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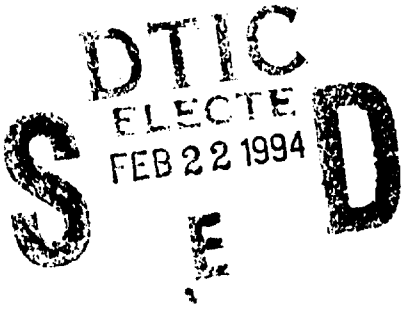

IDENTIFICATION OF PROBLEMS HINDERING LOGISTICS SUPPORT OF COMMERCIAL-OFF-THE-SHELF COMPUTER EQUIPMENT

THESIS

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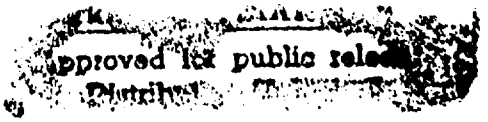

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THESIS

Presented to the Faculty of the School of
Logistics and Acquisition Management
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

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Preface

The purpose of this study was to:

(1) explore the advantages and disadvantages of COTS computer equipment.

(2) to explore the current support practices for COTS computer equipment.

(3) to explore options for future support concepts.

(4) to explore the need to standardize Air Force logistics support of deployable COTS computer equipment.

(5) to identify the specific problems currently hindering Air Force logistics support of COTS computer equipment.

(6) to propose a standardized support concept for COTS computer equipment.

We accomplished these objectives by performing a literature review and by administering a survey to logistics support experts.

In preparing this study and writing this thesis, we have had a great deal of help. We are deeply indebted to our faculty advisors Professor Richard Andrews and Professor Norman Ware for their patience, guidance, and technical assistance. We also wish to thank Capt Raymond Daly of the Air Force Logistics Management Center for his help in obtaining Desert Storm Lessons Learned material for the literature review. Finally, we would like to thank our wives Arlene and Diane for putting up with looking at our backs while we mauled our keyboards for endless hours.

William Z. Zeck

Jessie J. Rowe III

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Abstract

The purpose of this study was to identify the specific problems currently hindering Air Force logistics support of COTS computer equipment and to recommend a support concept to overcome these problems.

These objectives were accomplished with a literature review and a survey of logistics support experts. The survey asked the experts to identify problems hindering logistics support of deployable COTS computer equipment and to rank logistics support elements in order of importance.

One hundred surveys were sent out and thirty-three were returned. Data analysis indicated that the logistics support elements that are most problematic for the logistics support of deployable COTS computer equipment are supply support, technical data, manpower and personnel, training and training support, and maintenance planning. The experts ranked logistics support elements and factors in the following order of importance: supply support; maintenance planning; training and training support; technical data; manpower and personnel; computer resources support; support equipment; lack of understanding of user requirements; packaging, handling, storage, and transportation; lack of guidance; and facilities.

Fifty-seven percent of the experts recommended a combination bluesuit and contractor logistics support concept to

overcome the problems with the logistics support of deployable COTS computer equipment.

IDENTIFICATION OF PROBLEMS HINDERING LOGISTICS SUPPORT OF COMMERCIAL-OFF-THE-SHELF COMPUTER EQUIPMENT

I. Introduction

General Issue

Due to a recommendation by the President's Blue Ribbon Commission on Defense Management, commercial off-the-shelf (COTS) equipment will constitute a larger and larger percentage of our weapon systems inventories (18:23). Accordingly, Air Force logisticians will increasingly find themselves involved in projects that use COTS hardware (13:28). Commercial off-the-shelf equipment is "any item of supply that is available in the commercial marketplace" (12:184). Personal computers and workstations are two types of COTS equipment whose use is rapidly accelerating. Personal computers are desktop size data processing machines usually based on the Intel (or Intel clone) central processing unit (CPU) 80X86 family. Workstations are data processing machines similar in size and construction to personal computers, but are generally faster and more powerful due to their use of reduced instruction set chip (RISC) CPUs. This paper will refer to PCs and workstations as computer equipment.

The increase of COTS computer equipment in Air Force inventories is exacerbating existing logistics support problems for these items. According to a joint Air Force Logistics Command, Air Force Communications Command, and Air Force Systems

Command study on COTS, "the complications are driven by the lack of policy, process, and procedures for the acquisition and support of commercial items" (12:2). Commercial systems can be purchased and deployed faster than developmental systems, but creating and employing effective support for these COTS systems is difficult and time consuming (17:29). It is easy to rapidly field a deployable COTS computer system that has absolutely no logistics support tail. Many COTS assets have been and will be deployed on the battlefield. Desert Shield/Storm provided a recent example of the lack of a standardized logistics support concept for COTS computer equipment. The Air Force deployed many different types of COTS computer equipment to Desert Shield/Storm. As these computers began to fail, the users found themselves in a predicament. The computers (PCs and workstations) were needed to perform the mission, but there was no standardized logistics support mechanism in place to fix them.

Each user had to develop ad-hoc methods for getting his/her COTS computer equipment repaired. Based on the researchers experience supporting Desert Shield/Storm, these ad-hoc support mechanisms worked with varying degrees of success, but typically they were slow, ineffective, and inefficient. In fact, the most common method of supporting mission requirements was to beg, buy, borrow, or steal another PC or workstation. Thankfully, Desert Storm/Shield was a short conflict. In the researchers opinion, if it had been a prolonged affair, the Air

Force's "logistics support system" for COTS computer equipment could not have fulfilled mission requirements. With greater numbers of computers entering the inventory and more personnel having to become computer literate, it is clear that the need for a standard logistics support concept for all COTS computer assets is essential to our future peace time and war time operations.

Specific Problem

Air Force support of deployable COTS computer equipment needs further definition and standardization.

Investigative Objectives

This thesis:

(1) explores advantages and disadvantages of COTS computer equipment;

(2) explores current support practices for COTS computer equipment;

(3) explores the need to standardize Air Force logistics support of deployable COTS computer equipment;

(4) specifically identifies which of the integrated logistics support elements are the most problematic for Air Force logistics support of COTS computer equipment;

(5) explores options for future support concepts;

(6) and proposes a standardized support concept for COTS computer equipment.

Essential to identifying the specific problems currently hindering Air Force logistics support of COTS computer equipment, addressing the above objectives, and subsequently

developing a standardized support concept for this equipment is the concept of Integrated Logistics Support (ILS). According to Department of Defense Directive (DODI) 5000.2, Part 7, ILS is:

> **A disciplined, unified, and iterative approach to the management and technical activities necessary to:**
>
> **a. Developing support requirements that are related consistently to readiness objectives, to design, and to each other.**
>
> **b. Effectively integrating support considerations into the system and equipment design.**
>
> **c. Identifying the most cost-effective approach to supporting the system when it is fielded, and**
>
> **d. Ensuring that the required support structure elements are developed and acquired (9:2).**

ILS is comprised of ten elements. Many problems currently hindering logistics support of COTS computer equipment will be attributable to one or more of these ten elements. According to Department of Defense Directive (DODI) 5000.2, the ten DOD identified elements of logistics support are:

> **(1) Supply Support.**
>
> **(2) Technical Data.**
>
> **(3) Facilities.**
>
> **(4) Manpower and Personnel.**
>
> **(5) Packing, Handling, Storage, and Transportation.**
>
> **(6) Training and Training Support.**
>
> **(7) Support Equipment.**
>
> **(8) Computer Resources Support.**

(9) Maintenance Planning.

(10) Design Interface (9:2).

Scope

This thesis will study only stand alone commercial off-the-shelf personal computers and workstations. This thesis will not consider mainframe computers, mini-computers, or any computers embedded in other weapons systems.

Limitations

This thesis will not lay out a comprehensive logistics support plan for COTS computer equipment, but will lay the conceptual ground work for the future development of such a plan.

Assumptions

This thesis makes the following assumptions:

(1) The judgment sampling technique used will ensure experts are picked to complete the survey.

(2) Survey participants have been exposed to COTS computer equipment in the field or during the acquisition process.

Overview

This thesis will be composed of five chapters. Chapter one is the preceding introduction. Chapter two is a literature review that examines recent (1983 through present) journals, trade magazines, prior thesis research, and DOD regulations/directives to determine what is already known about current problems and possible solutions concerning COTS computer

support practices. Chapter three describes the methodology used to gather empirical data. Chapter four shows how the researchers analyzed the data, performed the statistical tests described in chapter three, and summarized the results of these tests. The analysis of this data specifically defines the problems hindering Air Force logistics support of COTS computer equipment. Chapter five provides conclusions about which logistics support problems are the bottlenecks to a standardized COTS computer support concept and proposes a strawman logistics support concept.

II. Literature Review

This chapter reviews current (1983 through present) journals, trade magazines, prior thesis research, and DOD regulations/directives to determine what is already known about current problems with and possible solutions to COTS computer support practices. This literature review will explore (a) advantages and disadvantages of COTS computer equipment, (b) current Air Force support policies and objectives, (c) current support practices for COTS computer equipment, (d)options for future support concepts, and review a previous COTS study performed by COTS Supportability Working Group. Factors a through d are vital to standardizing Air Force logistics support of deployable COTS computer equipment.

Advantages/Disadvantages of COTS

The use of COTS computer equipment in Air Force weapon systems has its advantages and disadvantages. The main advantages are (10:6):

a. Current & Advancing Technology.

b. Market-Based Pricing.

c. Up-Front Product Identification and Pricing.

d. Proven Performance and Reliability.

e. Reduced Acquisition Time & Cost.

f. Existing support base (spares, technical data, trained technicians) available when end item purchased.

Current & Advancing Technology. By using COTS computer equipment, the Air Force can take advantage of the rapidly accelerating technology taking place in the computer industry.

Market-Based Pricing. Because the Air Force is buying the COTS equipment "off-the-shelf" it can take advantage of the competitive forces of the capitalist economy.

Up-Front Product Identification and Pricing. Unlike specifically developed items, COTS equipment guarantees the Air Force knows what it is getting and at what price. There are no cost over runs or performance slips associated with COTS equipment.

Proven Performance and Reliability. Commercially available products have known performance factors and reliability data.

