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QUALITY HORIZONS'
FINAL REPORT

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VOLUME I

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QUALITY HORIZONS' STUDY TEAM

15 NOVEMBER 1979

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OBSERVATIONS AND RECOMMENDATIONS

TO ENHANCE

PRODUCT QUALITY

IN THE

OPERATIONAL ENVIRONMENT

PREPARED BY:

THE QUALITY HORIZONS' STUDY TEAM

WITH REPRESENTATIVES

FROM HQ AFSC, HQ AFCMD, ASD and SAMSO

THIS QUALITY HORIZONS' STUDY REPORT REFLECTS THE OBSERVATIONS, FINDINGS AND RECOMMENDATIONS OF THE MEMBERS OF THE QUALITY HORIZONS' STUDY TEAM. THE REPORT DOES NOT NECESSARILY REFLECT THE POSITION OF AIR FORCE SYSTEMS COMMAND WITH REGARD TO THE ISSUES RAISED OR RECOMMENDATIONS PRESENTED.

APPROVED:

BERNARD L. WEISS
COLONEL, USAF
STUDY DIRECTOR

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I.   EXECUTIVE SUMMARY

The Quality Horizons' Study was initiated by
General Alton D. Slay, Commander, Air Force Systems
Command, by letter dated 22 November 1978. The thrust
of the study effort was to determine ways to enhance
product quality in the operating environment. Study
objectives were to evaluate the AFSC approach to quality
assurance and identify changes with potential to: (i)
improve end item quality in field use, (ii) make contrac-
tors more responsible for their products, (iii) make more
effective use of resources, and (iv) apply appropriate
commercial practices.

Major study efforts were started in January
1979 and completed in June 1979. Written progress
reports were provided to General Slay throughout the
study. Progress and final report briefings were pre-
sented to General Slay and his staff on 29 March 1979
and 1 June 1979, respectively. Prior to the final
report briefing to AFSC/CC, the Product Division Com-
manders and the Commander of the Air Force Contract
Management Division were briefed as to the team's
observations and recommendations. Their concerns were
included in the final report briefing and final report.
The study team visited 66 selected governmental and
industrial organizations in the United States and over-
seas. The following is a summary of the team's major
observations:

(1) Attainment of field product quality is a
function of the interest and priority placed on quality
by top managers.

(2) Governmental and industrial organiza-
tions which have succeeded in obtaining high product
quality levels, blend the assurance sciences into one
high level organization which can act as a protagonist
in causing tradeoff analyses and in assuring a disci-
plined integration of efforts to obtain product quality.

(3) Agreement exists that product assurance
cannot be inspected into any product. Nevertheless,
AFSC places more emphasis on conformance verification
than attempting to influence product quality through
design, process control and test planning early in the
program life cycle.

(4) While various plans and programs have
been implemented or proposed in DOD for reduced levels

of in-plant surveillance, program managers are generally
reluctant to accept reduced in-plant Government quality
assurance activities, especially conformance inspections.

(5)   Commercial contracts are firm fixed price,
with limited customer financing, and sole source follow-
on buys are common with vendors that deliver a quality
product at a reasonable price.

(6)   In the commercial sector, warranties are
generally offered only as a result of competitive pres-
sures, such as in the commercial aircraft industry. Per-
formance incentives and award fee provisions are almost
never used in the commercial environment, either in the
U.S. or overseas, nor do foreign governments employ them.
Profits are their main incentive due to firm fixed pricing.

High levels of quality are obtained in the
commercial sector where top management demands product
quality or where competitive market pressures are such
that the customer has an alternate source. General Slay,
in Command Policy Letter 22, is on target with his drive
for increased competition and use of firm fixed price
contracts which adds impetus for enhanced product qual-
ity. Under firm fixed priced contracts, the full cost
responsibility rests on the contractor's shoulders.
The emphasis is on doing things right the first time.

The major recommendations of the Quality
Horizons' Study Team are listed in summary form below.
All recommendations are contained in the Action Plan
(Appendix I) and discussed in Section V.

