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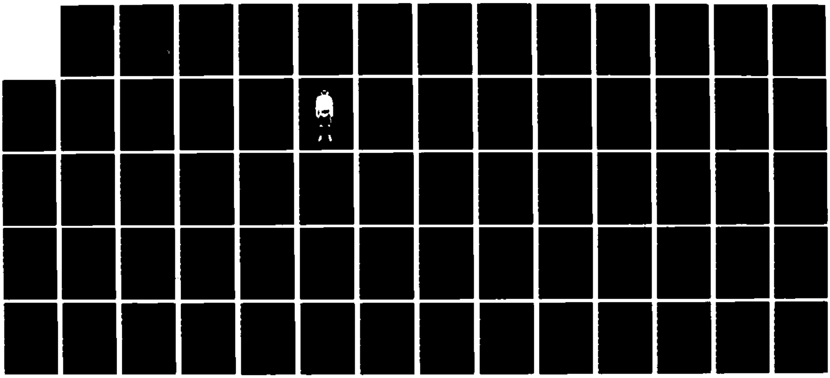

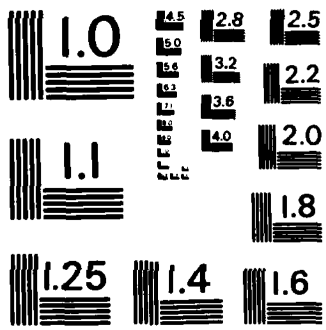

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AN EXAMINATION OF
THE LIFE SUPPORT EQUIPMENT
DEVELOPMENT AND ACQUISITION PROCESS

THESIS

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AFIT/GSM/XPX/85S-24

AN EXAMINATION OF THE LIFE SUPPORT EQUIPMENT DEVELOPMENT AND ACQUISITION PROCESS

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

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Master of Science in Systems Management

Jeffrey J. Moyer, B.S.

First Lieutenant, USAF

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Jeffrey J. Moyer

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Abstract

This thesis examined the process of life support equipment development and acquisition. This research identified how the present process works, and the problems of the process. The research was limited to the development and acquisition of life support equipment for tactical aircraft. However, most of the problems and steps of the process are shared by life support equipment programs for other users. The process was determined by referring to applicable regulations and interviewing people involved in the process. Problems were identified asking for them during the interviews, and by examining the process as a whole.

Seven problems are identified, of which five are considered correctable in the current defense acquisition framework. Four of the five problems deal with the management of the acquisition and development process, and combined indicate the lack of an integrated approach to the acquisition and development process. Solutions were developed from suggestions obtained during the interviews and through qualitative analysis of the problems. The results of this examination indicate that problems exist in the life support equipment development and acquisition process and that the development of an integrated process is necessary to solve these problems. An integrated solution is proposed in the recommendations.

AN EXAMINATION OF THE LIFE SUPPORT EQUIPMENT DEVELOPMENT AND ACQUISITION PROCESS

I. Introduction

General Issue

The acquisition of support equipment has always been slighted in the acquisition of weapons systems. Life support equipment has been no exception. According to a long time program manager in the Life Support Program Office, life support equipment has been developed on a piecemeal basis, often in a " firefighting " mode (34). As a result, life support equipment/pilot capabilities have begun to limit use of the full capabilities of aircraft because the life support equipment is not as advanced as the aircraft in which it is used (34).

Specific Problem

The present process of managing life support equipment development has not maintained pace with the rapid increase in aircraft performance (32). The objective of this research is to identify the problems of the life support equipment development and acquisition process and to develop a solution to these problems.

Background

Life support equipment for an aircraft pilot has long been considered the pilot's personal equipment rather than an integral part of the aircraft. However, this equipment is supposed to enable the pilot to operate in the cockpit. Today's fighter aircraft are designed to perform maneuvers at the limit of a pilot's physical capability, and the next generation of aircraft will exceed these limits. This makes the pilot a limiting factor in aircraft performance, and makes his life support equipment increasingly important.

In this thesis, life support equipment will be defined to include anti-G devices, oxygen masks, helmets, flight garments, and environmental control systems. This equipment enables the pilot to operate in the cockpit. Each piece of equipment limits the pilot's capabilities in some way. A heavy helmet increases fatigue. A vapor proof flight suit increases thermal stress. Thick chemical defense gloves reduce the usefulness of the fingers. These limitations are taken into consideration when developing life support equipment, but not when designing the aircraft in which the pilot has to perform (14).

The problems being experienced with the development and acquisition of life support equipment have not gone unnoticed. In January of 1982, the Vice Chief of Staff of the Air Force ordered an in-depth survey of life support equipment development, acquisition, training, and use (31). This was followed by a System Acquisition Management Inspection of the acquisition process (9). Both investigations uncovered problems and proposed solutions, but the problems still exist today (9;31). This research builds upon the recommendations and findings in these investigations.

Scope

This research examined only life support equipment which enables the pilot to operate in the cockpit. It did not include ejection seats, life preservers, and other survival equipment. In addition, the research was limited to fighter aircraft, where problems with life support equipment are beginning to limit aircraft performance (32).

Although this research is limited to fighter aircraft and non-survival equipment, the problems with the current process of life support equipment development and acquisition have also been noticed in other programs within the Life Support Program Office (32). Programs for Strategic Air Command, Military Air Command, and Air Training Command have also experienced the problems identified during this research (32). When reading this thesis, the reader may substitute the words 'using command' for Tactical Air Command or Tactical Air Forces almost everywhere, without affecting the validity of the statements.

Research Objectives

1. Determine how life support equipment is developed and acquired now.
    - What organizations are responsible?
    - What interface do they have with aircraft program offices?

2. Determine when life support equipment is considered in the acquisition cycle of an aircraft.
    - At what point in the acquisition process is life support equipment considered?
    - Who does the considering?
    - What is the result of these considerations?

3. Identify problems with the current process of life support equipment development and acquisition.

II. Background

Overview

The development and acquisition of life support equipment follows general procedures used in the development and acquisition of all Air Force systems. This chapter presents those procedures and a discussion of the types of life support equipment being considered in this thesis.

The Acquisition Process (1;18;17)

The acquisition of any system begins with the issue of a Statement of Operational Need (SON). The SON documents deficiencies in an operational command's ability to perform its tasks, which it cannot correct within its authority (3:3). Deficiencies are identified by continuous mission analysis by the operational commands (3:2). The SON is written by the operational commands with the assistance, if requested, of Air Force Systems Command, Air Force Logistics Command, Air Training Command, and the United States Air Force Security Service (3:3). These four organizations will be asked to comment on technology base availability, integrated logistics support, cost, safety, human factors, training needs, COMSEC, ELSEC, and electronic warfare associated with the SON (3:3). Once written, the SON is sent to Headquarters, United States Air Force, HQ USAF for validation. At this point, HQ USAF designates an office in HQ USAF/RD to act as the Office of Primary Responsibility (OPR) (3:4). The OPR will send the SON to the four organizations previously mentioned for their comments (3:4). If the SON is validated and funding is approved, HQ USAF issues a Program Management Directive (PMD). The PMD is written by a person within the OPR, referred to as the Program Element Monitor (PEM) (17:51). "The PEM is the expert everyone turns to for any and all information concerning his program" (17:51). The PEM presides over the program from initiation to deployment, and acts as the primary advocate for the program and the link between the user commands and the HQ USAF (17:51). The PMD contains program guidance and direction, command responsibilities, restraints and thresholds for cost, schedule, logistics supportability, and performance (18:8).

The program then goes into the concept exploration phase where alternative solutions to the original deficiency are identified and evaluated to determine the best solution(s). This phase and the remaining three phases are managed by a program office in Air Force Systems Command (AFSC) (1). Next, the program enters the demonstration and validation phase. In this phase, the best alternatives are further analyzed to determine their validity. Usually, a single solution for continued evaluation is chosen. Once the best solution is determined, the program moves into the full scale development phase. In this phase, the system and necessary items for support are designed, fabricated, and tested. The goal is to produce a near-production system to determine if the system meets the requirements in the statement of operational need and should be produced and deployed.

Production and deployment is the final phase of the process. During this phase, the system is produced and deployed to the field for operation.