Reduced Acquisition Time & Cost. Probably the biggest advantage of using COTS computer equipment is the reduced acquisition time. Typically, it takes seven to ten years to develop and field a weapon system designed specifically for the Air Force (19:53). During this seven to ten years, mission needs and technological solutions might change and the system might enter the inventory obsolete. COTS equipment, on the other hand, only takes one to three years to field (19:53). This short time span allows an almost immediate fulfillment of current mission needs and the use of the most up-to-date technology. Acquisition costs for COTS equipment are far less than for developed items. With COTS, the Air Force does not

directly pay for research and development (R&D) costs, engineering data development costs, or technical manual preparation costs (21:25).

Existing support base. Since COTS equipment is bought from a manufacturer that sells this equipment to many other customers, typically all of the support functions are available at time of purchase from the manufacturer. The manufacturer maintains the spare parts, technical data, and trained technicians necessary to maintain the equipment he sells. This can be a great advantage if the Air Force plans to let the original equipment manufacturer (OEM) support the system. The Air Force simply has to negotiate a support contract and instant logistics support is provided.

The main disadvantages of using COTS computer equipment as deployable weapon systems are:

a. Difficulty of logistics support.

b. Lack of control over design.

c. Lack of configuration control.

d. Constraints of inherent performance.

Difficulty of logistics support. While OEM support provides a convenient and adequate avenue for support of non-deployable COTS equipment, it creates many difficulties for deployable systems. Deployable systems used in a combat environment require rapid logistics support response. There simply is not time to ship the equipment back to the OEM for repair or to wait for an OEM technician to come and fix the

system during wartime or in a hostile environment. The advantage of reduced acquisition time discussed previously becomes a disadvantage for providing logistics support. A 30 January 1989 letter from AFCC Deputy Chief of Staff for Logistics to HQ USAF Maintenance Policy Division pointed out the problem caused by rapid acquisition of COTS systems and the time required to develop and employ a logistics support tail. The letter cited the cause of this problem:

> COTS vendors will not provide the proprietary engineering data necessary to support the provisioning process and the establishment of an organic depot repair capability. Consequently, COTS/NDI (non developmental item) spares are not catalogued and incorporated into the Standard Base Supply System (SBSS). As a result of this situation, the Air Force has fielded COTS/NDI equipment without: (a) the proper life-cycle logistical support, (b) addressing the issue of bluesuit maintenance of wartime critical deployable COTS/NDI, and (c) the manpower authorizations to provide such support.

Some of the specific problems with OEM support of deployable COTS computer equipment are discussed later in the Future Support Options section of this thesis.

Lack of control over design. Another disadvantage is that the Air Force has no influence on the design of the system. In other words, "what you see is what you get." The COTS computer may do only 90% of what the Air Force wants it to and the other 10% may be extremely critical to mission accomplishment. The Air Force has no design control over the manufacturer to get that desired 10%.

Lack of configuration control. Since the Air Force has no control over the design or redesign of a product, the contractor can change the design of a product at any time. Additionally, the OEM maintains exclusive rights to the design because the OEM developed it (5:5). Lack of configuration control may hamper Air Force logistics support of COTS computer equipment. As an example, if we want to order a spare part from base supply we need a national stock number (NSN). It is difficult to manage the assignment of NSNs to parts whose designs change frequently.

Constraints of inherent performance. Similar to the lack of control over design is the lack of control over inherent performance. The Air Force must accept whatever performance and reliability and maintainability (R&M) characteristics are available in the marketplace. For example, if the Air Force needs a system that has a mean time between failure (MTBF) of 10,000 hours and the best COTS system available only provides a MTBF of 8,000 then the Air Force must live with that limitation.

Current Support Realities/General Problems

Currently, the Air Force has no standardized logistics support concept for COTS computer equipment; there is only some general Air Force guidance available on providing contractor logistics support for COTS equipment. Unfortunately, this guidance tends to conflict with the reality of procuring COTS computer equipment. For example, Air Force Regulation 800-21 describes the items generally selected for contractor logistics

support (CLS) as those that are not wartime essential, have small inventories, are not cost effective when compared against cost associated with development of organic capability, are subject to rapid technical obsolescence, do not operate in a combat environment, and are procured as COTS systems and equipment(7:2). This guidance conflicts with the realities of COTS computer equipment use in today's Air Force. For example, PCs in today's Air Force can be found on most office desks; therefore, the inventory of PCs in the Air Force is extremely large. Additionally, Desert Shield/Storm witnessed the deployment of thousands of PCs to the combat area, and without those PCs, many wartime essential duties would have been delayed (i.e. developing an Air Tasking Order (ATO) by hand takes much longer than it does by computer and ATOs must be developed each day).

Often, the Air Force does not adequately plan for support of COTS. Each program office uses a different method for procuring COTS support. Each program manager (PM) develops a unique logistics support solution for each COTS program. Again, this may be fine for non-deployable systems, but the confusion of battle-field conditions necessitates a standard support concept. Why? Because the maintenance technician in the field does not have time to sort through different support concepts for different systems. He needs one concept for all systems. Additionally, lack of consistent guidance on COTS acquisition logistics may result in individual PMs emphasizing the wrong ILS

elements. This can lead to essential elements being over looked. This variability in support methods can force the maintenance technician to play the role of supply officer in order to keep accountability and acquire spare parts for COTS assets. These differing support strategies also risk losing critical Air Force owned spares and complicate warranty tracking (12:20).

Usually, each PM develops a support concept based on contractor logistics support (CLS) of the COTS computer system. Air Force Logistics Command/Air Force Systems Command Pamphlet 800-34 defines CLS as a preplanned permanent support concept that provides total, or near total, logistics support to a system or equipment by contract for its entire life cycle (8:32-1). Typically, the individual components of the computer system (i.e., monitor, keyboard, printer, chassis, external disk drives, and other peripherals) are treated as line replaceable units (LRUs). When a LRU breaks or malfunctions, it is boxed up and sent back to the contractor for repair or replacement (19:52). Some disadvantages to this system include:

a. Turn around time is unacceptable in a war-time environment.

b. To eliminate turn around times caused by the shipment of LRUs, expensive LRU spares must be maintained on or near the battlefield.

c. Shipping LRUs to and from contractors takes up valuable air transport space.

d. Contractor personnel cannot be counted on to provide field service under battlefield conditions if this service becomes necessary.

Perhaps the biggest problem with CLS of COTS computer equipment, as it exists today, is the variability of procedures for implementing the contracts. Since there is no standardized method for obtaining contractor support of COTS assets, each contract requires the user to learn a different set of procedures. While this may work in a peacetime environment, it is too confusing to use under the stress and confusion of the battlefield.

Future Support Options

Logistics support of COTS computer equipment needs further definition and standardization. There are three methods of logistics support that should be considered for COTS computer equipment. These methods are full CLS, Air Force organic support (bluesuit support), or some combination of CLS and bluesuit support. Each of these options must be graded upon how well it can satisfy the ten ILS elements.

Full CLS. Although CLS has shortcomings in its present form, it is still a viable support option for war-time COTS computer equipment. The Army effectively used CLS to repair its COTS computers in Saudi Arabia during Desert Shield/Storm, but it was not standardized, it was not available at the front lines, and it did not handle all of the army's requirements. It was, in fact, an ad-hoc arrangement used to satisfy the unique requirements of Desert Shield/Storm (11:22). Third party

computer maintenance firms are very adept at maintaining a variety of computer systems (3:64). The Air Force can take advantage of this ability and award a standard contract for all COTS assets deemed suitable for contractor logistics support. Using a standard contract to support all of the wartime COTS computer systems could simplify the job of field maintenance technicians. Maintenance technicians in a deployed environment need one set of standard procedures to follow for all of their COTS systems' maintenance.

While contractor support may be viable for some war-time COTS assets, the turn around times and uncertainty of the availability of support personnel under battlefield conditions still require resolution.

Leasing COTS computer equipment is a special sub-set of CLS which deserves separate consideration. Leasing should be considered as a means of acquiring COTS equipment and its support. Leasing can be used in many ways to help support COTS computer equipment. Air Force Regulation 700-4, Volume II identifies three types of leases available to the PM when procuring logistics support for COTS computer equipment. They are:

a. Straight lease. This is when resources are leased for a specific period with options for additional periods.

b. Lease on ownership plan. This is when the government leases tangible resources for a specific period after which lease payments cease and title is transferred to the government.

c. Lease with option to purchase. This is when the government leases tangible resources for a specific period with an option to purchase at a later date. The government may acquire ownership of the resources by invoking the contract options in the lease (6:6).

COTS computer equipment has a useful life of three to five years before it reaches obsolescence (16:5). After three to five years, while the equipment may still function, the software requirements may have surpassed the ability of the hardware. It may be cheaper to lease COTS computer equipment and its logistics support instead of buying the COTS equipment (2:69). By leasing, the Air Force can take advantage of the latest equipment without having to depreciate owned equipment. Problems with turn around times associated with CLS (shipping LRUs between user site and contractor facility) could be reduced by leasing extra equipment suites to act as LRU spares. Leasing is an area worthy of further exploration. As an option to leasing the equipment and contracting for its support, the Air Force could buy the COTS equipment, perform blue-suit maintenance on the equipment, and lease the spare parts. By leasing the spares, the Air Force can avoid configuration control problems of spares by by-passing the NSN process.

Air Force Organic Support (Bluesuit). With bluesuit support, the wartime user has total control over the logistics support process. Assuming the resources are available, the user controls the maintenance personnel, the spare parts, the turn around times, and the rest of the ten ILS elements.

Unfortunately, blue-suit support of COTS presents some major challenges. Four ILS elements that may present the biggest challenges in COTS computer blue-suit support are supply support, technical data, manpower, and training and training support.

Supply Support. Because the government did not fund the design of COTS computer equipment, it has no control over changes to the COTS computer equipment design; therefore, it has no configuration control over the item (20:7). Lack of configuration control makes it very difficult to procure, catalog, and stock spare parts, because COTS system designs are dynamic. As systems designs change, so do spare parts; so, it becomes very difficult for supply to keep NSNs up to date. It is so hard, in fact, for supply to keep NSNs up to date on COTS equipment that, in most cases, the Air Force just does not assign NSNs to COTS spares, and COTS spares are not available through normal supply channels. Supply support was a problem during Desert Shield/Storm. There were limited spare parts available to fix deployed computer equipment in Saudi Arabia (1:5). Additionally, COTS computer manufacturers do not like to continue production of spare parts for old designs. As computer manufacturers update their designs, component parts change. Then, when the Air Force buys replacement parts, the parts may not work in the Air Force's model of equipment.