(1)   AFSC must modify its current QUALITY
assurance program to a PRODUCT assurance program to
gain emphasis and attention to preventive efforts
during design, development and test. AFSC's present
program, while theoretically including preventive
actions through a broad array of specialities, is
heavily oriented toward in-plant conformance verifi-
cation. The change in organizational concept and
titles is necessary to reflect the increased emphasis
on front end involvement by the requisite engineering
and technical talents of the Product Divisions and
AFCMD.

(2)   In order to effectively implement the
product assurance approach, it is recommended that all
assurance disciplines, except manufacturing at AFCMD, be
consolidated into one organizational element reporting

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directly to the Commanders at all levels. This consolidation of skills is necessary to provide a critical mass of expertise and an organizational placement which will convert fragmented efforts toward product assurance to meaningful preventive actions and trade-offs.

(3) To motivate contractors to be more responsible for the quality of their products, the study team recommends selectively reducing the levels of in-plant conformance verification based upon a contractor's quality track record. A Minimum In-plant Surveillance (MIPS) program should be established where each contractor under AFPRO surveillance can make application for this reduced level of government surveillance. As the MIPS program proves successful, additional manpower can be reallocated to product assurance prevention efforts where greater returns from existing resources can be obtained.

(4) Positive actions must be taken to upgrade the training and education of the existing workforce and to provide for the orderly replacement of existing personnel through the establishment of a formalized three year intern program, geared to the skills necessary to perform product assurance in the aerospace community.

(5) Various recommendations are made in the area of contracting practices to support implementation and compliance with Policy Letter 22 and adopt, where feasible, existing commercial practices to enhance product quality. Specific recommendations cover the test of modified clauses which would restrict use of unilateral changes and modify procedures regarding point of final hardware acceptance. Other recommendations cover actions to reduce the level of Government financing of contracts, restrict progress payments, make greater use of award fee provisions and obtain authority to maintain two sources in production without a mobilization justification.

(6) A clear policy statement is required to support the use of contracting out to organizations (with hardware exclusion clauses) for selected product assurance functions requiring capabilities not available.

(7) The last group of recommendations emphasize the need for top management support to product assurance. A short, hard punching executive level training program is necessary to impart a sensitivity as to the benefits and risks of including or excluding product assurance considerations in Air Force programs. In addition, product assurance issues and actions should be made

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part of various management and program reviews held within AFSC or at contractors' facilities. Providing product assurance visibility to managers will aid in enhancing product quality. Contractors sense Air Force priorities and react accordingly.

Improved product quality is obtainable for Air Force systems. The Quality Horizons' Team observed the results that management attention and investment have achieved in improving product quality in Japan and Europe. Similar results were observed in many commercial firms visited in the United States where product quality is a distinct customer requirement. Techniques and skills are available to obtain improved quality. They must be used early during the design and development process. The product assurance approach prevents deficiencies and can reduce the required in-plant defect detection and corrective action efforts. The impact of product assurance requirement trade-offs on field performance must be considered. With scarce resources, product assurance considerations may not always be supported. Nevertheless, decisions have to be made based upon predicted impacts, fund availability, performance requirements and delivery schedules. Product assurance, like other performance requirements, demands management attention and investment - "there is no free lunch."

II. STUDY REPORT

A. Study Approach Overview

Charter - The Quality Horizons Study was established by Alton D. Slay, General, USAF, Commander, Air Force Systems Command, by correspondence dated 22 November 1978, (Volume II, Section 1). The study directive was based on a plan developed by the AFSC Quality Assurance Office and approved by James W. Stansberry, Major General, USAF, DCS/Contracting and Manufacturing, (Volume II, Section 3). The study approach, (Volume II, Section 4) contains four main points:

1. Examine the concepts of contractor responsibility for end item quality and reduced Government in-plant presence and how these concepts could be implemented, managed and enforced in AFSC based on experience in various government, commercial and foreign settings. Consider programs for certifying contractor QA systems and personnel while assuring no degradation in end item quality.