The majority of the early acquisition process is managed by Air Force Systems Command (AFSC). AFSC is responsible for the first three phases and part of the fourth phase. In the fourth phase, the system is turned over to Air Force Logistics Command for support, and to an operational or user command for operation. These other commands are involved throughout the acquisition process as advisors. Contacts between the program office and the user are facilitated by having representatives of the user command stationed at the base where the program office is located (18:43). The representatives are located in support offices (i.e. TACSO, Tactical Air Command System Office) and advise the program office of the user command's " ... interests and concerns related to the operational use of the system" (18:43). The support offices also provide guidance relative to the user command's performance and schedule requirements (18:44). The user command is also responsible for developing plans for operations and support of the system. According to AFR 57-1, Operational Requirement Statement of Operational Need (SON), the operational command is responsible for formulating the System Operations Concept (SOC) (3:23). The SOC is a "formal document that describes intended purpose, employment, deployment, and support of a system" (3:23). The SOC must be completed before the beginning of the full scale development phase (3:20). The SOC contains the mission task of the system (reference to need described in SON), a description of the system, the operational environment in which the system will be used, and a very detailed description of employment, deployment, and support (3:41). Employment is a description of how and for what the system will be used, and deployment is a description of when and where the system will be used (3:41,42).

Not all systems go through the entire acquisition process. Each program tailors the process to fit its needs. However, the general format and regulations apply to all programs regardless of where in the process they start.

The Development Process

In the very beginning of the acquisition process, the availability of the technology base to correct a deficiency is examined. If that technology base is not available and the need is a valid one, the technology base must be developed.

The development of technology in the Air Force is carried out by the Air Force's laboratories (7). Technology development is carried out in-house and through contractors. The laboratories are given direction through exposure to SONs, the Vanguard Planning Summary, and Technology Need (TN) documents (6;7). The Vanguard Planning Summary provides prioritized broad technology goals the Air Force wants to achieve (6:6). A TN is:

A document in which an AFSC organization (excluding laboratories) describes an area of technological effort that will have a broad application to the orderly development of systems, subsystems, or capabilities (7:1).

Some TNs are written by engineers at AFSC product divisions and are based on problems encountered during development and initial operation of new systems. Product divisions are the organizations which contain the program offices that manage the acquisition process.

Life Support Equipment (14)

Life support equipment includes a large number of diverse items. Everything from ejection seats to long underwear is included under this grouping. This research will examine only those items which allow the pilot to operate in the cockpit. The following sections describe some of this equipment and the limitations it can impose on pilots.

Anti-G Devices. Anti-G devices are systems designed to help the pilot operate in the high-G environment of high performance fighter aircraft. G refers to the force exerted on an object caused by acceleration of that object. The forces exerted on the pilot while performing maneuvers are measured in relation to how many times the force of gravity the pilot experiences (1G=one times the force of gravity, 2G=twice the force of gravity). Force exerted down upon the head of a pilot restricts blood flow to the brain, which can cause loss of consciousness (LOC) (8:991). To combat this, anti-G devices help the pilot force blood to the brain. The

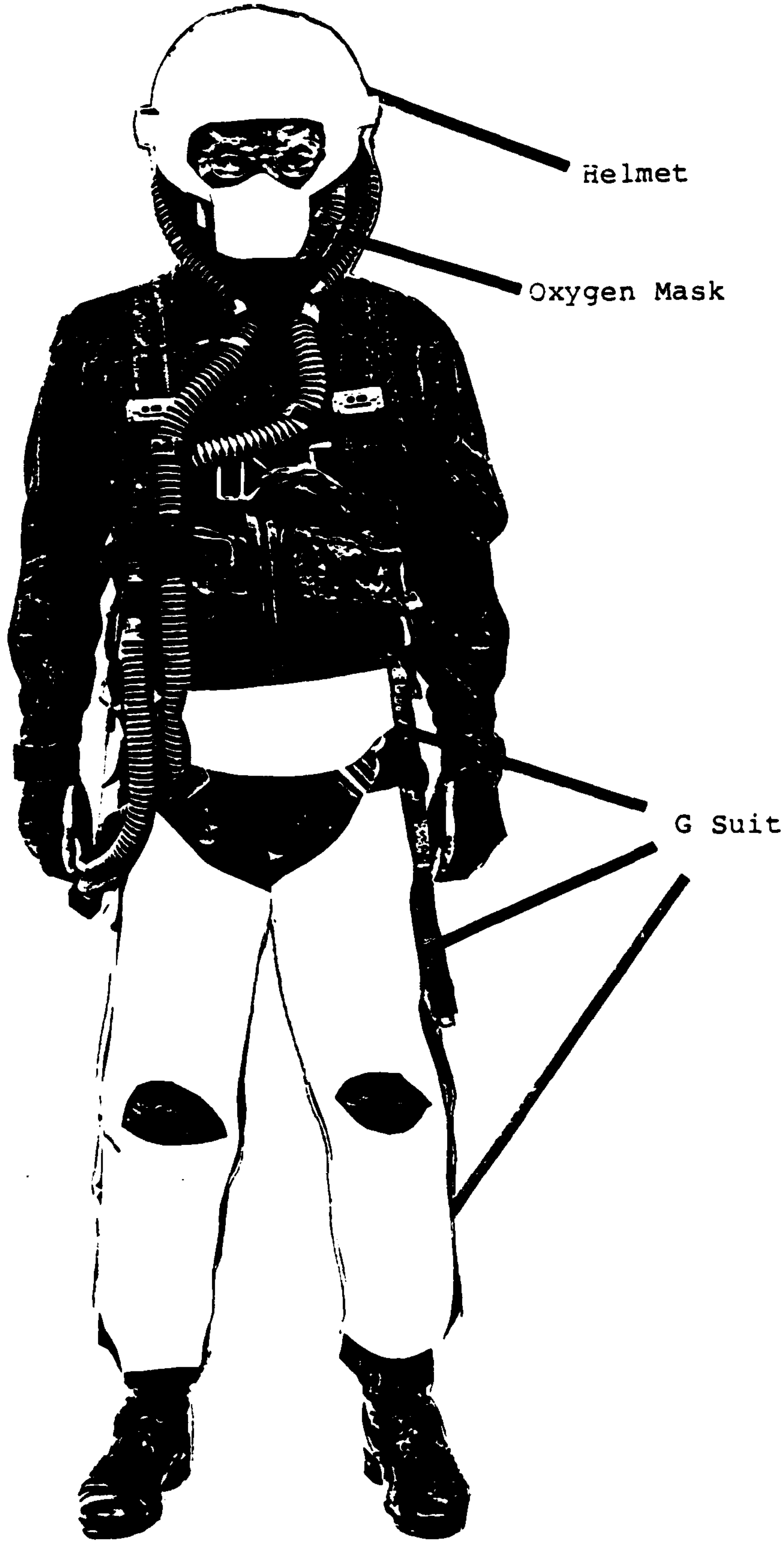

Figure 1. Aircrew Member Wearing Life Support Equipment

system consists of a G detector, G-suit, and air pressurization system. The G-suit, shown in Figure 1, is a pair of chaps the pilot wears over his flight suit (23:2). The chaps contain bladders which are inflated with air at the onset of increased G's. The bladders exert pressure on the legs and abdomen which forces blood into the body cavity where it can be more readily pumped to the brain (14). The G-suit worn by today's pilots is very similar to the suit as originally developed in the 1930's with only minor modifications (34). In addition to wearing the G-suit, the pilot performs anti-G maneuvers to increase his blood pressure, which causes blood to continue flowing to the brain (24). Anti-G maneuvers consist of rapid and strenuous tightening of most of the muscles of the body (24). The effort required to properly perform the maneuver is very fatiguing and fatigue reduces the pilot's capability to withstand high G's. Fatigue is one of seven identified causes of G-induced LOC. The remaining six are listed below.

1. Rapid G onset.
2. Crewmember not flying the aircraft.
3. Pressurization hose to G-suit disconnected.
4. Improper diet.
5. Mentally unprepared.
6. Lack of available conditioning program. (28)

This list was determined by a survey conducted by the Air Force Inspection and Safety Center (AFISC), Norton AFB

CA. The AFISC survey reported 1093 incidents of G-induced LOC from 6400 anonymous replies received (28).