Technical Data. Air Force Technical Orders (TOs) are manuals required to perform any maintenance, inspection,

servicing, or operation on a piece of equipment. When the Air Force acquires equipment via the COTS route, no Air Force mil-spec formatted TOs are procured. The COTS equipment is delivered with contractor user manuals, which are usually inadequate for performing in depth maintenance actions. The Air Force can, of course, supplement the commercial manuals, but this can become a mini-acquisition and cost the Air Force a great deal of time and money (therefor defeating the purpose of COTS).

Lack of adequate technical data is currently a major problem in the logistics support of HQ ACC's Constant Source program. Constant Source is a COTS workstation that receives input from various intelligence sources that will be deployed with every ACC F-16 wing. The current maintenance concept calls for bluesuit maintenance, but the manuals provided with the workstations are inadequate to permit bluesuit maintenance. The program was developed so rapidly that there was no time to write Air Force TOs or supplement the OEM manuals, therefore; Constant Source is currently not logistically supportable (22:1).

Manpower. The USAF currently achieves the majority of COTS computer equipment maintenance via contractor support. If blue-suit personnel pick up this support function, the impact on current communications-electronics manpower may be overwhelming. Any additional maintenance assumed by the Air Force may require

additional manpower authorizations. These manpower authorizations may result in additional funding requirements.

Training and Training Support. Presently, the Air Force has no formal technical school to train technicians in small computer (PC and workstation) repair; therefore, technicians must be trained by contractors. Contractor training is expensive and specific. An Air Force technician needs a very broad training program to ensure he is able to service a wide range of computer platforms.

Lack of formal and widely available small computer training is currently a logistics supportability problem for HQ ACC's Sentinel Byte program. Sentinel Byte is a deployable COTS workstation that is used to download and interpret enemy threat information to certain ACC fighter wings. The current Sentinel Byte maintenance concept calls for bluesuit support. Unfortunately, there is no training readily available for Air Force technicians on small computers or workstations (23:1).

Training on acquiring logistics support for COTS equipment in general is lacking. Since the acquisition and support processes for COTS resources are different from the Air Force acquisition and support processes for developed equipment, a training program for personnel involved with the planning for support of COTS equipment needs to be developed (12:23).

Combination of CLS and Bluesuit Support. This option would take the best of CLS and bluesuit support to form a logistics support concept for COTS computer equipment. For

instance, COTS computer equipment could be maintained by CLS at the depot level and by bluesuiters at the organizational level. Spare parts could be leased from the contractor and maintained by the contractor, but kept with the deployable COTS computer equipment for use by bluesuit technicians during exercises or deployments.

COTS Supportability Working Group Study

On 29 December 1989, the COTS Supportability Working Group was formed. This working Group was concerned with all types of COTS equipment and not just COTS computer equipment. The working groups was tasked to (17:30):

a. Identify supportability challenges facing implementing, supporting, participating, and using commands.

b. Visit Air Force and Private industry to get their perspective, approaches, and procedures on both effective and ineffective support practices.

c. Verify data collected through on-site visits where practical.

d. Provide briefing and final report to the AFSC, AFLC, and AFCC commanders. The final report shall contain specific recommendations for policy and procedural changes.

The working group approached these tasks using a four step approach: first, they defined the most pressing problems or concerns associated with COTS acquisition logistics; second, they presented several questions which would form the basis for data-gathering; third, they gathered data; and fourth, they

developed a mission statement (17:30). The Working Group's mission statement reads:

> The Working Group will recommend for incorporation in the appropriate documentation specific policy, guidance, and procedures that ensure Supportability considerations are incorporated into the selection, integration and support of commercial items (17:31).

The COTS Supportability Working Group defined the most pressing problems or concerns associated with COTS acquisition logistics as (17:31):

(1) Proliferation of Support methods.
(2) Decreasing availability of support funding.
(3) Lack of universal definitions among the government and contractors.
(4) Lack of bidders, or high bids, to inadequate requirements statements.
(5) Poor responsibility assignment for interface items connecting COTS.
(6) System life cycles longer than Contractor Logistics Support (CLS) contracts.
(7) A developmental mindset among acquisition personnel.

The Working Group used the following questions as a basis for data gathering (17:31):

(1) What should the spares policy on stock, store, and issue for COTS items be?
(2) Are the same tools and solutions for COTS needed as for developed systems?
(3) How should long-term supportability for COTS be managed? Should there be periodic review and assessment?
(4) Should a "COTS Center of Excellence" be established?

The Working Group divided into sub teams to collect data from industry, acquirers, and users/supporters. The industry team collected data from The Bank of Boston, Commonwealth of Massachusetts, First Mutual of Boston, Kollsman, Massachusetts

Institute of Technology, Raytheon, and Saunders. The acquirers team collected data from Aeronautical Systems Division, the Ballistic Missile Office, Computer Systems Division, Electronic Systems Division, Standard Systems Center, Sacramento Air Logistics Center, and Space Systems Division. The users/supporters team collected data from Air Force Communications Command, Air Force Space Command, Air Weather Service, Military Airlift Command, Strategic Air Command, Sacramento Air Logistics Center, and Warner Robins Air Logistics Center.

After gathering and analyzing the data, the Working Group came up with following recommendations (17:34):

1. Indicate contractor support is preferred unless mission needs are not met.
2. Apply vendor support concepts whether support is organic or contract.
3. Don't modify commercial items.
4. Develop support requirements, life-time support strategy, and contract language for commercial items up front.
5. Link the requirements process to market analysis.
6. Emphasize the acquisition strategy should fund initial support of organically supported items.
7. Modify the cataloguing process and the Standard Base Supply System for commercial items.
8. Emphasize system integration tools to meet the engineering challenge for commercial items.
9. Train to change the developmental mind-set and to improve management agencies.
10. Identify market analysis functions in acquisition and program management agencies.
11. Establish a commercial item support center of excellence until new policy and processes are in place.
12. Establish clear definitions.
13. Analyze and coordinate before changing support.
14. Prototype new ideas on selected programs.
15. Form a commercial item support strategy panel.
16. Select the vendor concept that meets Air Force needs.

17. Use the Standard Base Supply System for government-owned spares.
18. Use Contractor Owned and Maintained Base Supply and service contracts for contractor-owned spares.
19. Define support requirements up front.
20. Use modular design approaches with portable software.
21. Accept commercial support.
22. Focus on full-scale development support objectives in source selection.
23. Adapt industry practices.

Conclusion

Commercial off-the-shelf computer equipment is becoming common in the Air Force inventory. Presently, there is no standard logistics support concept for COTS computer equipment. A standardized logistics support concept needs to be developed for COTS computer equipment using either contractor logistics support, blue-suit support, or a mixture of the two (depending on system requirements). If a mixture is used, each piece of the mixture (CLS, or blue-suit) should be standardized. The maintenance technicians in the field need to be able to follow the same procedures for obtaining support for every system.

While the COTS Supportability Working Group performed an in-depth study on logistics support problems of COTS equipment in general, little has been published that specifically concerns COTS computer equipment. Additionally, little has been published concerning the different support options available for COTS computer equipment, and even less has been written that details how to best implement a standardized support concept based on one or more of these options. Also, even though there has been some investigation about the general problems

encountered in supporting COTS computer equipment on the battlefield, no research has been done on what the specific problems are and which problems cause the greatest bottlenecks for developing a standardized logistics support concept for COTS computer equipment.

III. METHODOLOGY

This chapter describes the methodology used to collect and analyze data gathered during the thesis research. This chapter also describes how the data was analyzed to determine which ILS elements pose the greatest problems to COTS computer equipment logistics support.

Investigative Objectives

This thesis:

(1) explores advantages/disadvantages of COTS computer equipment;

(2) explores current support practices for COTS computer equipment;

(3) explores options for future support concepts;

(4) explores the need to standardize Air Force logistics support of deployable COTS computer equipment;

(5) identifies the specific problems currently hindering Air Force logistics support of COTS computer equipment;

(6) and proposes a standardized support concept for COTS computer equipment.

Methodology

Method. A mail survey was used to interrogate Air Force communications-computer experts to determine the specific problems currently hindering Air Force logistics support of COTS computer equipment. The survey was mailed to 100 experts out of the population of Air Force communications-computer experts at various locations throughout the Air Force (within CONUS)

including Air Force Materiel Command (AFMC), Air Combat Command (ACC), Air Mobility Command (AMC), Air Force Communications Command (AFCC), and Headquarters United States Air Force (HQ USAF). The survey technique was chosen in order to obtain the largest sample possible while satisfying time and monetary constraints.

Population of Interest. The sample was selected using a non probability judgment technique. Surveys were mailed to the directors of communications-computer directorates (SCs) of major Air Force units. The SCs assigned the surveys to their units' communications-computer experts for completion. The survey raters were asked to complete the survey within ten working days. Follow-ups (reminders) were sent to non-respondent units thirty days after the initial mailing to improve the response rate. Thirty-three surveys were returned for a response rate of thirty-three percent.

Instrument Development and Testing. The survey questionnaire was developed by the researchers to specifically satisfy the investigative objective. Both researchers have extensive experience in the logistics support and the communications-computer fields. The survey questionnaire consisted of nineteen questions. Questions one through eight asked about the participants' job experience. Question nine and ten asked the participant to provide a yes or no answer to questions on COTS supportability. Question eleven asked the experts to rank the logistics support elements in order of

importance. Question twelve asked participants to use a Likert type scale (1-6) to rate the importance of different logistics support factors regarding COTS computer equipment. Question thirteen provided a place for the experts to write, in their own words, the problems associated with logistically supporting deployable COTS computer equipment. Question fourteen asked the experts to choose the best method for supporting deployable COTS computer equipment. Questions 15 through seventeen asked yes or no questions coupled with a Likert scale to assess some specific problems with COTS supportability. Question eighteen asked if there are any other problems hindering logistics support of deployable COTS computer equipment. Question nineteen provided a space for the participants to state how they would improve the logistics support for deployable COTS computer equipment. The surveys was mailed with a self-addressed envelope to improve the response rate. An example of the survey is illustrated in exhibit one at the end of this section.