2. Identify the type of contractual relationships which would provide strong positive or negative incentives that successfully place the responsibility for item quality with the contractor. Examine commercial practice for possible application in Air Force contracts.

3. Evaluate the qualifications of the AFSC QA work force and changes required in recruitment, training, education and assignment to strengthen the future work force.

4. Develop the proper QA organization structure and manning including the concept of a product assurance office, to implement changes resulting from the study.

It was assumed that there would be no increase in overall manpower that would result from recommendations contained in this study.

Team composition - Colonel R. C. Preston, Jr., Chief of Staff, HQ AFSC, was originally selected as the Study Director. However, prior to commencing the study, he was nominated for Brig Gen and reassigned. Col Bernard L. Weiss, Deputy for Contracting and Manufacturing, Aeronautical Systems Division, was named to replace Col Preston on 15 January 1979, (Volume II, Section 2). The ultimate team composition included:

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Col Bernard L. Weiss
Deputy for Contracting and Manufacturing
Aeronautical Systems Division

Mr. Arthur A. Shannon
Deputy Director, Quality Assurance
Headquarters Air Force Contract Management Division
Mr. Shannon was Deputy Study Director

Mr. Donald W. Robinson
Director, Policy and Review
Deputy for Contracting and Manufacturing
Aeronautical Systems Division

Lt Col Michael M. McMillan
Chief, Aeronautical and Armament Division
Systems and Support Contracts Directorate
DCS/Contracting and Manufacturing, HQ AFSC

Lt Col Richard E. Tracey
Chief, Reliability and Quality Assurance Division
System Acquisition Management Support Directorate
ICBM Program Office
Space and Missile Systems Organization

Mr. Ira J. Epstein
Quality Assurance Engineer
Quality Assurance Office
DCS/Contracting and Manufacturing, HQ AFSC

Capt Raymond R. Honaker
Staff Quality Assurance Manager
Quality Assurance Division
Directorate of Manufacturing
Deputy for Contracting and Manufacturing
Aeronautical Systems Division

Capt John R. McNally
Manufacturing Staff Officer
Manufacturing Management Division
Directorate of Manufacturing
Deputy for Contracting and Manufacturing
Aeronautical Systems Division

Advisors to the study team included:

Capt C. B. Gresham, AFLC/JAN

AFSC Product Division Quality Assurance Directors

NSIA and AIA committees for Quality and Contracts

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B.   Study Approach - The team developed its
assessment of the Command quality assurance program
from the following sources:

1.   A review of the results of previous stud-
ies with findings pertinent to the AFSC QA function.

2.   Meetings and discussions with quality
assurance professionals in government, industry, and
professional organizations.

3.   Briefings and discussions at each Product
Division and AFCMD.

The team visited 66 government agencies and
industrial firms in the United States, Japan, Germany,
Denmark, Norway and Belgium.   The industrial firms
visited were engaged in work involving total commercial,
total defense or a combination of the two.   The govern-
ment organizations visited included both DOD and civilian
agencies.   Each location visited (Tables 1 and 2) was
provided a briefing (Appendix 2) to describe the intent
of the visit and the reason for the AFSC study.   The
organizations visited usually provided a briefing on
their view of quality assurance, their organization,
and recommendations with regard to the team's study
objectives.   Following this, the team conducted an in-
depth interview, concentrating on those unique aspects
of the organization visited and innovations they had
implemented or suggested for consideration.

Areas Examined - The team developed a question-
naire, (Volume II, Section 5) which was used during each
interview to assure areas of consideration were not over-
looked and to provide a more structured recording of
their observations.   The major areas of consideration
were: organization/manning, education/training, quality-
planning, quality measurement, subcontracting, contract
requirements/warranties/incentives/guarantees, and field
service.   Summary highlights of the interviews are
contained in Section IV, Study Observations.   Details of
each visit, such as completed questionnaires, copies of
briefings and handouts provided are contained in separate
trip folders for each visit.

Briefings Conducted - On 29 March 1979,
General Slay and his staff were provided an interim
briefing outlining the results of visits to that
date and the principle observations. General Slay
supported the briefing presented and highlighted
the importance of the study effort. He offered no
redirection. A copy of this briefing is contained
in Volume II, Section 7.

