy version of the F-111. Additional functions of the ADN are outlined in enclosure (1). The planned integration of naval personnel into the System Program Office is indicated on the organizational chart, enclosure (2).

4. The Assistant Chief for Plans and Programs, BuWeps, currently RADM A.M. Shinn (code C) will exercise full coordination authority over the F-111B program for Chief, BuWeps. The BuWeps F-111B Program Manager (Code CD-3) in RADM Shinn's office will act as point of contact within BuWeps where requests for guidance and support or other questions from the Assistant Director for Navy Program in the SPO, or other external agencies, may be referred. This centralization of program management authority is not to be construed to limit free exchange of information among BuWeps, the SPO and other agencies at all appropriate levels. On the contrary, direct communication between Air Force and Navy counterparts is essential to the success of the program and is encouraged.

## Appendix V (Continued)

5. The Air Force F-111 System Program Director exercises control over the configuration of the weapon system through the SPO Configuration Control Board (CCB). The CCB, normally chaired by the Director, has the responsibility for evaluation and approval or disapproval of all changes after the configuration baseline for each end item is established. The Assistant Director for Navy Program (ADN) in the SPO shall be a member of the CCB and he shall prepare the Navy position in relation to each change proposal brought before the board. Dissenting opinions of the ADN member of the CCB will be made a matter of record and will be forwarded to the Chief, BuWeps. Should a decision of the Air Force chairman of the CCB be questioned by the Chief, BuWeps, it will be referred to the Interservice Senior Configuration Board.

6. The Interservice Senior Configuration Board is established jointly by the Commanding General, Aeronautical Systems Division and the Chief, BuWeps. This board will be composed of equal voting members from the Air Force and Navy, plus a chairman. The board will be chaired by an officer of flag or general rank and the chairmanship will be rotated between services on a 6-month basis. The objective of this board is to control design and engineering changes from the General Dynamics/Grumman weapon system proposal of September 10, 1962, to insure minimum Air Force and Navy aircraft divergence, consistent with meeting mission requirements and minimizing total program costs. This board's responsibility for configuration management will be the same as that required of the F-4B/C Interservice Senior Configuration Board by the Deputy Secretary of Defense in memo to the Service Secretaries dated February 22, 1963, to wit:

(*a*) Insure a coordinated review and approval of all changes affecting the Department of Defense inventory of all F-111 aircraft. Strict control shall be exercised over changes to component equipment which is common to the aircraft of both services.

(*b*) Insure that costs and leadtime of engineering, tooling, production, retraining, parts inventories, technical data, and aircraft availability are developed prior to change decisions.

(*c*) Develop procedures that will enable each service to take necessary action on "safety-of-flight" change requirements, on an emergency basis, prior to interservice considerations if necessary.

7. Navy is responsible for the development and procurement of the Hughes Aircraft Company PHOENIX Missile System which is to be furnished as Government Furnished Aircraft Equipment (GFAE) for installation in the F-111B. Navy also is responsible for the development and procurement of the Pratt-Whitney TF-30 engines to be furnished as GFAE for installation in the F-111A and F-111B. These major GFAE contractors and General Dynamics/Grumman have been directed to develop detailed plans for integrating the PHOENIX Missile System and TF-30 engine in the F-111B. These plans are being jointly prepared and will be mutually agreed upon between General Dynamics/Grumman and each of the prime GFAE contractors before submission for approval by the Chief, BuWeps and the System Program Office.

8. The Air Force is budgeting for all development costs of the F-111 aircraft and the TF-30 engine. The Navy is budgeting for all development costs of the PHOENIX Missile System and except for this system, the Navy essentially budgets only for end item manufacturing cost of the F-111B. Enclosure (5) indicates the detail rules for computing Navy F-111B R.D.T. & E. funding.

9. There is a problem area, not yet resolved, which is of major concern to the Navy. The original General Dynamics/Grumman proposal, on which Navy's acceptance was based, included assembly of the F-111A at Fort Worth and the F-111B at Peconic River, Long Island. General Dynamics has stated that disruption of this original proposal would invalidate estimates for cost, performance, and delivery schedule on which General Dynamics/Grumman proposal was submitted and accepted. However, there appears to be interest in USAF Headquarters in having the F-111B assembled at Fort Worth rather than Peconic River. An Air Force/Navy team has studied this alternate assemble proposal and reported that additional cost would accrue if both versions of the aircraft were assembled at Fort Worth. The Commanding General, Air Force Systems Command, was satisfied with the report and stated his position that the F-111B should be assembled and tested at the Grumman plant as originally proposed and evaluated. Nevertheless, the question is as yet unresolved and may delay program accomplishment and possibly invalidate original program estimates.