Plan of Analysis. Once the survey data was collected, it was entered in a relational computer data base. The computer data base grouped identical questions and summed the responses of all questionnaires for each question. The sum of each logistics support element being ranked was calculated and the sums were rank ordered from lowest to highest. Logistics support elements with lower sums are considered by the experts as more important to the logistics supportability of deployable COTS computer equipment than those with higher sums. The sum of

each Likert Scale question was divided by the number of questionnaires to arrive at a mean. The mean for each element was used as the basic sample statistic. The mean for each question was also judged against a standard (set by the researchers) to determine if the associated logistics support factor is important. Based on the wording associated with the Likert scale, all means less than 4.5 are considered non-significant. A large-sample test of hypothesis about the population mean was conducted to determine if each question's mean is less than the cut-off (standard) of 4.5. The original hypothesis states "the population mean is equal to 4.5." The alternate hypothesis states "the population mean is less than 4.5." All other survey data was tabulated and presented in simple percentage form.

IV. Data Analysis

This chapter shows how the data was analyzed. Specifically, this chapter describes the characteristics of the experts who filled out the surveys, it shows how the statistical tests described in chapter three were performed (and summarizes the results of these tests), and it shows the outcome (in percentages) of non-Likert Scale questions. The analysis of this data specifically defines the problems hindering Air Force logistics support of COTS computer equipment.

Respondent Characteristics

Out of the one hundred surveys mailed out during this study, thirty-three were returned. The first eight questions asked about the participant's job history in order to demonstrate the data gathered is credible. The following figures one through eight illustrate the results of these 'demographic' type questions:

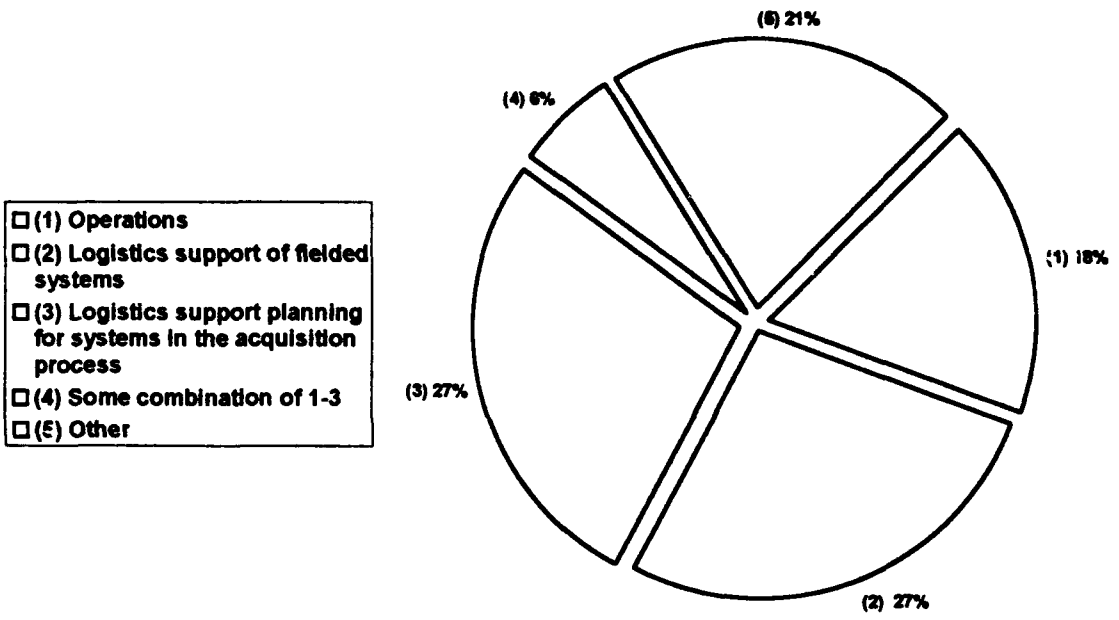

Figure 1. Respondents' current job descriptions

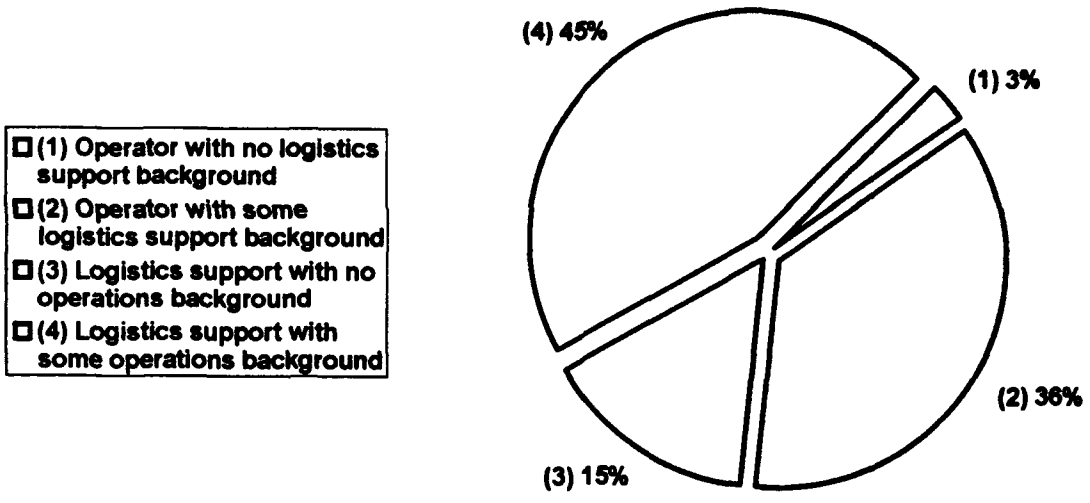

Figure 2. Respondents' job history

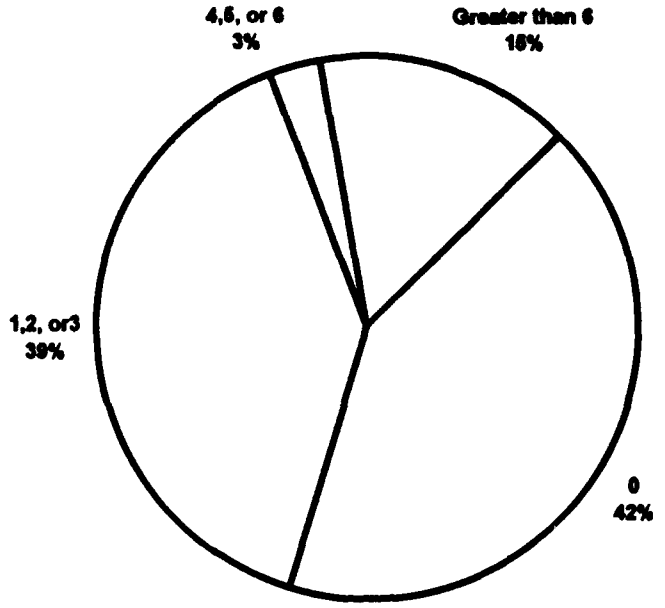

Figure 3. Number of formal logistics support training courses attended by respondents

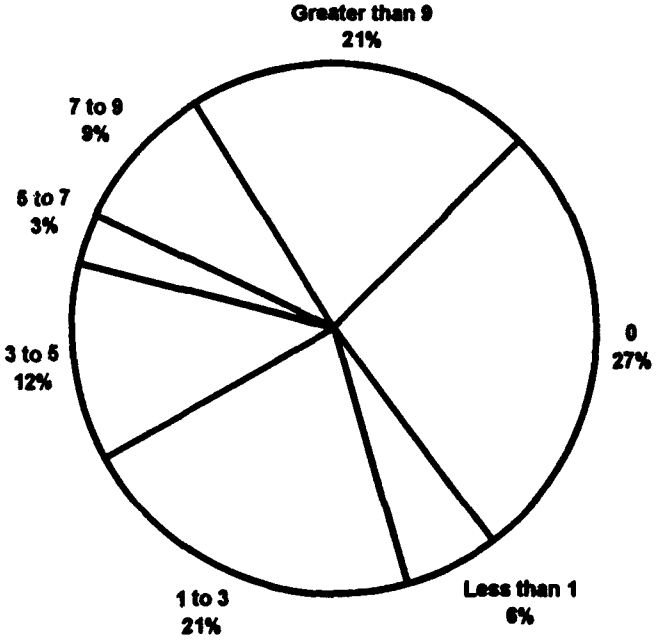

Figure 4. Number of years of experience respondents have in operational logistics

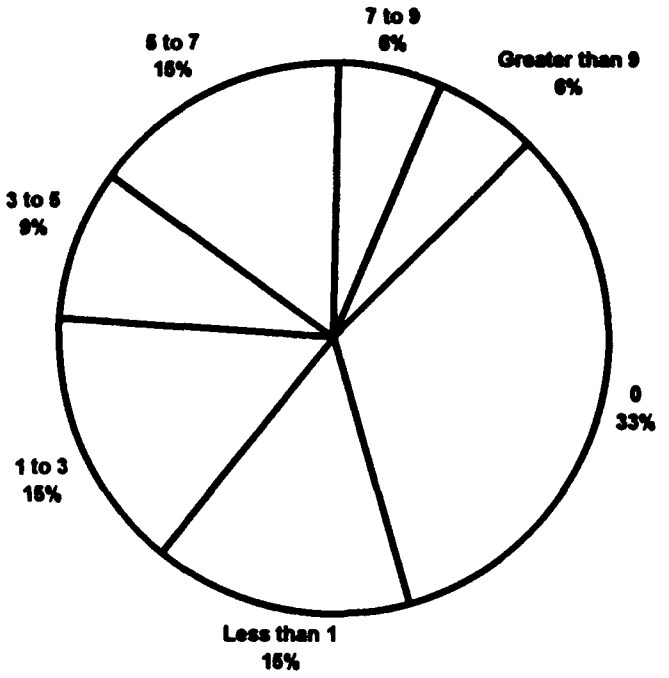

Figure 5. Number of years of experience respondents have in acquisition logistics