A well-trained pilot wearing a G-suit and anticipating the onset of high G´s can withstand at least 9G´s and a G onset rate of 6G´s/second (24). The F-16 aircraft is designed to perform maneuvers at 9 G´s for an extended period of time (11). The Advanced Tactical Fighter (ATF) is being designed to at least meet this figure. In addition, it may have other life support equipment requirements beyond that of any current fighter (11). A survey done at F-16 training/operations squadrons revealed that more than 45% of the pilots pull more than 7 G´s during air to air maneuvers (12:1). This survey was accomplished by reviewing the video tape recordings of actual flight data (12:1). Studies have shown that the most important factor in G-induced LOC is not the level of G´s but the onset rate (39:4). The TAC survey does not address this issue. Two F-16 aircraft and their pilots were lost due to G-induced LOC. In both cases, the Air Force determined that high G onset rate was the cause of the LOC (24).

Chemical Defense Gear. Preparing to operate in a chemical warfare environment involves the addition of extra clothing and protective gear to the pilots´ normal equipment. This added gear increases the thermal stress on the pilot and reduces the utility of his hands. A recent Army study of the effect of chemical defense gloves showed a significant reduction in dexterity when wearing the gloves (10:47). The study also showed that a significant amount of practice was necessary to achieve an acceptable level of performance of manual dexterity while wearing the gloves (10:47).

A recent study done by the USAF School of Aerospace Medicine (USAFSAM) revealed that F-4 and A-10 aircrews felt that " heat stress during ground operations and low level missions was the greatest physical stress." (27:3). A study done in 1965 by the Aerospace Medical Research Laboratories, showed the effect of high ambient temperatures on short-term memory (38:1). Sunny days can cause cockpit temperatures to exceed 100 degrees fahrenheit. Prolonged exposure to this temperature range can cause a small degradation of short-term memory according to the study (38:3).

Oxygen Systems and Helmets (34). Aircraft have crew oxygen systems supplied by either a gaseous or liquid source. The amount of oxygen in the breathing air is controlled according to the altitude of the aircraft. The system consists of a storage bottle, plumbing, regulator, hose, and mask. Over the years, the system has remained relatively unchanged. A new mask and a new regulator were developed with reduced resistance to breathing. Recently, the development of an onboard oxygen generating system (OBOGS) has brought attention to the oxygen system. The OBOGS reduces the ground support needed for aircraft and thus increases the bare base capability.

Aircrew helmets not only provide protection for the pilot's head, but also are used to provide communications, and eye protection. The oxygen mask hooks onto the helmet and contains a microphone. The helmet contains the ear-phones.

The helmet has remained basically unchanged since the Korean War. The development of lightweight, high-strength plastics has allowed the weight of the helmet to be reduced without reducing its protective properties. In addition, helmets can now be fitted with special lenses to protect the pilot from nuclear flash blindness. The next development in helmet technology will be helmet mounted displays (11). Already, there are helmet mounted sights. Prototypes of helmets that display all necessary information on the helmet lens are being tested. The miniaturization of electronics and optical displays will some day reduce the weight and bulk of these systems to an acceptable level.

Summary of Life Support Equipment. In all the descriptions of life support equipment above, one factor should be noted. This factor is that life support equipment has changed very little in recent years. New systems are now being developed, but a gap between aircraft and life support equipment performance has been established (34;32).

III. Methodology

Overview

The research effort was broken into two sections. The first section determined the present process by which life support equipment is developed and acquired. This investigation was accomplished by a review of the applicable regulations and directives, and through interviews with the people involved in the process. The second section analyzed the present process to identify problems with the process, and develop solutions to correct these problems.

Methodology Justification

There were three methods available to conduct this research. First, the present process could have been determined solely by referring to the regulations. This method was deemed unacceptable because the process involves a great number of people in different organizations, all of whom can interpret the regulations in his or her own way. Second, the present process could have been determined by interviewing or surveying only the people. This method was also considered unacceptable, because it ignores the possibility that the 'right' or written process may be different from the one in use, and may in fact, alleviate the problems presently being encountered if followed. The third method, and the one used, involves a combination of the first two methods. Using this method, the actual process as conveyed by the people can be compared with the current directives.

Having chosen this combination method, the vehicle for contacting the people was chosen. The accessibility and cooperativeness of the Life Support Program Office personnel lent itself to the use of the personal interview. The Life Support Program Office personnel provided telephone numbers of all the people they dealt with in other organizations. During the background research, most of these other organizations were contacted and found to be very helpful and willing to provide information. Their cooperativeness, combined with the need to obtain personal insight into the research problem, lead to the decision to use personal and telephonic interviews.

Interview Format

Interviews were conducted on an informal basis, in-person whenever possible. The interview began by introducing the interviewee to the research effort and explaining to him or her why they were being interviewed. The first question typically asked was, " What are you and your organization responsible for in the process of life support equipment development or acquisition?" The interview would continue until the interviewer felt he understood that person's and organization's responsibilities in the process. The interviews concluded with the questions, " Do you see any problems with the present process of life support equipment development and acquisition?", and " What, if any, solutions do you have to these problems?" Appendix D illustrates the format and questions used during interviews.

Problem Identification

Problems were identified in two ways. First, problems were solicited during the interviews. These problems were bound to contain the bias of the individuals. To eliminate problems based on personal bias, problems were examined for support by several individuals. Problems were also identified by examining and comparing the comments obtained during the interviews. This was an intuitive process performed by the author. Problems were identified when different organizations had differing opinions as to responsibilities, the current condition of the acquisition and development process, and the existence of problems.

The problems were examined to determine which were major problems. Major problems are those problems directly impacting the effectiveness of the process, and not attributable to uncontrollable factors like personalities.

Development of Solutions

After identifying the major problems in the process, proposed solutions to these problems were developed. The solutions came from comments obtained in the interviews and from a creative flow of ideas accomplished by brainstorming.

IV. Findings

Overview

The following pages present the information collected in accomplishing the research objectives. The answers to the questions posed under each objective are based on comments attained through the interviews and the examination of the regulations.

Research Objective 1

Determine how life support equipment is developed and acquired now.

The present process of life support equipment development and acquisition involves five major organizations (14). The organizations are (1) Tactical Air Command (TAC), (2) HQ USAF, (3) Life Support Program Office, (4) Aerospace Medical Division (AMD), and (5) the Air Force Inspection and Safety Center (AFISC) (2).

At TAC, the Deputy Chief of Staff for Requirements, Special Systems Division, HQ TAC/DRPS, conducts mission analyses to identify deficiencies in present capabilities to meet present or future threats (16). According to Maj David A. Fisk, Deputy Chief of Special Systems Division, HQ TAC/DRPS writes the Statements of Operational Need (SONs) and System Operations Concept (SOC) for life support equipment (16).

There are two offices at the HQ USAF involved in the process (2). The Air Space and Air Traffic Services

Division, Directorate of Operations and Readiness, HQ USAF/XOOTF, provides operational oversight of programs, while the Deputy Chief of Staff for Research, Development, and Acquisition, Directorate of Development and Production, HQ USAF/RDPT, provides the Program Element Monitor (PEM), and acts as the Office of Primary Responsibility (OPR) for validating SONs for life support equipment programs (2;32). HQ USAF/RDPT also issues the Program Management Directives (PMD) (32;34).

The Aerospace Medical Division (AMD) is responsible for research and development in support of life support equipment acquisition (4;29). The Aerospace Medical Research Laboratories (AMRL) and the United States Air Force School of Aerospace Medicine (USAFSAM), both part of AMD, conduct basic research and exploratory development of technology for life support equipment (4;29). AMD conducts advanced development of life support systems to determine proof of concept in preparation for transitioning the programs to the Life Support Program Office for acquisition (29;35). A good example of this function is the Tactical Life Support Systems Program (TLSS) (29). The purpose of TLSS, according to Capt David A. Reinholz, Chief Engineer, is to provide a " ... proof of concept for advanced designs ... of ... an integrated life support system" (30:1). According to AFSCR 23-5, Organization and Mission Field Aerospace Medical Division, AMD is also responsible for "... informing potential users of newly completed technologies and take the initiative in providing for the use of such technology" (4:2). Lt

Col James M. Livingston, AMD Liaison Officer to Aeronautical Systems Division, said AMD is not actively promoting their programs to potential users (22).