## Appendix V (Continued)

10. The development of detailed plans for the integration of the Phoenix missile system and TF-30 engine in the F-111B are being delayed because the SPO has withheld approval of Grumman's assembly and test of the Navy aircraft. In addition, the development of these plans are affected by a current incompatibility between General Dynamics, Hughes, and Pratt-Whitney contracts as regards these contractors' relationships. At BuWeps request, a conference was held at Wright Field on February 8, 1963, concerning clauses in General Dynamics' letter contract which in effect exceeded the scope of responsibilities that should be contractually delegated to General Dynamics with respect to its relations with Hughes and Pratt-Whitney. The Air Force SPO representatives at the conference recognized a need for contractual revisions and submitted their suggested changes to be compared with BuWeps suggested changes. A contractor liaison clause developed by the conferees for inclusion in the General Dynamics contract is attached as enclosure (4). The F-111 system program director was not present during the drafting of this clause and its implementation as an amendment to General Dynamics contract is being withheld, waiting his approval. The contractor liaison clause includes instructions for coordination and cooperation between prime contractors which are necessary for proper administration of related Air Force and Navy R.D.T. & E. contracts over the next 5 years.

K. S. MASTERSON.

ADDITIONAL FUNCTIONS OF THE ASSISTANT DIRECTOR FOR NAVY PROGRAM

The Assistant Director for Navy program in the Air Force system program shall function additionally as follows:

(1) He shall report for duty to the Commanding General Aeronautical System Division. He shall report to the BuWeps fleet readiness representative for naval administrative matters. He shall be under the technical direction of the Chief, BuWeps, who normally will exercise such direction through the BuWeps F-111B program manager.

(2) He shall be responsible, under such procedures as the system program director (SPD) may establish, for the preparation of these portions of the system package program plans which concern the Navy aircraft.

(3) He shall delegate road directive authority within the SPO for all matters lying within his competence and resources which affect the Navy aircraft. Heavy reliance shall be placed on his discretion to act independently or to refer to the Chief, BuWeps, matters which require decision or action by BuWeps, or higher authority. Such discretion extends to all matters except—

(*a*) Deviations from established Navy policy;
(*b*) Changes to funding of the program;
(*c*) Navy approval of the system package programs plans;
(*d*) Changes to aircraft delivery schedules; and
(*e*) Aircraft changes degrading Navy mission performance, or altering operational characteristics.

(4) He shall seek guidance and assistance through the BuWeps F-111B program manager as needed and keep him informed on program status, progress, problems, significant events, matters of a controversial nature, and decisions made on his own initiative.

(5) He shall provide the Air Force with full access to the Navy Phoenix missile system program, TF-30 engine programs, and other Navy GFE programs scheduled for installation on the F-111

(6) He shall transmit matters of a directive nature to Navy field activities, when required, through BuWeps.

(7) He shall be a member of the SPO Configuration Control Board (CCB).

RULES FOR COMPUTING NAVY R.D.T. & E. F-111B FUNDING

*Total system development.*—Air Force will fund all system development requirements.

*Flyaway—Air vehicle.*—Navy will fund for end item manufacturing and spares manufacturing.

*Peculiar aerospace ground equipment (AGE).*—Navy will fund for end item manufacturing and spares manufacturing.

*Training.*—As concerns hardware, Navy will fund for end item manufacturing and spare manufacturing. Navy will totally fund for all other selected nonhardware items.

*Data.*—Navy will fund for engineering data, technical orders, and manuals that are peculiar to the Navy requirements.

*Engineering change orders.*—Navy will fund for end item manufacturing and spares manufacturing.