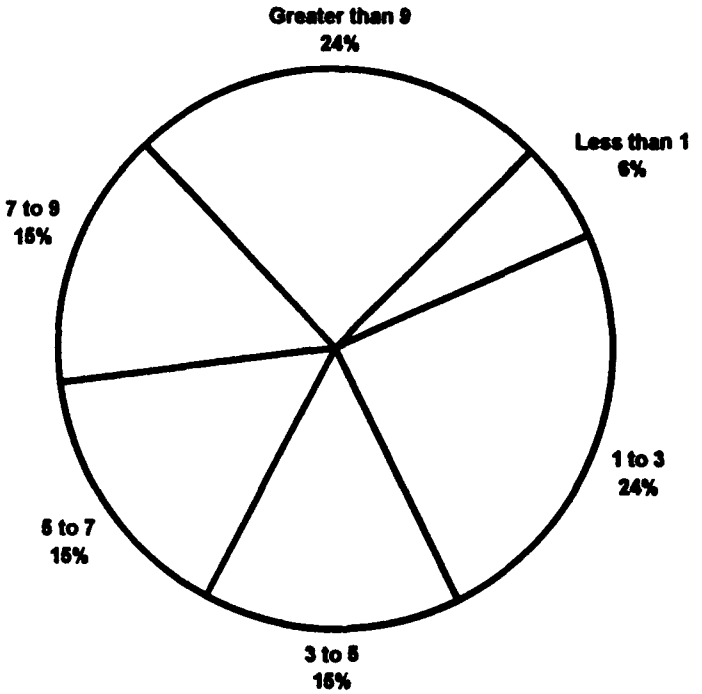

Figure 6. Number of years of experience respondents have in the computer field

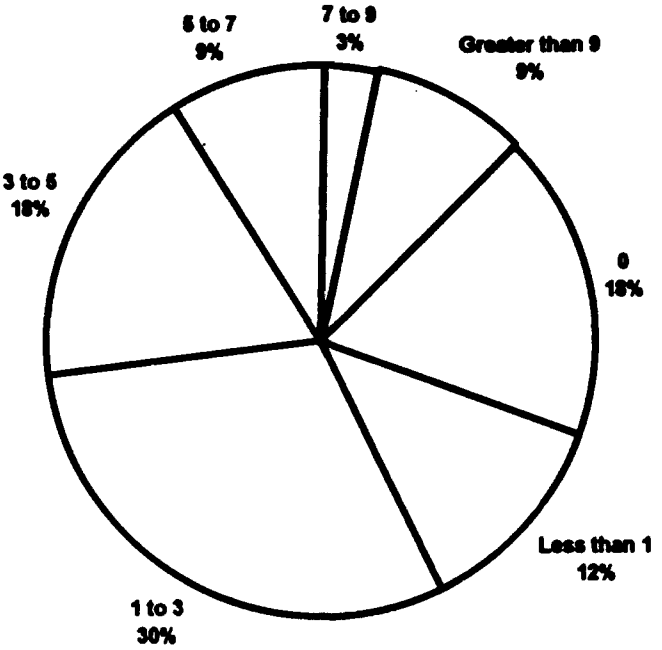

Figure 7. Number of years of experience respondents have been involved in the logistics support of COTS equipment

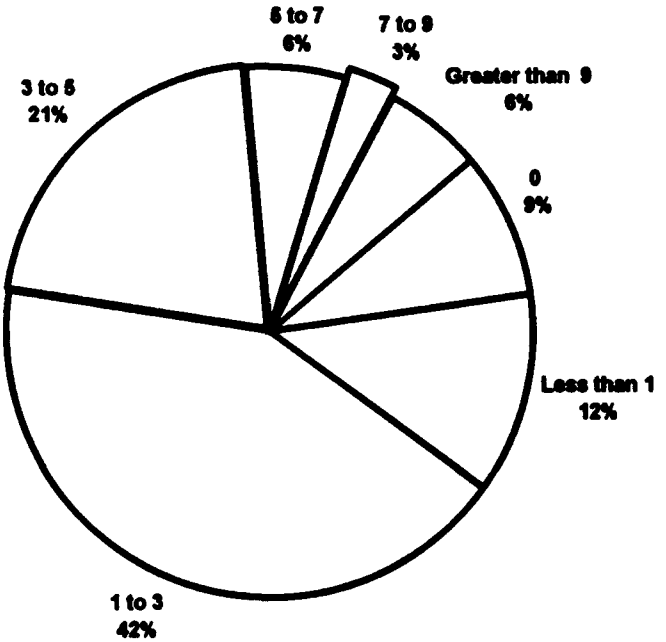

Figure 8. Number of years of experience respondents have been involved in the logistics support of COTS computer equipment

As figures one through eight clearly indicate, the data collected for this study comes from people with a great deal of experience in the logistics support of Air Force equipment. In fact, 60 percent of the respondents are currently working in the logistics field and 90 percent of them have a job history of logistics support experience. Fully 57 percent of the people surveyed have had at least one formal logistics support course. Forty-five percent of the respondents have greater than three years experience in the operational logistics field, 36 percent have greater than three years experience in the acquisition logistics field, 69 percent have greater than three years experience in the computer field, 39 percent have greater than three years experience in the logistics support of COTS equipment, and 36 percent have greater than three years experience in the logistics support of COTS computer equipment.

Ranking of Logistics Support Elements

Question eleven asked participants to rank logistics support elements in order of importance with respect to the logistics support of deployable COTS computer equipment. An element ranked as 1 meant that it was considered more important to the respondent than an element ranked as 2, a 2 is more important than a 3, and so on. The survey asks the experts to rank the following nine logistics support elements and three additional areas of concern: supply support; technical data; facilities; manpower and personnel; packaging, handling,

storage, and transportation (PHS&T); training and training support; support equipment; computer resources support; maintenance planning; lack of guidance from regulations, directives, and manuals for the logistics support planning of COTS computer systems during the acquisition process; lack of understanding of the users' logistics support requirements for COTS computer systems; and other. The computer data base added all the rankings for a given support element together to arrive at a sum. The elements were ranked according to their sums from lowest to highest. Elements with lower sums are deemed more important than elements with higher sums. For instance, supply support was ranked number 1 by four respondents, number 2 by eight respondents, number 3 by four respondents, number 4 by three respondents, number 5 by four respondents, number 6 by three respondents, number 7 by three respondents, number 9 by three respondents, and number 10 by one respondent for a sum of 140 (which happens to be tied with maintenance planning for the lowest sum and makes these two elements the most important ones). The elements ended up being ranked as displayed in table 1:

TABLE 1.

RANKING OF LOGISTICS SUPPORT ELEMENTS

ELEMENT	RANK	SUM
Supply Support	1	140
Maintenance Planning	1	140
Training and Training Support	2	148
Technical Data	3	153
Manpower and Personnel	4	164
Computer Resources Support	5	197
Support Equipment	6	216
Lack of Understanding of User Requirements	7	220
PHS&T	8	251
Lack of Guidance	9	268
Facilities	10	280
Other	11	363

Statistical Testing of Likert Scale Data

Question twelve asked participants to rate nine logistics support elements on a Likert scale ranging from one to six. The ratings were added together for each support element to arrive at a sum. The sum for each Likert Scale question was then divided by the number of questionnaires to arrive at a mean. For instance, the supply support element received five ratings of one, three ratings of two, ten ratings of three, nine ratings of four, five ratings of five, and one rating of six for a sum of 108; 108 was then divided by the number of surveys returned (33) to arrive at a mean of 3.2727. The mean for each element was used as the basic sample statistic. The mean for each question was judged against a standard (set by the researchers) to determine if the associated logistics support factor is considered a problem by logistics support experts. Based on the wording associated with the Likert scale, all means less than

4.5 are considered non-significant. A one-tailed large-sample test of hypothesis about the population mean was conducted to determine if each question's mean (μ) is less than or equal to the cut-off (standard) of 4.5. The original hypothesis (H_o) states "the population mean is equal to 4.5." The alternate hypothesis (H_a) states "the population mean is less than 4.5." The large-sample test of hypothesis is performed by using the sample mean ($\bar{x}$), the hypothesized mean (μ_o), and the standard deviation of the sample ($\sigma_{\bar{x}}$) to develop a test statistic z. The test statistic z is then checked to see if it is less than the negative of a z value taken from a table of normal curve areas for a given level of confidence (α) (for a more complete explanation of this statistical procedure please see reference 15). If the test statistic z is found to be greater than the negative of the table value of z (for a given α) then we accept the original hypothesis. If the test statistic z is found to be less than the negative of the table value of z (for a given α) then it is said to fall in the reject region; this means that we reject the original hypothesis and accept the alternative hypothesis. The statistical notation for this experiment follows:

H_o: $\mu = \mu_o$

H_a: $\mu < \mu_o$

Test Statistics: $z = \frac{\bar{x}-\mu_o}{\sigma_{\bar{x}}}$

Reject Region: $z < -z_\alpha$

Table 2 shows the sum, mean, standard deviation, and z value of each support element's Likert scale ratings.

TABLE 2.

RESULTS OF LIKERT RATINGS OF SUPPORT ELEMENTS

Support Element	Sum of Ratings	Mean of Ratings	Standard Deviation	Test Stat	Table Value	Accept Ho
Supply Support	108	3.2727	1.3526	-.9074	-1.645	Yes
Technical Data	95	2.8788	1.5157	-1.0696	-1.645	Yes
Facilities	61	1.8484	1.1214	-2.3645	-1.645	No
Manpower & Personnel	84	2.5455	1.3940	-1.4021	-1.645	Yes
PHS&T	69	2.0909	1.1282	-2.1353	-1.645	No
Training	98	2.9697	1.5306	-.9998	-1.645	Yes
Support Equipment	74	2.2424	1.2255	-1.8422	-1.645	No
Computer Resources Support	74	2.2424	1.2508	-1.8049	-1.645	No
Maintenance Planning	86	2.6061	1.5194	-1.2465	-1.645	Yes

As Table 2 shows, the value of z for a 95% confidence level (an α of .05) is -1.645 and the test statistic for facilities, PHS&T, support equipment, and computer resources support all have values less than -1.645. In other words, we are 95% confident that the means of these elements are less than the cut-off of 4.5. Since the means of these elements fall below the cut-off, the data indicates that these logistics support elements are not major problems for the logistics support of deployable COTS computer equipment. Therefore; the data indicates that the logistics support elements that hinder logistics support of deployable COTS computer equipment are

supply support, technical data, manpower and personnel, training and training support, and maintenance planning.

Outcome of Non-Likert Scale Questions

Question nine of the survey asked participants if, based on their experience, deployable COTS computer equipment was properly logistically supported. Out of the thirty-three surveys returned, thirty respondents answered the question. Twenty-four (80% of those who answered the question) of the respondents answered "no" (that, based on their experience, deployable COTS computer equipment is not properly logistically supported). Only six (20% of those who answered the question) of the respondents answered "yes" (that, based on their experience, deployable COTS computer equipment is logistically supportable). Of the six who answered "yes", four listed their job histories as primarily operators, one listed his job history as primarily acquisitions, and one listed his job history as primarily maintenance.