The Life Support Program Office is designated by AFR 55-27, Air Force Life Support Systems Program, as the office to oversee the acquisition of life support equipment (2). The Life Support Program Office is also responsible for working on the early concept phase of manned weapon systems to assure early consideration of life support equipment needs (2). According to Col William Smith, Director of the Life Support Program Office, there was very little work done by the Program Office in the concept phase of manned weapon systems acquisition before the Advanced Tactical Fighter (ATF) (32). The Life Support Program Office is also responsible for inter and intra command coordination and configuration management of life support equipment programs (2). The Program Office is transferring its unusual configuration management responsibility to Air Force Logistics Command (32).

The Air Force Inspection and Safety Center, Life Sciences Division, AFISC/SEL, is responsible for monitoring programs to ensure safety standards are met, according to AFR 55-27 (2:4). AFISC also studies mishap reports and recommends improvements to operational procedures and equipment for existing systems to HQ USAF/XOOTF (2:4). By doing this, AFISC creates new programs without validated Statements of Need which the Life Support Program Office must accomplish (32). Sometimes, these programs are not wanted and even fought against by Tactical Air Command (TAC) (32).

Research Objective 2

Determine when life support equipment is considered in the acquisition cycle of an aircraft.

Life support equipment needs are first considered in Statement of Operational Need (SON) (16). The SON includes a statement requiring the identification of any necessary life support equipment (16). The Systems Operations Concept (SOC) includes life support equipment considerations (3). The SOC is developed before the full scale development phase of aircraft acquisition (3). According to Edward R. Hughes and Capt Steven Novicki, human factors engineers in the F-16 aircraft program office, life support equipment is dictated by aircraft design and mission (19). This fact was verified by Col William Smith, Director of the Life Support Program Office (32). According to Mr. Hughes and Capt Novicki, the necessary life support equipment is selected from existing Air Force equipment (19). Life support equipment is slightly modified to fit into some aircraft, according to Stephen R. Mehaffie, Deputy Program Manager, CREST Advanced Development Program Office (25).

Col Smith and Lt Col James M. Livingston, AMD Liaison Officer in the Aeronautical Systems Division Deputy for Development Planning, ASD/XR, stated that life support equipment is not considered a design performance variable in the aircraft design process (22;32). Mr. Kenneth Troup, a long-time program manager in the Life Support Program Office, did state that the life support equipment for the SR-71 aircraft was developed and acquired by the SR-71 program office (34). The Advanced Tactical Fighter (ATF) program office has included life support equipment considerations in the concept development phase of the aircraft (11;22). The ATF program office included life support equipment in total aircraft cost trade-off studies, and instructed contractors that the use of government furnished life support equipment in their designs would not be acceptable (11). Lt Col Claude Bolton, Chief of Projects in the ATF program office, stated the program office is working on integrating the man into the aircraft in the conceptual phase, which has included taking a very close look at life support equipment (11). Col Smith said the ATF program office has agreed to develop and acquire all its own life support equipment (32).

Research Objective 3

Identify the problems with the current process of life support equipment development and acquisition.

Col Smith, Maj Peter F. Hanley, Lt Col William L. Epperson, and Mr Troup, all of the Life Support Program Office, identified inadequate involvement of the user in the acquisition process as a big problem (14;32;34). Lt Col Ronald W. Bell who helped conduct the System Acquisition Management Inspection (SAMI) of the Air Force life support systems program also noted this problem (9). However, Col

Smith and Lt Col William Oberline, Chief Special Systems Division, DCS for Requirements Headquarters Tactical Air Command, agree that the user has become increasingly involved in the acquisition process during the six months of this research (26;32). Both the program office and Tactical Air Command are satisfied with the flow of communications between the organizations (14;26;32). Maj Joseph J. Farcht, TAC Liaison Officer, TACSO-A (Wright-Patterson AFB), stated the Life Support Program Office doesn't always come to the TACSO to find out TAC's position on life support equipment programs (15). Maj Farcht did comment that the Life Support Program Office was acting more responsibly than in the past, in its efforts to coordinate with TAC (15).

Lt Col Oberline felt that the lack of operational experience among Life Support Program Office program managers has hindered the acquisition of field-acceptable life support equipment (26). Lt Col Oberline feels that inexperienced program managers cannot fully comprehend the environment in which the life support equipment they are developing is to be used (26). This problem was also mentioned by Lt Col Alfred T. Schneider who was involved in the "Deep Look" in-depth survey of the Air Force life support systems program (31).

Maj Farcht felt that the Life Support Program Office had often operated in a reactive state due to a lack of planning (15). Col Smith commented that the Life Support Program Office lacked disciplined management of programs which caused problems (32). The problems occur when changes to the program are desired by the user. Formerly, the program office tried immediately to initiate the change without first calculating the cost in time and money, and presenting this information to the user, allowing the user to determine if the change is worth the cost (32). The program office is attempting to correct this problem by baselining all its programs (32). Each program's requirement to be met, schedule, cost, and end product are documented. This information allows the program office to calculate the effect of any proposed change to a program. People from TAC and the Life Support Program Office agreed that a lack of resources, funding and manpower, was a problem (32;33;34).

Col Smith commented that aircraft developers have an attitude towards life support equipment similar to their attitude towards logistics (32). Aircraft developers see life support equipment selection and development as something necessary, but not critical in the development of a new aircraft (32). Lt Col Livingston commented that this attitude was not unwarranted in the past, but with the dramatic increases in aircraft performance now being developed, life support equipment can no longer be considered as something the pilot wears (22).

Another problem identified relates to the issue of standardization. The Air Force develops aircraft with specific missions in mind, but would like to have life support equipment that provides protection for all the missions (22). Col Smith and Mr. Mehaffie agree that standard equipment does not function as advertised in all scenarios (25;32).

The final problem identified was a lack of direction to the life support equipment developers at AMD and the Aerospace Medical Research Laboratories (AMRL) (22). Lt Col Livingston does not feel AMD and AMRL are given enough direction or incentive to properly develop the technology necessary to meet future life support equipment needs (22).

V. Results and Discussion

Overview

Having completed the interviews and survey of regulations, the identified problems were examined to determine which were the major problems. This examination and its results are presented in this chapter. After determining the major problems, a solution to the problem was developed. Some of the ideas for the solution came from the interviews. A brief discussion of the development of the solution is included in this chapter. The details of the actual solution are discussed in chapter six.

Determining the Major Problems

Seven problems were identified during the interviewing process. Two of the seven problems could be called facts of life. The first of these problems is the lack of funding for life support equipment programs. This problem is caused by the relatively low priority of life support equipment among other Tactical Air Command programs (15). The author of this thesis formerly worked in aircraft fire protection and found several similarities between life support equipment programs and fire protection programs. In both cases, funding and interest by operational commands was limited unless some mishap occurred involving the equipment. When this happened, everything had to be done yesterday and money was no problem, but when nothing was going wrong, support and funding were extremely limited. This is something that will probably never change. Operations is the major concern of operational commands and will continue to be so. The problem of insufficient funding cannot be resolved by regulation but will continue to be a battle for the Life Support Program Office.

The second fact of life problem is the attitude of aircraft developers towards life support equipment. As Col Smith stated, aircraft developers have had a logistics-like attitude towards life support equipment. How do you change a person's attitudes? An attitude change is not easily achieved. This is especially true when even advocates of improving life support equipment considerations, like Lt Col Livingston, feel that the attitude was not unwarranted in the past.

Examining the remaining five problems, four relate to management of the process. The four problems are (1) inadequate user involvement, (2) insufficient operational experience of Life Support Program Office program managers, (3) undisciplined management of programs by the Life Support Program Office, and (4) insufficient direction for the equipment developers at the Aerospace Medical Division (AMD) and the Aerospace Medical Research Laboratory (AMRL). Some of the difficulties in managing the process can be related to the nature of the equipment, according to Col Smith (32). The chemical defense side of life support equipment is the example Col Smith cited (32). It is difficult for the user to develop a System Operations Concept (SOC) for equipment to be used in an environment nobody has fought in before

(32). Col Smith cited the SOC for the Aircrew Eye Respiratory Protection program which called for operating "ops normal" (32). As discussed in chapter two, all pieces of life support equipment limit pilot capabilities in some way. This SOC is unreasonable and now the Life Support Program Office must negotiate with the user to determine what level of degradation they will accept and at what cost. Such negotiations require extra time and effort on the part of the user and the program managers.