## Appendix V (Continued)

CONTRACTOR LIAISON CLAUSE

1. The following equipment will be procured by the Government from the other contractors (OC) listed hereunder and shall be supplied to the system contractor (SC), as defined in AFR 375-1 par. j, as Government-furnished aeronautical equipment.

| Contractor | Contract No. | Equipment |
|---|---|---|
| Pratt & Whitney Aircraft, Hartford, Conn. | Nov. 63-0140-f | Engine TF-30. |
| Hughes Aircraft Co., Culver City, Calif. | Nov. 63-0379-d | Phoenix missile system. |

2. It is intended that the above equipments shall function integrally with the weapon system being procured under this contract. To assure the greatest degree of compatibility in this respect, it is necessary that the SC and the OC maintain close liaison with each other on all matters pertaining to equipment integration, specifications, equipment reliability, handbook and technical data, maintenance and test equipment, supportability, maintainability, configuration control and training equipment. Therefore it is recognized and agreed that the SC shall:

(*a*) Evaluate, coordinate and/or make comments on all data, including proposed changes, ECP's, drawings, specifications and revisions thereto, that pertain to the SC equipment that affect form, fit, function, performance, installation or any other feature to insure complete compatibility with the weapon system, and

(*b*) Furnish to the OC's for evaluation, coordination and/or comments all data including proposed changes, ECP's, drawings, specifications and revisions thereto that pertain to the SC equipment that affect form, fit, function, performance, installation or any other feature to assure complete compatibility of the weapons system.

(*c*) Negotiate any necessary changes to arrive at a mutually satisfactory resolution. The SC and the OC will obtain agreement between their respective corporate officials within 45 days after identification of the changes. Where agreements cannot be reached within such period of time the SC shall forward, within 5 days, to the ASC contracting officer (ASZBKK) and the Bureau of Naval Weapons (CD-3) the portion of individual data and/or changes which have been mutually agreed to by the SC and the OC, along with a complete explanation of all matters upon which agreement has not been reached, setting forth the reasons for disagreement between the SC and the OC.

3. The weapon system contractor shall establish such management and technical liaison with the other contractors to insure that all equipment will properly function as an integrated system. To this end, the prime system contractor, in conjunction with each of the other contractor(s), agrees to develop a joint plan of action (within the scope of this contract and those cited in paragraph 1 above) covering but not limited to the following areas:

(*a*) Detailed procedures for accomplishing the requirements enumerated in paragraph 2 above.

(*b*) Arrange for the exchange of technical or other personnel as required between SC and the OC's plants, test sites or other involved locations to facilitate the integration discussed herein.

(*c*) Copies of all data, information, and correspondence furnished to the other contractor(s), which affect form, fit, function, performance, or schedule, shall be forwarded to the Aeronautical Systems Division (ASZBKK) and to the Bureau of Naval Weapons (CD-3) simultaneously.

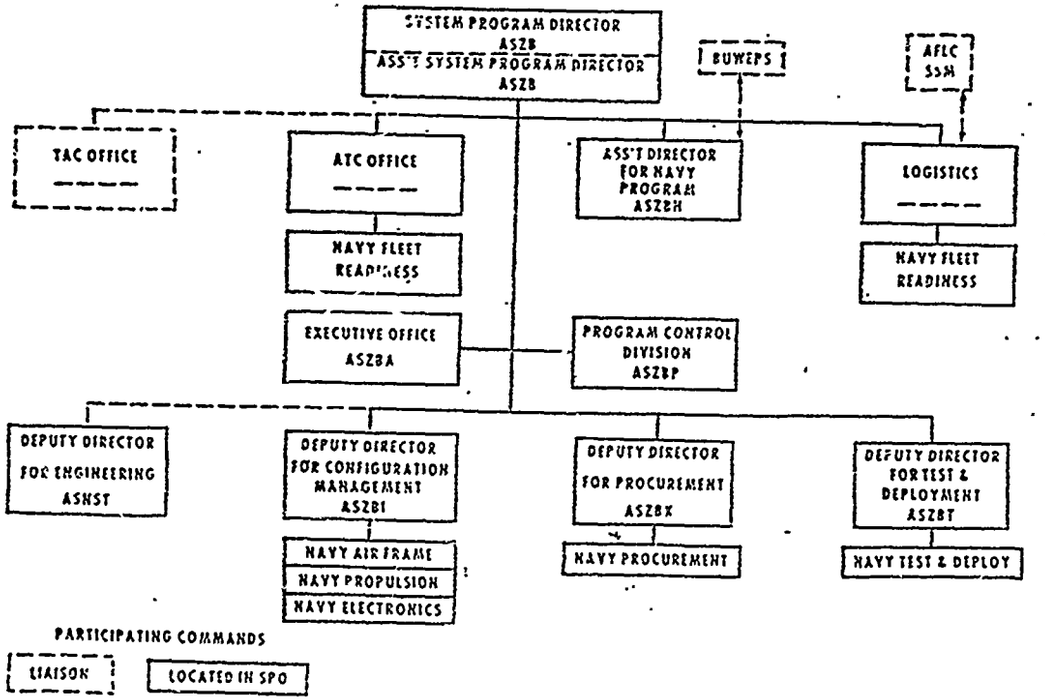
(*d*) Seven copies of the joint plan, specified above, including one copy which will be reproducible, shall be submitted for approval by the SC to the contracting officer, Aeronautical Systems Division (ASZBKK) within 30 days after acceptance of this amendment to this contract.