Similarly, question 10 of the survey asked participants if, based on their experience, the logistics support of COTS computer equipment is adequately planned. Out of the thirty-three surveys returned, thirty respondents answered the question. Twenty-eight (93% of those who answered the question) of the respondents answered "no" (that, based on their experience, logistics support of COTS computer equipment is not adequately planned). Only two (7% of those who answered the question) of the respondents answered "yes" (that, based on

their experience, logistics support of COTS computer equipment is adequately planned). The data clearly indicates that logistics support experts believe that there is inadequate logistics support for deployable COTS computer equipment and logistics support is inadequately planned for.

Question 14 of the survey asked participants to choose, based on their experience, a logistics support concept that would best solve the problems associated with the logistics support of deployable COTS computer equipment. The survey gave participants the choice among bluesuit support, contractor logistics support, some combination of bluesuit and contractor logistics support, and other. Figure 9 shows the results of the respondents' answers.

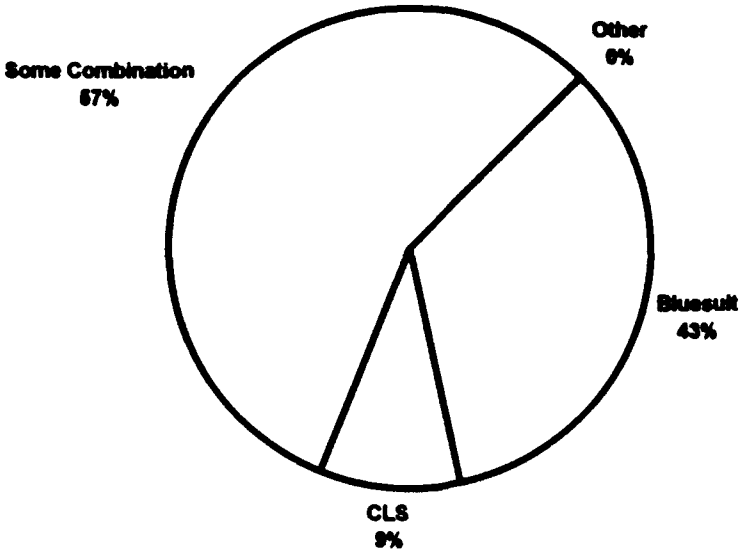

Figure 9. Logistics support concept that would best solve logistics support problems of deployable COTS computer equipment

As Figure 9 shows, the data suggests that logistics support experts believe that some combination of bluesuit and contractor logistics support is the best concept for solving the logistics support problems associated with deployable COTS computer equipment.

Question 15 asked participants if the lack of guidance from regulations, directives, and manuals is a cause of deployable COTS computer equipment being fielded without viable logistics support. Twenty-nine of the thirty-three respondents answered the question. Eighteen (62% of those who answered) of the respondents answered "yes", (that lack of guidance from regulations, directives, and manuals is a cause of deployable COTS computer equipment being fielded without viable logistics

support). Eleven (38% of those who answered) of the respondents answered "no", (that lack of guidance from regulations, directives, and manuals is not a cause of deployable COTS computer equipment being fielded without viable logistics support). This question also asked the participants to rate the severity of this problem using a Likert scale. The average Likert scale rating of this problem was 3.9 which, based on the respondents' experience and the wording associated with the Likert scale, suggests that this problem falls between "sometimes prevents mission accomplishment" and "often prevents mission accomplishment."

Question sixteen asked participants if the lack of a standardized logistics support policy for deployable COTS computer equipment is a cause of COTS computer equipment being fielded without viable logistics support. Thirty-one of the thirty-three respondents answered the question. Twenty-two (71% of those who answered) of the respondents answered "yes", (that lack of a standardized logistics support policy is a cause of deployable COTS computer equipment being fielded without viable logistics support). Nine (29% of those who answered) of the respondents answered "no", (that lack of a standardized logistics support policy is not a cause of deployable COTS computer equipment being fielded without viable logistics support). This question also asked the participants to rate the severity of this problem using a Likert scale. The average Likert scale rating of this problem was 4.3, which based on the

respondents' experience and the wording associated with the Likert scale, suggests that this problem falls between "often prevents mission accomplishment" and "almost always prevents mission accomplishment."

Question 17 asked participants if the people in charge of acquiring deployable COTS computer equipment understand the logistics needs of the users of that equipment. Twenty-nine of the thirty-three respondents answered the question. Twenty-three (79% of those who answered) of the respondents answered "no", (that people in charge of acquiring deployable COTS computer equipment do not understand the logistics needs of the users of that equipment). Six (21% of those who answered) of the respondents answered "yes", (people in charge of acquiring deployable COTS computer equipment understand the logistics needs of the users of that equipment). For those respondents who answered "no", the question went on to ask if this lack of understanding is a cause of COTS computer equipment being fielded without viable logistics support. Twenty-two of the Twenty-three respondents who answered "no" to the previous question answered this question. Seventeen (77% of those who answered) of the respondents answered "yes", (that a lack of understanding of users needs is a cause of COTS computer equipment being fielded without viable logistics support). Five (23% of those who answered) of the respondents answered "no", (that a lack of understanding of users needs is not a cause of COTS computer equipment being fielded without viable logistics

support). This question also asked the participants to rate the severity of this problem using a Likert scale. The average Likert scale rating of this problem was 4.2, which based on the respondents' experience and the wording associated with the Likert scale, suggests that this problem falls between "often prevents mission accomplishment" and "almost always prevents mission accomplishment."

Subjective Responses

Questions 11, 13, 14, 15, 16, 17, 18, and 19 of the survey allowed space for the survey respondents to write in subjective information that they thought would be helpful to the researchers. The following paragraphs are a synopsis of the survey respondents subjective inputs.

Question 11 asked respondents to rank nine of the ILS elements and two related concerns in order of importance. One survey respondent stated that the lack of an attempt to identify COTS procured PCs as deployable and not limiting the number of deployable PCs as the number one problem associated with proper logistic support of deployable COTS PCs. One survey respondent ranked as the number one problem the failure of the user to understand their own requirements.

Question 13 allowed respondents to identify specific problems with the nine ILS elements under study and provide suggested fixes. The following breakout is a list of their inputs:

a. *Supply support:* Five respondents stated that the lack of readily available spares posed a major problem in supporting COTS PCs. They recommended that adequate spares be purchased at the time of PC purchase. Six respondents said that the inability of the current Air Force supply system to handle spares made it difficult to order and obtain needed spares in a timely manner. Some of the individual recommended fixes for the two aforementioned problems are: develop mission support kits for PCs; Obtain WRM stock for PCs; establish a single manager for procurement of all PCs, related spares, and disposable items (paper, ribbons, et.); and establish a "care taker" to store and maintain all spares that may be needed during wartime.

b. *Technical data:* Six respondents stated that current technical data does not provide enough detail to allow Air Force maintainers to adequately support PCs in the field. As a solution to this problem, one respondent recommended validation/verification of all required manuals prior to PC purchase.

c. *Facilities:* Six respondents stated that requirements for work space, air conditioning, power, et. posed difficulties when deploying PCs. However, none of the respondents recommended any solutions.

d. *Manpower and Personnel:* Eleven of the respondents stated that the lack of authorized maintainers for PCs is a huge problem. All suggested that Manpower studies be conducted to

determine required authorizations and that funding be obtained to man maintenance positions.

e. *Packaging, handling, storage, and transportation:* Six respondents experienced problems with PCs arriving in unserviceable condition following deployment via military air. All suggested that when PCs are procured the packaging needed for deployment should be procured also. In addition, because the majority of deployable COTS computer equipment may deploy via military air, one respondent suggested that e all deployable PCs be planned for in Operations Plans. This would help ensure additional logistics support planning associated with the other ILS elements.

f. *Training and training support:* Nine respondents stated that adequate maintenance training was not available to users. Some suggested remedies are to have AETC establish a PC maintenance course and standardize PC training at all levels throughout the Air Force.

g. *Support Equipment:* Five respondents stated that adequate diagnostic/test equipment wasn't available for maintainers in the field. The recommended fix to this problem is to procure required support equipment at the time of PC procurement.

h. *Computer resource support:* Two respondents reported problems with availability of diagnostic software. Their recommended fix is to procure appropriate software concurrently with PC procurement.

i. *Maintenance planning:* Five respondents noted the lack of a standardized structure being used to plan for the appropriate PC quantities to be procured, the level of maintenance required, the types and numbers of AFSCs required for maintenance, and the operational environment the PCs would be operating in. One respondent stated that problems exist with warranties that accompany current PC procurements (warranties aren't good in all operational environments). All suggested that much more emphasis be put on maintenance planning prior to procurement of PCs.

Question 14 asked survey respondents to identify what they thought the best logistics support concept would be for the Air Force. Seven respondents (all of which selected some combination of bluesuit and contractor support) stated that bluesuiters should maintain enough spares and a repair capability to ensure continued support of operations while the more sophisticated hardware can be shipped back to the contractor. All agreed that organizational level maintenance should be accomplished by Air Force personnel, and depot level and warranty work should be accomplished by contractors. One respondent recommended that mission critical items be maintained by the Air Force and non-mission critical items be maintained by the contractor.

Question 15 asked if the lack of guidance from regulations, directives, and manuals were a cause of deployable COTS PCs being fielded without viable logistics support. Six respondents

stated that there was little to no guidance available and that a need for guidance exist. They recommended that acquiring agencies work closer with the user to determine maintenance requirements and publish/update applicable guidance as required.

Question 16 asked survey participants if the lack of a standardized logistics support policy for deployable COTS computer equipment was a cause of COTS computer equipment being fielded without viable logistics support. Of those respondents that answered yes (20) to this question nine of the respondents stated that a standard Air Force wide policy needed to be established. None of the respondents suggested a process for establishing a policy.

Question 17 asked survey respondents if based on their experience, do the people in charge of acquiring deployable COTS computer equipment understand the needs of the user of that equipment. Of those that answered no (20) to this question four stated that the acquirers don't recognize the impact of not enough spares being available for high failure rate items. However, no suggested remedies for this problem were given.