The lack of operationally experienced program managers also requires extra effort by the user. Without detailed descriptions of how, where, and for what the life support equipment will be used, inexperienced program managers may develop equipment that meets the specifications, but is unacceptable for use in the field. Simply using more experienced program managers will not solve the problem either. Any years used to gain operational experience, are years not used learning the acquisition process. A balance of operationally experienced and acquisition experienced program managers must be maintained. According to TACR 20-5, one of the responsibilities of the TACSO is to advise the program offices of TAC requirements and positions (5). This implies the TACSO should be helping the Life Support Program Office maintain an operational view during the acquisition process.

The third problem relates directly to management of the programs within the Life Support Program Office. The undisciplined management which used to prevail in the program office caused problems in the past. However, as discussed in the previous chapter, Col Smith is attempting to correct this problem, and Maj Farcht in the TACSO feels Col Smith is succeeding (15;32).

The fourth problem relating to managing the process is insufficient direction to AMD and AMRL. This problem affects the process for years to come, because the equipment now being developed in AMRL will probably take ten to fifteen years to be ready for acquisition. This problem may be the cause of the gap that has developed between life support equipment and aircraft performance. Without proper direction and incentive, it is difficult for the researchers to keep pace with aircraft development. Any improvement to the acquisition and development process which does not include discussion of long range planning will achieve at best short-lived success. The problem in developing a solution is how to guide the researchers without crushing their creativity.

Examining these four problems as a whole, indicates problems exist throughout the development and acquisition process. Any solution to the problems identified must be comprehensive in nature. The solution must include some method of coordinating the efforts of all five of the organizations. These four problems together indicate the existence of a major problem. The major problem is the lack of an integrated and coordinated effort that spans the entire process. The involvement of the Air Force Inspection and Safety Center (AFISC) in the process complicates the task of coordinating the effort. The AFISC is an organization not normally involved in identifying requirements as discussed in chapter two. The comment from Col Smith that AFISC initiated programs are not always wanted by TAC, dictates the need for improving the way AFISC is involved in the process.

The final problem identified related to using standardized equipment in aircraft. Col Smith and Mr. Mehaffie agreed that standardized equipment does not perform as advertised in all scenarios (25;32). Not all aircraft have the same life support requirements, and some have similar requirements but with varying degrees of protection needed. In high performance aircraft, can standardization savings cover developing equipment to worst case scenarios? Or worse, can standardization savings cover the loss of life and aircraft in that one scenario for which the life support equipment was not designed?

Through examination of the six problems, two major problems were identified. The first major problem is the lack of an integrated, coordinated effort spanning the entire process and the second major problem is attempting to use standard equipment in all high performance aircraft.

Solution Development

Several solutions to problems were obtained during the interviews. Although not all of the solutions suggested were intended to solve major problems, some of these solutions still had value. Three solutions deserve examination. The first of these solutions is making aircraft program offices responsible for the development and acquisition of all aircraft specific life support equipment, which was suggested by Col Smith (32). This was also suggested as a solution to the problem of using standard equipment on high performance aircraft. It provides a link between aircraft and life support equipment development which would help eliminate the gap between the performance of aircraft and that of the life support equipment. By tying life support equipment to a major weapon system, this solution would also help to alleviate the problem of insufficient funding which was identified as a fact of life problem. This solution provides many benefits but has one drawback. Development of life support equipment by each aircraft program office could be costly, in terms of acquisition and support. The cost would come from having specific design, testing, technical orders, and training required for each new aircraft. The cost could be reduced by the use of standard fittings, hoses, and other small sub-elements of the life support equipment systems, without experiencing the problems associated with using standard entire life support systems.

The second solution to be examined is emphasizing personal advocacy of programs to overcome bureaucratic inertia, as suggested by Lt Col Livingston (22). This was suggested as a solution to the problems of insufficient funding, aircraft developers attitudes, and insufficient user involvement. This solution relies entirely on the communicative skills of the program managers in the Life Support Program Office. It is attractive because it requires no regulation or structure changes. It is also important because it points out that people are the most important part of the process. It falters because program office, laboratory, and Tactical Air Command (TAC) personnel are constantly changing. This solution might work well when an excellent communicator is in the Life Support Program Office, but provides no contingency for when the communicator leaves.

The final solution obtained during interviews was requiring more operationally experienced program managers in the Life Support Program Office, as suggested by Lt Col Oberline (26). This solution was intended to solve the problem of a lack of operational experience among Life Support Program Office program managers. This solution also should help the problem of insufficient user involvement. It should help increase user involvement in two ways. First, the operationally experienced program manager would be more likely to contact the user when considering design and schedule changes, because he or she feels more comfortable feel more comfortable interfacing with the user than the program manager without operational experience. Second, the user should be more receptive to the experienced program manager. This should also increase user involvement. It should be noted that acquisition is the primary job of a program manager and so simply placing operational people in the Life Support Program Office may cause more problems than it solves. People with both operational and acquisition experience are not plentiful and are in demand in both the Air Force and private sector. This limits the number of experienced program managers that can be obtained and retained.

The three suggestions discussed above are usable, but do not address the major problem of the lack of an integrated and coordinated effort spanning the entire process. Several ideas were analyzed to solve this problem. The first idea was to hold an annual conference on life support equipment involving all five organizations. An annual worldwide life support equipment conference is now in existence. For the proposed conference to work, a format with specific goals, such as developing a five year master plan, would have to be developed and implemented. This format would make the conference more than paper presentations on existing and proposed programs. Another idea to integrate the effort was to develop a management information system (MIS) for the process. The MIS would allow all the organizations to follow the progress of programs from development through acquisition and into deployment. With the information more readily available, user involvement would be easier, and safety considerations could be identified earlier and justified more easily. The Life Support Program Office has taken a step in this direction by baselining all its programs as discussed in chapter four (32).

The availability of the information in the baseline document helps the user make better decisions and helps the Life Support Program Office manage its programs with more discipline.

The final solution integrates the three solutions obtained from the interviews, and adds a mechanism for coordinating the entire effort based on the ideas presented in the previous paragraph. The solution also contains a method of tying life support equipment development to aircraft development to prevent the performance gap between the two from widening. The final solution is presented in the next chapter.

VI. Summary and Recommendations

Summary

The process of life support equipment development and acquisition involves five organizations. The organizations are (1) Tactical Air Command (TAC), requirements identifier and equipment user; (2) Headquarters, United States Air Force (HQ USAF), overall coordinator and requirements validator; (3) the Life Support Program Office, acquisition program manager; (4) the Aerospace Medical Division, technology developer and researcher; and (5) the Air Force Inspection and Safety Center (AFISC), identifier of safety needs through mishap analysis. The life support equipment development and acquisition process has limited interaction with the aircraft development and acquisition process. The life support equipment for a pilot is dictated by the aircraft design, and every attempt is made to use standard equipment on all aircraft. This is done despite the fact that the Air Force designs aircraft for specific missions.

Several problems with the process and its interface with the aircraft development process have been identified. These problems are (1) insufficient user involvement throughout the acquisition process, (2) insufficient operational experience among Life Support Program Office program managers, (3) insufficient resources for life support equipment programs, (4) undisciplined management of programs by the Life Support Program Office, (5) the poor attitude of aircraft developers toward life support equipment, (6) using standard equipment on high performance aircraft, and (7) insufficient direction to the life support equipment developers.

Examination of these problems led to the identification of two major problems. The first major problem is the use of standardized equipment in high performance aircraft. The second major problem is the lack of an integrated and coordinated effort that spans the entire process. The problems of insufficient funding and aircraft developers attitudes were determined to be fact of life problems. These problems were not addressed directly in the solution development process because they will exist until some uncontrollable state of nature changes. The problem of undisciplined management by the Life Support Program Office is already being addressed by the program office. Their solution to this problem is incorporated in the final solution.