(*e*) If a joint plan cannot be reached in this time period, the SC will forward to ASD a copy of the plan to the extent agreed upon, and setting forth reasons for disagreement between the SC and the OC.

4. In the event that an occasion arises where an agreement cannot be reached within the time period specified herein, for requirements referenced in paragraphs 2 and 3 above, between the prime system contractor and the other contractor(s) the matter upon which agreement has not been reached will be submitted to the Aeronautical Systems Division (ASZBKK) and the Bureau of Naval Weapons (CD-3). The decision of the Government as furnished by the contracting officer, Aeronautical Systems Division (ASZBKK) shall be final except where the procedures set forth in the "disputes" clause are appropriate, and the rights of the parties thereunder are not waived hereby.

## Appendix V (Continued)

AIR FORCE F-111 SYSTEM PROGRAM OFFICE ORGANIZATION




[Ref 172:1817-1822]

## Appendix W: Past Performance of Boeing and General Dynamics

Cost and 'cost realism' are mentioned repeatedly through out the TFX program. The Subcommittee's investigator, Mr. Nunnally, prepared the following two tables to show past performance of Boeing and General Dynamics on different weapon systems covered by various types of contracts.

### TABLE XVII

### Boeing Program Performance

THE BOEING CO.

*History of program performance versus contract estimates*

[In thousands]

| Program | Proposed target | Negotiated target | Negotiated changes | Total | Final cost to Government | (Over) or under target amount | Percent |
|---|---|---|---|---|---|---|---|
| C-97 | $741,226 | $715,350 | $13,171 | $728,521 | $709,920 | $18,601 | 2.6 |
| B-47 | 1,861,850 | 1,782,169 | 109,063 | 1,891,253 | 1,836,850 | 54,403 | 2.9 |
| KC-135 | 1,413,382 | 1,337,062 | 72,206 | 1,409,268 | 1,402,065 | 6,603 | .5 |
| IM-99 Bomarc | 1,619,819 | 1,540,627 | 74,227 | 1,616,154 | 1,526,087 | 89,067 | 5.5 |
| B-52 (Wichita) | 2,196,730 | 2,128,700 | 140,552 | 2,273,312 | 2,271,016 | 7,326 | .3 |
| B-52 (Seattle) | 1,346,295 | 1,315,171 | 70,777 | 1,391,948 | 1,467,540 | (72,592) | (5.2) |
| Total | 9,179,332 | 8,819,489 | 497,996 | 9,317,485 | 9,214,078 | 103,407 | 1.1 |

NOTE.—Contractor furnished figures.

[Ref 172:1051]

### TABLE XVIII

### General Dynamics Program Performance

GENERAL DYNAMICS CORP.

*History of program performance versus contract estimates*

[In thousands]

| Program | Proposed target | Negotiated target | Incremental procurements | Negotiated changes | Total negotiated fee or profit | Total | Final cost to Government | (Over) or under | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Amount | Percent |
| F-102 | $649,553 | $651,013 | $174,253 | $163,201 | $60,023 | $998,510 | $1,011,253 | ($12,743) | (1.3) |
| F-106 | 334,095 | 371,499 | 206,593 | 88,589 | 63,701 | 830,772 | 829,846 | 926 | .1 |
| B-58 | 1,050,911 | 1,051,377 | 1,240,118 | 102,681 | 144,772 | 2,538,848 | 2,737,736 | (198,888) | (7.8) |
| Total | 2,114,559 | 2,074,789 | 1,721,294 | 294,401 | 277,586 | 4,368,130 | 4,578,835 | (210,705) | (4.8) |

NOTE.—Contractor furnished figures.