Question 18 asked the survey respondents if based on their experience, are there any other problems contributing to COTS computer equipment being fielded without viable logistics support. Two respondents stated lack of funding for spares and manpower as a problem. One respondent stated that due to the lack of planning for deployable COTS PCs, airlift is a problem.

One respondent stated COTS procured PCs are not built to be deployed.

Question 19 asked survey respondents to briefly state how they would improve the logistics support of deployable COTS computer equipment. Five respondents suggested more attention be applied to all the ILS elements when planning to procure COTS PCs. Two respondents suggested that blanket purchase agreements be used at local levels to acquire spares and test equipment. The following list consolidates all other recommendations made by the respondents answering question 19:

a. Concentrate on procuring small, light, hardened, and ruggedized PCs that would be designated as those to be used for deployments.

b. Limit the number of PCs to be deployed to a given location, thus helping to ensure better maintenance support.

c. Treat all PCs and associated equipment as throw-away items and replace them when broken.

d. Assign NSNs to all spare PC parts and stock list them.

e. Procure PCs that have warranties which allow for bluesuit maintenance while in the field.

f. Develop a standard matrix that can be used to assist in planning for support of COTS computer equipment.

g. Combine all communications organizations under one umbrella, thus putting COTS PC responsibility in a centralized location.

h. Procure notebook size computers with portable printers for deployment and maintain some WRM assets like monitors and spares.

V. Conclusions

General Observations

This research clearly demonstrates that there are problems with logistics support of deployable COTS computer equipment. Further, the data indicates that the following logistics support elements are the main causes of these problems: supply support, maintenance planning, training and training support, technical data, and manpower and personnel. The logistics support experts ranked the factors hindering logistics support of deployable COTS computer equipment in the following manner (from most to least problematic):

1. Supply Support
1. Maintenance Planning
2. Training and Training Support
3. Technical Data
4. Manpower and Personnel

Logistics support experts also indicated that the following factors also hinder logistics support of deployable COTS computer equipment:

a. A lack of guidance from regulations, directives, and manuals.

b. The lack of a standardized logistics support policy.

c. A lack of understanding of user requirements by the people in charge of acquiring deployable COTS computer equipment.

The experts picked a combination of bluesuit and contractor logistics support as the logistics support concept that will best solve the problems associated with the logistics support of deployable COTS computer equipment.

Strawman Support Concepts

The data gathered during this research effort indicates that a number of problems currently exist with supporting deployable COTS PCs. Based on the data and recommendations provided by COTS PC experts the researchers offer two strawman support concepts, one for current Air Force assets and one for future Air Force procurements.

Support for the Current Deployable COTS PC Inventory: The researchers believe that the following suggestions should be used to better support current Air Force deployable COTS PCs:

1. Establish an Air Force POC to provide in-depth guidance on supporting COTS PCs in-garrison and when deployed.
2. Establish a MAJCOM POC for support of all deployable COTS PCs and associated equipment.
3. Identify by unit the total number of COTS PCs to be used as deployable assets.
4. Add all deployable COTS PCs and associated equipment to the unit type code (UTC) they will be used in support of.
5. Develop in-depth MAJCOM guidance which outlines the process of procuring, deploying, and supporting deployable COTS PCs and associated items.
6. Develop requirements and authorize mission support kits (MSK) for deployable COTS PCs.

7. Provide MAJCOM guidance on obtaining necessary technical data to support deployable COTS PCs.

8. Develop Air Force resupply procedures for all deployable COTS PC assets. The 67 series AFM is a potential source for publishing procedures.

9. Authorize and fund manpower positions for managing and maintaining deployable COTS PCs at the unit level.

10. As current maintenance contracts at all organizational levels expire renegotiate warranties to allow for bluesuit maintenance when COTS PCs are employed under wartime conditions.

11. As a minimum, establish a deployable COTS PC maintenance training course which covers all types of PCs identified for deployment within the Air Force. Suggest AETC develop and conduct this as an Air Force sponsored course.

Support for Future Deployable COTS PC Procurements: The following suggestions for supporting future buys of deployable COTS PCs are based on the suggestions given by survey respondents and analysis conducted by the researchers:

1. Establish a Single Manager for Procurement of all new deployable COTS PCs and their required support (technical data, spares, et...).

2. Ensure that all available technical data is detailed enough to allow bluesuit maintenance at the level necessary to ensure mission accomplishment.

3. Procure MSK (recommend out-right purchase) and any additional spares (recommend lease on ownership plan) necessary to ensure adequate training and operational support.

4. Ensure that maintenance planning of all new deployable COTS PCs is complete and coordinated with the intended user of the system prior to procurement.

5. Ensure that warranties are negotiated to allow for in-depth bluesuit maintenance when COTS PCs are deployed under wartime conditions.

6. During peacetime, allow for preventive maintenance and routine maintenance of deployable COTS PCs to be accomplished by the user. Suggest all warranty and

major maintenance be accomplished via a maintenance contract with the supplier during peacetime.

7. Ensure that suppliers are contractually obligated to provide required spares for the estimated useful life of the system that is being procured.

8. Ensure that future deployable COTS PCs are purchased with the required packaging necessary to withstand the riggers of deploying via the military transportation system.

Applicability to Other COTS Equipment

The specific logistics support elements that were identified as problematic for logistics support of deployable COTS computer equipment should also be problematic for non-computer COTS equipment; however, the proposed solutions to the problems associated with logistics support of COTS computer equipment will not necessarily be appropriate for other COTS equipment.

Recommendations for Future Research

The following is a list of areas the researchers believe to be relevant in the area of supporting deployable COTS PCs:

1. What would be the impact of funding the required manpower to train technicians and, maintain and manage deployable COTS PC assets?

2. What would be the best method of providing and managing spares necessary to support deployable COTS PCs and what is the associated impact on the Air Force supply system?

3. What would be the dollar impact associated with acquiring warranties that allow for in-depth bluesuit maintenance when COTS PCs are deployed under wartime conditions?

4. What would be the funding and timing impact associated with ensuring COTS PCs have more in-depth technical data and better packaging for mobility?

5. What impact does the current Air Force COTS PC inventory have on military airlift capabilities when deploying and when requiring resupply support?

APPENDIX

Sample of Survey Sent to Air Force Logistics Support Experts

GLOSSARY OF TERMS FOR LOGISTICS SUPPORT OF DEPLOYABLE COTS COMPUTER EQUIPMENT SURVEY.

ACQUISITION LOGISTICS FIELD: If you have ever been involved in planning for the support of a new system or the support of a modified system, then you have done acquisition logistics work. This type of work includes but is not limited to: (For further definition of the following terms, see DODI 5000.2, part 7.)

SUPPLY SUPPORT--providing inputs to spare parts requirements (What needs to be bought and how many?).

TECHNICAL DATA--writing, reviewing, or documenting a need for technical data (Is the tech data accurate, usable, and adequate?).

FACILITIES--providing inputs that address the need for additional or modification of facilities for a system (What kinds of buildings, shops, etc., are required by the system?).

MANPOWER AND PERSONNEL--providing inputs to the requirements of manpower and personnel of a system (Does the system require additional manpower spaces or new skills?).

PACKAGING, HANDLING, STORAGE, AND TRANSPORTATION--providing inputs to the packaging, handling, storage, and transpiration requirements of a system.

TRAINING AND TRAINING SUPPORT--providing inputs to the training or training support needed for a system (What kind of training and training aids are required? Is existing training adequate or do new courses need to be developed?).

SUPPORT EQUIPMENT-- providing inputs to support equipment needs of a system (What types of stands, power carts, test equipment, etc., does the system require?).

COMPUTER RESOURCES SUPPORT--providing inputs to the computer resources support needs of a system (What types of software, test equipment, hardware does the system require?).

MAINTENANCE PLANNING--providing inputs to the maintenance planning needs of a system (What should the maintenance concept be? One level, two level, three level, contract support, etc. Under what conditions will maintenance be performed? What are the reliability requirements?).

DESIGN INTERFACE--providing inputs to the design of a system (Is the system design capable of supporting intended mission? Does the design allow for maintainability? Does the system design cut down on the need for support equipment and spare parts?).

OPERATIONAL LOGISTICS FIELD: If you have been involved in the day-to-day maintenance, supply, or training functions of any system, then you have experience in the operational logistics field.

COMMERCIAL OFF-THE-SHELF (COTS) EQUIPMENT: Any item of supply that is available in the commercial marketplace. Examples include Z-248 computers, SUN workstations, Air Force sedans, etc.

LOGISTICS SUPPORT OF
DEPLOYABLE COMMERCIAL OFF-THE-SHELF COMPUTER EQUIPMENT
FACTUAL SURVEY

This factual survey is a research tool designed to help determine if there are any specific problems that hamper the logistics support of deployable commercial off-the-shelf (COTS) computer equipment. The information gathered will be used to develop a standardized support concept for deployable COTS computer equipment. Please take a few minutes to answer the following questions.

1. Which of the following best describes your current job?

____ Operations of systems.

____ Operational logistics support of fielded systems.

____ Logistics support planning for systems in the acquisition process.

____ Other. Please explain in the space below.

_____

_____

_____

_____

2. Which of the following best describes your job history?

____ Exclusively an operator with no logistics support background.

____ Primarily an operator with some logistics support background.

____ Exclusively in logistics support functions with no operations background.

____ Primarily in logistics support functions with some operations background.

____ Other. Please explain in the space below.

_____

_____

_____

_____

3. How many formal logistics support (acquisition or follow-on support) training courses have you attended ?

____ None ____ One, Two, or Three ____ Four, Five, or Six

____ Greater than six

4. How many years of experience do you have in the operational logistics field?

____ Zero. ____ Less than one. ____ One to three.

____ Three to five. ____ Five to seven.

____ Seven to nine. ____ Greater than nine.

5. How many years of experience do you have in the acquisition logistics field?

____ Zero. ____ Less than one. ____ One to three.

____ Three to five. ____ Five to seven.

____ Seven to nine. ____ Greater than nine.

6. How many years of experience do you have in the computer field?

____ Zero. ____ Less than one. ____ One to three.

____ Three to five. ____ Five to seven.

____ Seven to nine. ___ Greater than nine.

7. How many years have you been involved in the logistics support of COTS equipment?

____ Zero. ____ Less than one. ____ One to three.

____ Three to five. ____ Five to seven.

____ Seven to nine. ___ Greater than nine.

8. How many years have you been involved in the logistics support of COTS computer equipment?

____ Zero. ____ Less than one. ____ One to three.

____ Three to five. ____ Five to seven.

____ Seven to nine. ____ Greater than nine.

9. Based on your experience, is deployable COTS computer equipment properly logistically supported?
(circle one)

YES **NO**

10. Based on your experience, is the logistics support of COTS computer equipment adequately planned?
(circle one)

YES **NO**

11. Please rank the following logistics support elements* and related concerns (concerning deployable commercial off-the-shelf computer equipment) in order of importance with one being most important and eleven being least important. Place the number in the space before the element and use each number only once. **EXAMPLE**: If , based on your experience, Technical Data is the most important element - put a 1 in front of it. If Maintenance Planning is the second most important - put a 2 in front of it. Continue until you have ranked all of the elements.