The development of the final solution drew upon suggestions obtained during interviews, and integrated these suggestions with ideas from the author. The final solution is designed to address both major problems and provide a mechanism for linking life support and aircraft development.

Recommendations

The final solution to the two major problems is discussed below along with recommendations for future work.

The Solution. The solution begins with the creation of a management information system (MIS) for the process. The MIS would include databases on the status of current and proposed development and acquisition programs, a prioritized list of Tactical Air Command (TAC) and Air Force Inspection and Safety Center (AFISC) requirements, a list of aircraft developments which may require new life support technology, and a description of how each requirement is being, or is expected to be met. The baselining being done by the Life Support Program Office provides the starting point for development of the MIS. The Aerospace Medical Division (AMD) and the Aerospace Medical Research Laboratory (AMRL) will be required to baseline their programs. The prioritized list of requirements and how they are to be met should be developed as the result of a yearly conference of representatives of the five organizations. The conference would be formatted such that the listing of existing and proposed programs, requirements, and aircraft developments with life support implications would be compiled before the conference. The conference would then focus on prioritizing requirements and programs, and developing plans for meeting all the requirements. The Air Space and Air Traffic Services Division, Directorate of Operations and Readiness, HQ USAF/XOOTF, and the life support and chemical defense Program Element Monitors from the Deputy Chief of Staff for Research, Development and Acquisition, Directorate of Development and Production, HQ USAF/RDPT, would be responsible for planning and hosting the conference. The

Transition Planning Directorate of AMD, AMD/XR, and the Plans, Test, and Integration Group of the Life Support Program Office, ASD/AESX, would be responsible for watching aircraft developments and determining when new life support technology may be needed. This job requires close relations with the Deputy for Development Planning at the Aeronautical Systems Division, ASD/XR. This part of the solution creates an integrated and coordinated process. It provides a planning document for directing the Life Support Program Office and AMD and AMRL. This part of the solution also requires increased user involvement and brings AFISC into the process in a way designed to improve the acceptability of their suggested programs.

The second part of the solution attacks the problem of using standardized equipment in high performance aircraft. The solution is to give the responsibility of aircraft specific life support equipment development and acquisition to the aircraft program offices. Not only does this part of the solution tackle the problem of standardization, but it also helps to eliminate the gap between aircraft and life support equipment performance, and ties life support equipment development to aircraft development to prevent the gap from occurring again. Perhaps when the first part of the solution is fully implemented, and the next generation aircraft are in deployment, the second part of the solution may become obsolete. This would occur because of the inclusion of the impact of aircraft developments in the conference and

MIS. However, because of the existing gap between aircraft and life support equipment performance, the second part of this solution is necessary.

Recommendations for Future Work.

1. Survey the people contacted in this study to determine their opinions on the proposed solution.

2. Conduct this same type of study at yearly intervals to determine the progress being made in improving the process.

3. Develop a format for the conference suggested in the solution.

4. Determine the information requirements for developing the MIS suggested in the solution.

Appendix A: Interview Summaries

9 November 1984. Epperson, Lt Col William L. and Maj Peter F. Hanley, Plans, Test, and Integration Group, Life Support Program Office, ASD/AESX.

- AMD, AMRL, AFISC, and the ATF SPO should be contacted.
- Life support equipment limitations are taken into account when developing the equipment, but not when developing the aircraft in which they are to be used.
- Limited data is available on how aircraft are really flown.
- Capt Reinholz, AMD/RDSL, should be contacted regarding the Tactical Life Support System (TLSS) program.
- TLSS is looking at a totally integrated life support system.
- Dr Van Patten, AMRL, is doing work on G protection.
- Steve Mehaffie, AMD, is working on Aircrew Escape Program, CREST, and worked on ACES II ejection seat in Life Support program office.
- Janice Gavern is Human Factors engineer for Life Support program office.
- Life Support program office was the only organization working with life support equipment.
- Equipment was developed independently from the aircraft.
- AMD and the program office have had past differences.
  -- ex. HFRP G valve, AMD developed valve and presented to program office thinking it was ready for production. Program office said it lacked data necessary to go into production and began its own development program. AMD accused the program office of dragging its feet, and the program office accused AMD of pushing for production before the valve was ready.
- The Life Support program office and Aircraft program offices communicate frequently.
- The Life Support program office is currently working with B-1 program office on PLZT program and with the HH-60 program office on LARS (Lightweight Avionics Radio System)

16 November 1984. Mc Naughton, Col Grant, M.D., Aeromedical Division, Life Support Program Office, ASD/AESA.

- G induced loss of consciousness (LOC), is caused by loss of blood flow to the brain.
- It is the biggest problem in tactical aircraft.
- Accelerating through a turn exerts pressure down on head and impedes blood flow to the brain.
- The brain has 4-6 second blood reserve.
- You fight G effects by raising blood pressure.
  -- anticipate G onset
  -- perform straining maneuver, inhale quickly and contract muscles to force blood to heart

-- wear a G suit which consists of air bladders in chap-like garment, when increased G's are detected the bladders inflate helping the pilot force blood from the legs and abdomen to the heart

- A pilot can withstand 9 G's and an onset rate of +6 G's per second if prepared and properly conditioned.
- Contact Maj Mike Livingston, ASD/XR AMD Liaison Officer, concerning life support for the ATF.

20 November 1984. Mehaffie, Stephen R., Deputy Program Manager CREST Advanced Development Program, AMD/RDS.

- ACES II ejection seat was pushed by AFSC headquarters level, due to the high injury and fatality rate for ejections in 1967.
- Life support equipment has slight configuration differences between aircraft, but is basically the same.
- Life support equipment does not perform as advertised in all scenarios.
- AMD is attempting a systems approach to life support equipment in the 6.3 development stage, but Mr. Mehaffie thinks it is a very difficult task.
- Two examinations of the Air Force life support systems program have been conducted.
    -- "Deep Look", Lt Col Al Schneider, AFISC
    -- SAMI, System Acquisition Management Inspection, Lt Col Ron Bell, AFISC
- Life support equipment development takes longer than aircraft development.
- Life support equipment has increased risk because it is in 6.3 phase not 6.4 phase, like aircraft development.
- The increased risk is one reason aircraft program offices did not develop life support equipment.

27 November 1984 through 23 May 1985. Smith, Col William, Director, Life Support Program Office, ASD/AES.

- Talk to Mr. Bill Yri regarding Air Force reg on the life support systems program.
- Life Support SPO has very little interface with ASD/XR.
- ASD/XR is where concept exploration phase of aircraft acquisition is done.
- Life Support SPO has a lot of dealings with the aircraft SPO's.
- The system spec for an aircraft is not sufficient to develop the necessary life support equipment.
- Life support equipment is dictated by aircraft design.
- Life support equipment has been thought of in the same way as logistics.
- Ken Troup should be contacted regarding life support equipment for the SR-71, and regarding the history of life support equipment.

- The life support equipment aircraft interface is becoming increasingly complex.
- Life support equipment is not designed for specific aircraft.
- Life support equipment does not necessarily perform as advertised in all aircraft.
- Life support equipment has not maintained pace with aircraft development.
- The systems approach to aircraft development must include life support equipment.
- The Life Support program office has 2 PEMs from HQ USAF/RDPT and an operational representative from HQ USAF/XOOTF.
- Life Support program office has problems getting reasonable operations concepts from TAC.
  -- ex. for the Aircrew Eye Respiratory Protection (AERP), a chemical defense program, TAC delivered a operations concept calling for operating "ops normal"; this is unrealistic. TAC must tell the program office what level of degradation is acceptable and exactly how the equipment will be used. Part of the problem is the nature of the equipment. Nobody has fought in a chem/bio warfare environment and so no experience can be drawn upon to write the operations concept.
- There existed a lack of disciplined management in the life support program office before.
- The reason life support equipment development has lagged behind aircraft development is that man was never the limiting factor before the F-15 and F-16.
- Now that man is a limiting factor, life support equipment becomes a performance design variable.
- There is a need to advance life support equipment to keep pace with aircraft performance.
- The answer is having the life support equipment for high performance aircraft developed specifically for that aircraft by the aircraft prime contractor.
- Life support equipment development for other systems must be a team effort including the Life Support program office, the contractor, and the user.
- Problems not only with TAC, but also with SAC, MAC, and ATC programs.