[Ref 172:1050]

## Appendix X: Commonality of TFX

Figure 11. depicts the common and service peculiar components on the F-111 aircraft [Ref 138:50].

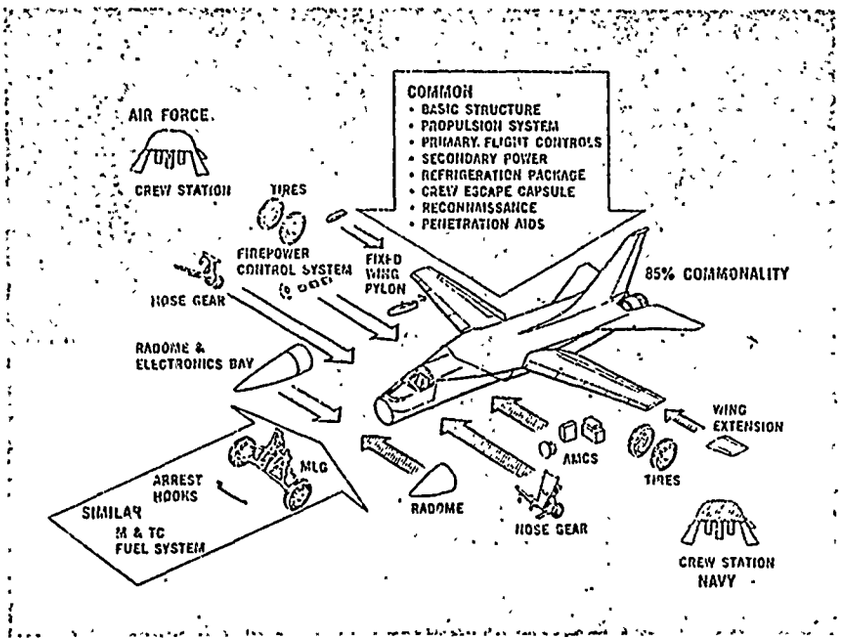



Figure 11. Commonality of TFX

## Appendix Y: Fourth Round Scores

TABLE XIX

Fourth Round Scores

| | General Dynamics | | Boeing | |
|---|---|---|---|---|
| | Raw | Weighted | Raw | Weighted |
| Technical | 96.9 | 209.3 | 92.4 | 192.4 |
| Operational | 24.8 | 215.2 | 28.2 | 237.4 |
| Logistics | 24.8 | 187.7 | 24.8 | 89.1 |
| Management, production costs | 29.1 | 150.2 | 26.7 | 135.3 |
| Total | 175.6 | 662.4 | 172.1 | 654.2 |

[Ref 172:1911]

## Appendix Z: A Systems Management Philosophy

Perception of what 'Systems Management' is varies among people. A generally accepted definition states that a system is "an organized or complex whole' [Ref 95:367]. Management is succinctly defined as 'an intelligent, purposeful activity-deliberately trying to achieve predetermined goals' [Ref 10:2]. In combining these two definitions, it should be apparent that the systems management philosophy does not negate the basic functions of planning, organizing, coordinating, directing and controlling. Rather, there is a change of emphasis. The functions are integrated and performed with an appreciation of the dynamicism of the interplay between the organization and its environments-the internal, competitive and external systems [ref 95:383]. The systems manager then, is that individual who does this integration of diverse efforts directed toward a specific objective [Ref 5:13]; he is of necessity, an 'integrator-generalist' who has an appreciation for the inter-relatedness of his 'system' with the internal, competitive and external systems [Ref 58:65].

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# VITA

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13. ABSTRACT

This report presents a philosophy for the use of the case method in systems management education. The case method is defined and its background and development are discussed. The use of cases, and their analyses, is discussed from two viewpoints; that of the teacher and that of the student. Explicit suggestions are offered to the teacher to help him in forming a 'modus operandi' which will insure maximum results from case studies. Guidance is offered which will assist the student in analyzing cases. A systematic problem solving model is developed which can be reproduced and handed out to a class. This model can also be used by managers analyzing problems on the job. The concluding chapters of this paper are devoted to a case study of the acquisition of the Tactical Fighter, Experimental (TFX). This case is designed primarily for study by systems managers; it is a study of the interrelationships and complexities involved in a major Defense Department decision. Following the case is the teacher's aid which discusses some of the salient features of the case study.

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