___ **SUPPLY SUPPORT**

___ **TECHNICAL DATA**

___ **FACILITIES**

___ **MANPOWER AND PERSONNEL**

___ **PACKAGING, HANDLING, STORAGE, AND TRANSPORTATION**

___ **TRAINING AND TRAINING SUPPORT**

___ **SUPPORT EQUIPMENT**

___ **COMPUTER RESOURCES SUPPORT**

___ **MAINTENANCE PLANNING**

___ **LACK OF GUIDANCE FROM REGULATIONS, DIRECTIVES, AND MANUALS FOR THE LOGISTICS SUPPORT PLANNING OF COTS COMPUTER SYSTEMS DURING THE ACQUISITION PROCESS**

___ **LACK OF UNDERSTANDING OF THE USERS' LOGISTICS SUPPORT REQUIREMENTS FOR COTS COMPUTER SYSTEMS**

___ **OTHER** (PLEASE EXPLAIN IN SPACE PROVIDED BELOW)

_____

_____

_____

_____

*Note: Design interface has purposely been left out of the ten logistics support elements because it does not apply to COTS equipment.

12. Nine of the ten elements* of logistics support are listed below. Please place an X by those that, based on your experience, are logistics support problems for deployable Commercial Off-the-Shelf (COTS) computer equipment. Please use the codes below to indicate the degree of mission impact for each of the elements of logistics you selected. SEE LEGEND AT BOTTOM OF PAGE.

ELEMENTS OF LOGISTICS SUPPORT		DEGREE OF MISSION IMPACT					
1. SUPPLY SUPPORT	_____	1	2	3	4	5	6
2. TECHNICAL DATA	_____	1	2	3	4	5	6
3. FACILITIES	_____	1	2	3	4	5	6
4. MANPOWER AND PERSONNEL	_____	1	2	3	4	5	6
5. PACKAGING, HANDLING STORAGE AND TRANSPORTATION	_____	1	2	3	4	5	6
6. TRAINING AND TRAINING SUPPORT	_____	1	2	3	4	5	6
7. SUPPORT EQUIPMENT	_____	1	2	3	4	5	6
8. COMPUTER RESOURCES SUPPORT	_____	1	2	3	4	5	6
9. MAINTENANCE PLANNING	_____	1	2	3	4	5	6

LEGEND

1 = NEVER PREVENTS MISSION ACCOMPLISHMENT
2 = SELDOM PREVENTS MISSION ACCOMPLISHMENT
3 = SOMETIMES PREVENTS MISSION ACCOMPLISHMENT
4 = OFTEN PREVENTS MISSION ACCOMPLISHMENT
5 = ALMOST ALWAYS PREVENTS MISSION ACCOMPLISHMENT
6 = ALWAYS PREVENTS MISSION ACCOMPLISHMENT

*Note: Design interface has purposely been left out of the ten logistics support elements because it does not apply to COTS equipment.

13. The following space is provided for you to provide specifics on the problems you identified on the previous page. Briefly state the specific problem(s) and how you would solve the problem(s). Provide a response for only those items you checked on the previous page. Do not feel obligated to use the entire space provided. If you need more space feel free to continue on back of page.

SUPPLY SUPPORT:

_____

_____

_____

_____

TECHNICAL DATA:

_____

_____

_____

_____

FACILITIES:

_____

_____

_____

_____

MANPOWER AND PERSONNEL:

_____

_____

_____

_____

PACKAGING, HANDLING, STORAGE, AND TRANSPORTATION:

_____

_____

TRAINING AND TRAINING SUPPORT:

SUPPORT EQUIPMENT:

COMPUTER RESOURCES SUPPORT:

MAINTENANCE PLANNING:

14. Based on your experience, which of the following logistics support concepts would best solve the problems associated with the logistics support of deployable COTS computer equipment?

___ **BLUESUIT:** Air Force personnel perform maintenance at all levels. Air Force owns and maintains all logistics support resources (i.e. spares, support equipment, tech data, etc.).

___ **CONTRACTOR LOGISTICS SUPPORT:** Contractor personnel perform maintenance at all levels. Contractor owns and maintains all logistics support resources (i.e. spares, support equipment, tech data, etc.).

___ **SOME COMBINATION:** For instance: Air Force personnel perform maintenance at organizational level and contractor performs maintenance at higher level; or Air Force personnel perform all maintenance, but lease spares from contractor, etc.

If **SOME COMBINATION**, please explain how you would combine the types of support to achieve an effective logistics support mix.

_____

_____

_____

_____

___**OTHER**

If **OTHER**, please explain.

_____

_____

_____

_____

15. Based on your experience, is the lack of guidance from regulations, directives, and manuals a cause of deployable COTS computer equipment being fielded without viable logistics support? (circle one)

YES **NO**

If yes, rate the severity of the problem using the scale below. (circle one)

1 2 3 4 5 6

Based on your experience, what is the main problem and how would you fix it?

_____

_____

16. Based on your experience, is the lack of a standardized logistics support policy for deployable COTS computer equipment is a cause of COTS computer equipment being fielded without viable logistics support? (circle one)

YES **NO**

If yes, rate the severity of the problem using the scale below. (circle one)

1 2 3 4 5 6

What is the main problem and how would you fix it?

_____

_____

17. Based on your experience, do the people in charge of acquiring deployable COTS computer equipment understand the logistics needs of the users of that equipment? (circle one)

YES **NO**

If no, based on your experience, is this lack of understanding a cause of COTS computer equipment being fielded without viable logistics support? (circle one)

YES **NO**

If yes, rate the severity of the problem using the scale below. (circle one)

1 2 3 4 5 6

What is the main problem and how would you fix it?

_____

_____

LEGEND

1 = NEVER PREVENTS MISSION ACCOMPLISHMENT
2 = SELDOM PREVENTS MISSION ACCOMPLISHMENT
3 = SOMETIMES PREVENTS MISSION ACCOMPLISHMENT
4 = OFTEN PREVENTS MISSION ACCOMPLISHMENT
5 = ALMOST ALWAYS PREVENTS MISSION ACCOMPLISHMENT
6 = ALWAYS PREVENTS MISSION ACCOMPLISHMENT

18. Based on your experience, are any other problems contributing to COTS computer equipment being fielded without viable logistics support? (circle one)

YES **NO**

If yes, please provide a brief explanation.

_____

_____

_____

_____

19. Briefly state how you would improve the logistics support of deployable COTS computer equipment.

_____

_____

_____

_____

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_____

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_____

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_____

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VITA

Captain Jessie J. Rowe III was born on 21 March 1959 in Cannon AFB, New Mexico. He graduated from Fletcher High School in Neptune Beach, Florida in 1977 and enlisted in the U. S. Air Force in April 1978. He began as a Fuels Specialist for the 56th Supply Squadron at Macdill AFB, Florida. In October 1980 he was then reassigned to the 18th Supply Squadron at Kadena AB, Japan. In October 1983 he retrained into Manpower Management. In January 1984 he was assigned to Detachment 20, Management Engineering Team, Tyndall AFB, Florida. In August 1985 he received a Bachelor of Science in Business Management from The University of Maryland and immediately attended Officer Training School. Upon graduation in January 1986 he received a reserve commission in the USAF and was assigned to Ogden Air Logistics Center, Hill AFB, Utah as an Airmunitions Program Manager where he was responsible for managing the production and fielding of over $7 billion of munitions. In August 1988 he was assigned to the 5th Combat Communications Group, Robins AFB, Georgia, as Chief of Logistics Plans. There he was responsible for ensuring logistics support for all personnel and equipment until entering the School of Logistics and Acquisition Management, Air Force Institute of Technology, in May 1992.

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Captain William Z. Zeck was born 3 December 1962 in Ventura, California. He graduated from Livingston Academy High School, Livingston, Tennessee in 1981. Captain Zeck enlisted in the Air Force in April 1984. He started his military career as an Airlift Aircraft Maintenance Technician for the 63rd Organizational Maintenance Squadron at Norton AFB, California. In 1987, while stationed at Norton, Capt Zeck earned a Bachelor's degree in Professional Aeronautics from Embry-Riddle Aeronautics University. Upon completion of his Bachelor's degree, Capt Zeck applied and was accepted into Officers' Training School (OTS). He graduated from OTS and earned his commission on 18 March 1988. In April of 1989, after an unsuccessful attempt at undergraduate pilot training, Capt Zeck was assigned to the Tactical Communications Division at Langley Air Force Base, Virginia where he managed the mobility missions of the three CONUS Combat Communications groups. In February of 1991, Capt Zeck was reassigned to Headquarters Tactical Air Command where he managed the acquisition logistics of intelligence, computer, and communications systems. Capt Zeck entered the School of Logistics and Acquisition Management, Air Force Institute of Technology in May 1992.

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13. ABSTRACT (Maximum 200 words)

The purpose of this study was to identify the specific problems currently hindering Air Force logistics support of COTS computer equipment and to recommend a support concept to overcome these problems.

These objectives were accomplished with a literature review and a survey of logistics support experts. The survey asked the experts to identify problems hindering logistics support of deployable COTS computer equipment and to rank associated logistics support elements in order of importance.

One hundred surveys were sent out and thirty-three were returned. Data analysis indicated that the logistics support elements that are most problematic for the logistics support of deployable COTS computer equipment are supply support, technical data, manpower and personnel, training and training support, and maintenance planning.

Fifty-seven percent of the experts recommended a combination of bluesuit and contractor support to solve COTS support problems.

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