18 December 1984. Troup, Kenneth F., Program Manager, Life Support Program Office, ASD/AESD.

- Originally the Life Support Program Office was responsible for initiating new programs in life support equipment.
- The program office operated in a fire-fighting mode reacting to things happening in the field.
- Now, the SPO director is limited to PMD's based on user SON's.
- There are several problems with the process:
  -- the process is too long

-- user not aware of future needs

-- AMRL not under pressure to develop in 6.3 area, no direction being given

-- lack of directional link between life support equipment and aircraft

- Life support equipment is not as advanced as aircraft.
- Current G suit was developed in late 1930's by AMRL for aircraft.
- Helmets have not changed much since Korean War.
  -- lightweight material added
  -- fitting system changed
- Oxygen systems have not changed significantly in the same time period but are changing now.
  -- new regulator and mask developed recently
  -- on board oxygen gas generating system has been developed
- Life support equipment for SR-71 was developed by aircraft program office.
- HH-60 program office is developing life support equipment specifically for that helicopter.
- Several possible solutions to current problems:
  -- allow program flexibility by giving line item money to Life Support SPO director
  -- require aircraft prime contractor to supply and develop life support equipment for aircraft

20 December 1984. Hughes, Edward R. and Capt Steven Novicki, Human Factors Engineers, F-16 Equipment Engineering, ASD/YPEC.

- F-16 is designed to pull and maintain 9 G's.
- F-16 is designed for +6 G per second G onset rate.
- Aircraft is designed and then life support equipment needs are identified.
- Life support equipment is selected from equipment already in use.
- Capt Novicki feels the Air Force has the equipment necessary to meet the life support needs of current and future aircraft.
- F-16 initial design work was done in ASD/XR.
- An F-16 pilot survey on G's pulled during flight has been accomplished.

11 January 1985. Livingston, Lt Col James M., AMD Liaison Officer, Development Objectives Directorate, ASD/XRF.

- Requirements are listed in the 10 year road map, the TN system, and SONs.
- XRF determines (life support) performance requirements based on concept exploration.
- XRF is also involved in determining feasibility of of aircraft design based on existing life support equipment.

- XRF cannot issue a requirement to be met by AMD or AMRL.
- They can only suggest programs or suggest a TN be written.
- On the ATF, contractors were told to consider life support equipment and were told government furnished equipment would not be acceptable.
- ATF has included life support equipment in trade-off studies.
- XR can see future requirements, but cannot direct AMD and AMRL.
- Life Support Program Office does advanced development and production, but cannot direct AMD and AMRL, and the program office is limited to programs with PMDs which come from SONs.
- AMD and AMRL are given minimal direction.
- Why develop life support equipment to cover full range of flight envelopes, when some aircraft are more specific?
- It might be more feasible to develop aircraft specific life support equipment.
- One solution to the current situation is the use of personal advocacy of programs.

18 January 1985. Bolton, Lt Col Claude, Chief of Projects, Advanced Tactical Fighter Program Office, ASD/TAS.

- The ATF has been looking at life support equipment from the beginning from the viewpoint of integrating the pilot into the aircraft.
- This included looking at the crew station, environmental control system, canopy, ejection seat, and displays.
- Helmet mounted sights are now in use and may be used on the ATF.
- Helmet mounted displays are under development but are not advanced enough to use in the ATF. (too heavy and bulky)
- Contractors were asked to identify life support equipment according to their design,
- The technology needed for life support equipment exists or is being developed in all areas except G protection.
- G protection work done by AMD, AMRL, and USAFSAM has limited manpower and funding.
- Users are looking for immediate fixes.
- Program offices can only look at hardware in the advanced development phase due to time constraints.
- Only the labs (AMD, AMRL, and USAFSAM) have the time and know-how to develop the equipment.
- The desired programs must be advocated to get money and manpower.
- Advocacy must be done through the program element.

24 January 1985. Reinholz, Capt David A., Chief Engineer, Tactical Life Support System, Directorate of System Acquisition, AMD/RDSL.

- TLSS is an attempt to integrate G, high altitude, thermal, and chemical protection.
- TLSS a low risk program using lab proven technology.
- AMD, AMRL, and USAFSAM have the physiological experts.
- AMD, AMRL, and USAFSAM do work in the 6.2 and 6.3 areas.
- Boeing has patented an anticipatory G valve.
- He will send program goals and overview in talking paper.

25 January 1985. Turner, Lt Col James S., Chief, Transition Planning Directorate, Aerospace Medical Division, AMD/XRX.

- AMD does work with the human operator.
  - -- Determining the utility of man in space.
  - -- Determining mission requirements.
  - -- Assisting in equipment design.
- He will send mission statement.

30 January 1985. Van Patten, Robert, Chief, Accelerations Branch, Aerospace Medical Research Laboratory, AMRL/BBS.

- AMRL does programs in 6.1 and 6.2 areas, but mostly in the 6.2 area.
- Ideas for programs come from the Life Support Program Office, Aircraft Program Offices, SONs, AMD, the Air Force Systems Command Planning Guide, Vanguard Documents, and from within AMRL.
- He is currently working on a fix for the F-16 G valve problem.
- His office is looking at improving G tolerance through an improved G suit, a new G valve, changing the seat angle, a new sensor system for determining blood flow to the brain, and the use of a CO_2 and oxygen mix.

1 February 1985. Elam, Maj Carl M., Mission Area Analyst, Science and Technology, HQ Air Force Systems Command, HQ AFSC/XR.

- The technology base planner looks at all technology.
- The technology base planner:
  - -- Identifies how technology relates to needs in mission areas.
  - -- Obtains laboratory assessment of technology and mission needs.
- Laboratories view SONs and use the PPBS to obtain funding.

- Guidance from top is not heavy handed or structured.
- Laboratories write annual report to Air Force Systems Command Directorate of Laboratories.
- This report provides a formal feedback process to guidance.
- The real problem is communication between the Air Staff and laboratories.

1 February 1985. Williams, Lt Kimberly, Strategic Defense Development Officer, Directorate for Planning Strategy, Aeronautical Systems Division, ASD/XRX.

- This office conducts Vanguard Planning.
- The desired output of Vangaurd Planning is input to the Air Force Systems Command (AFSC) Program Objective Memorandum (POM).
- This office conducts Mission Area Analysis (MAA).
  - -- Defines the mission.
  - -- Conducts resource analysis to identify major deficiencies.
  - -- Rank goals.
  - -- Analyze and compare goals with Five Year Defense Plan (FYDP).
- The planning takes a 20 year outlook.
- List of programs developed is briefed HQ AFSC Council, AFSC Product Divisions, industry, and user commands.

15 March 1985. Bell, Lt Col Ronald W., Systems Acquisition Manager Inspector, Acquisition Management Division, HQ Air Force Inspection and Safety Center, HQ AFISC/IGYB.

- Lt Col Bell helped conduct the Systems Acquisition Management Inspection (SAMI) of the Air Force life support systems program.
- The total process was examined including the user, developer, and support.
- Insufficient user involvement in the acquisition process was one problem identified.
- The main finding was not the existence of problems, but that the problems were not being addressed.

15 March 1985. Fisk, Maj David A., Deputy Chief Special Systems Division, DCS for Requirements, HQ Tactical Air Command, HQ TAC/DRPS.

- This office determines requirements and writes SONs for life support equipment.
- Requirements are documented in SONs.
- Requirements are determined based on the mission and present deficiencies to accomplish the mission.
- Requirements can also be future requirements.

15 March 1985. Schneider, Lt Col Alfred T., Life Support Officer, Life Sciences Division, HQ Air Force Inspection and Safety Center, HQ AFISC/SEL.

- A "Deep Look" survey of the Air Force Life Support systems program was conducted between January and October of 1982.
- The survey was done at the request of, and reported to, the Vice Chief of Staff of the Air Force.
- The survey looked at the following organizations:
  - -- the Manpower and Personnel Center
  - -- Air Force Logistics Command
  - -- 33 operational units
  - -- the Life Support Program Office
  - -- the Air Logistics Centers
  - -- the Air Force Operational Test and Evaluation Center.
- The survey was in-depth and examined survival training, personnel training, and the operations and procedures of the organizations listed above.
- Suggestions that came out of the survey included increasing the operational experience and emphasis of the Life Support Program Office program managers, and maintaining personal interest in the programs.
- A Functional Management Inspection of the training and utilization of egress personnel was conducted by operational people.
- A worldwide Life Support Conference will be held 26 to 28 March 1985.

15 March 1985. Stephens, Maj Dwain E., Program Manager, A-7/A-10 Training, Directorate of Training, HQ Tactical Air Command, HQ TAC/DOTF.

- Maj Stephens is the chairman of the G induced Loss of Consciousness (GLC) Working Group.
- The GLC problem was first identified in the F-15 prototype.
- The reason it has not yet been corrected is a lack of money for programs.

13 May 1985. Oberline, Lt Col William, Chief Special Systems Division, DCS for Requirements, HQ Tactical Air Command, HQ TAC/DRPS.

- There are very good communications between the Life Support Program Office and TAC/DRPS.
- The Life Support Program Office has no problem getting good detailed requirements.
- The problem lies with the program office.
- The program office program managers lack operational experience and don't understand the environment they are developing equipment for.

29 May 1985. Farcht, Maj Joseph J., TAC Liaison Officer, Chief Fighter/Attack Division, Tactical Air Command Systems Office, TACSO-A.

- TACSO provides daily support to Life Support Program Office when needed.
- TACSO provides the program office with contacts at HQ TAC.
- The TACSO is an extension of the DCS for Requirements and the DCS for Logistics at HQ TAC.
- The TACSO has 4 pilots and 3 Weapons Systems Officers (WSOs).
- The TACSO monitors program office activities, keeps TAC informed, and represents TAC at meetings in the program office.
- The program office doesn´t always come to the TACSO for help.
- Maj Farcht believes it is easy for the program managers to be consumed in their daily activities and neglect placing their programs in the context of TAF priorities.
- The interface with the program office has been improving.
- The program office is contacting the TACSO more often.
- The program office is often in a reactive stage due to minimal long range planning.
- The answer to improving the performance of the program office is people. Good, responsible program managers.
- Life support equipment programs are ranked relatively low on TAC´s prioritized programs list.

Appendix B: Glossary of Terms (18)

Concept Exploration Phase. The identification of and exploration of alternative solutions or solution concepts to satisfy a validated need, usually through the use of contracts with competent industry and educational institutions. This phase requires active involvement of all participating commands to identify the candidate solutions and their characteristics. One or more of the selected candidate solutions are then approved for entry into the Development and Validation phase. (AFR 800-2)

Demonstration and Validation Phase. The period when selected candidate solutions are refined through extensive study and analyses; hardware development, if appropriate; tests; and evaluations. The objective is to validate one or more of the selected solutions and give a basis for deciding whether to proceed into Full-Scale Development. (AFR 800-2)

Full-Scale Development Phase. The period when the system and the principal items necessary for its support are designed, fabricated, tested, and evaluated. The intended output is a minimum: a preproduction system that closely approximates the final product; the documentation needed to enter the production phase; and the test results that show the product will meet requirements. This phase includes the acquisition of long lead production items and limited production for operational test and evaluation. (AFR 800-2)

Government Furnished Property. Government furnished property is property in the possession of or acquired directly by the government and subsequently delivered or otherwise made available to the contractor. (AFM 67-1)

Mission Area Analysis (MAA). Continuous analysis of assigned mission responsibilities in several mission areas, to identify deficiencies in the current and projected capabilities, to meet essential needs, and to identify opportunities for the enhancement of capability through more effective systems and less costly methods. (AFR 57-1)

Product Division. Those organizational bodies within AFSC responsible for system acquisition. These bodies are ASD, ESD, AD, BMO, and SD. (18:273)

Production and Deployment Phase.

(1) The period from production approval until the last system is delivered and accepted. The objective is to efficiently produce effective and supportable systems to the operating units. This includes the production of all principal and support equipment.

(2) Deployment. The period encompassing the process of uniting facilities, hardware and software, personnel, and procedural publications; and delivering an acceptable

integrated system to the using and supporting commands. This overlaps the production phase. (AFR 800-2)

Program Element Monitor (PEM). The PEM presides over a program throughout the acquisition life cycle. The PEM is assigned from within the Air Staff and provides corporate memory and is the link between the Air Staff and the user command. The PEM is the primary program advocate. (17:51)

Program Management Directive (PMD). The HQ USAF document that directs the implementing and participating commands and satisfies documentation requirements. It is used during the entire acquisition life cycle to state requirements and request studies, as well as initiate, approve, transfer, modify, or terminate programs. The content of the PMD is tailored to the needs of each program. (800-2)

Program Management Responsibility Transfer (PMRT). The transfer of program management responsibility for a system (by series), or equipment (by designation), from the implementing command to the supporting command. PMRT includes transfer of engineering responsibility. (AFR 800-4)

Program Manager. The single Air Force manager (system program director, program/project manager, or system/item manager) during any specific phase of the acquisition life cycle. (AFR 800-2)

Program Office. The office of the program manager and the single point of contact with industry, Government agencies, and other activities participating in the system acquisition process. It is the office the program manager sets up for the acquisition of systems, subsystems, equipment, munitions, or modifications to them. (AFR 800-2)

Statement of Operational Need (SON). A formal numbered document used to identify an operational deficiency and state the need for a new or improved capability for US Air Force forces. (AFR 80-14)

Support Equipment. Support equipment includes all equipment required to perform the support function, except that which is an integral part of the mission equipment. It does not include any of the equipment required to perform mission operations functions. (AFR 800-12)

System Operational Concept (SOC). A formal document that describes the intended purpose, employment, deployment, and support of a system. (AFR 80-14)

Technology Need (TN). A document in which an AFSC organization (excluding laboratories) describes an area of technological effort that will have a broad application to the orderly development of systems, subsystems or capabilities. (7:1)

Appendix C: Abbreviations and Acronyms

AD	Armament Division
AFISC	Air Force Inspection and Safety Center
AFLC	Air Force Logistics Command
AMD	Aerospace Medical Division
AMRL	Aerospace Medical Research Laboratory
ASD	Aeronautical Systems Division
BMO	Ballistic Missile Office
ESD	Electronics Systems Division
GFE	Government Furnished Equipment
MAA	Mission Area Analysis
PEM	Program Element Monitor
PMD	Program Management Directive
PMRT	Program Management Responsibility Transfer
PO	Program Office
PPBS	Planning, Programming, and Budgeting System
SD	Space Division
SOC	System Operational Concept
SON	Statement of Operational Need
SPO	Systems Program Office (see Program Office)
TAC	Tactical Air Command
TACSO	Tactical Air Command System Office
TN	Technology Need
USAFSAM	U.S. Air Force School of Aerospace Medicine
6.1	Designation for basic research
6.2	Designation for exploratory development
6.3	Designation for advanced development
6.4	Designation for engineering development

Appendix D: Interview Format

Name, Rank:

Organization:

Duty Title:

What are your organization's responsibilities in the life support equipment development and acquisition process?

What other organizations do you interface with?

What problems do you see with the performance of life support equipment?

What problems do you see with the life support equipment development and acquisition process?

What are your suggestions for eliminating these problems?

Specific questions based on the mission of the organization and expertise of the individuals.

What other organizations should I contact to get a complete picture of the life support equipment development and acquisition process?

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This thesis examined the process of life support equipment development and acquisition. This research identified the how the present process works, and the problems of the process. The research was limited to the development and acquisition of life support equipment for tactical aircraft. However, most of the problems and steps of the process are shared by life support equipment programs for other users. The process was determined by referring to applicable regulations and interviewing people involved in the process. Problems were identified by asking for them during the interviews, and by examining the process as a whole.

Seven problems are identified, of which five are considered correctable in the current defense acquisition framework. Four of the five problems deal with the management of the acquisition and development process, and combined indicate the lack of an integrated approach to the acquisition and development process. Solutions were developed from suggestions obtained during the interviews and through qualitative analysis of the problems. The results of this examination indicate that problems exist in the life support equipment development and acquisition process and that the development of an integrated process is necessary to solve these problems. An integrated solution is proposed in the recommendations.

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