Commanders of each of the AFSC Product
Divisions (ADTC, ASD, ESD and SAMSO) and AFCMD were
provided briefings on the results of the study.
Their comments, (Volume II, Section 8) were con-
sidered in developing the final briefing to
General Slay on 1 June (Volume II, Section 9).

Progress Reports - General Slay was pro-
vided bi-weekly progress reports, (Volume II, Section
6). The progress reports summarized the major obser-
vations made during each reporting period.

ORGANIZATIONS VISITED

(United States)

COMMERCIAL

MILITARY PRODUCTS*

Bendix   Honeywell

COMMERCIAL PRODUCTS

Western Electric	Bell Labs	RCA Avionics
Sears	Quasar	Gates Lear Jet

COMMERCIAL & MILITARY PRODUCTS*

Texas Instruments	Hughes	Northrop
Cleveland Pneumatic	Boeing	Douglas
General Electric	Beech	TRW
(Aircraft Engine Group)	Cessna	

GOVERNMENT

HQ USAF
Office of the Secretary of Defense (OSD)
HQ Defense Logistics Agency (DLA)
Electronic Systems Division (ESD)
Armament Development Test Center (ADTC)
Space & Missile Systems Organization (SAMSO)
Air Force Contract Management Division (AFCMD)
HQ Federal Aviation Administration (FAA)
National Aeronautics & Space Administration, Houston (NASA)
Federal Aviation Administration (NW Region)
Defense Contract Administration Services, Atlanta
HQ AFSC/SDD
Aeronautical Systems Division (ASD)
Naval Material Command (NAVMAT)
Naval Air Systems Command (NAVAIR)
US Army Development and Readiness Command (DARCOM)

OTHER

Airline Representatives:

Southwest   American   United

National Security Industrial Association (NSIA)
Aerospace Industries Association of America Inc (AIA)
Electronic Industries Association (EIA)
ARINC

*Included visit to CAS Office

TABLE 1

ORGANIZATIONS VISITED
(Overseas)

JAPAN

COMMERCIAL PRODUCTS	COMMERCIAL & MILITARY PRODUCTS
Ricoh Company	Nippon Electric
Nissan	Mitsubishi
Nippon Steel	

GOVERNMENT AGENCIES

US Embassy Mutual Defense Office
Central Procurement Office
Technical Research Development Office

OTHER

Union of Japanese Scientists & Engineers (JUSE)

GERMANY

COMMERCIAL & MILITARY PRODUCTS

LITEF (Litton Technische Werke)
MBB (Messerschmitt Bolkow - Blohm)

GOVERNMENT AGENCIES

Det 16/AFCMC
Federal Ministry of Defense

DENMARK

COMMERCIAL PRODUCTS	COMMERCIAL & MILITARY PRODUCTS
Bruel & Kjaer	Standard Electric

GOVERNMENT AGENCIES

US Embassy Office of Defense Cooperation
Ministry of Commerce
Royal Danish Air Force Air Material Command

NORWAY

COMMERCIAL & MILITARY PRODUCTS

NEBB (Norsk Elektrisk & Brown Boverl)
Kvaerner
Kongsberg KV

GOVERNMENT AGENCY

Defense Combined Material Agency (DCMA)

BELGIUM

COMMERCIAL & MILITARY PRODUCTS

MBLE (Manufacture Beige DeLampes Et De
  Materiel Electronique)

GOVERNMENT AGENCIES

Contract Administration Services Europe (CASEUR)
Ministry of Defense (MOD Belgium)

TABLE 2

III.   CURRENT AFSC APPROACH

In order to set the stage for recommendations to enhance quality assurance functions in Air Force Systems Command, we must briefly review our current approach. This review covers the major organizations involved in quality assurance.

A.   Laboratories

AFSC Laboratories are primarily involved in basic research and development. Product quality assurance is not normally an element of major concern either for in-house development work, research, exploratory system or equipment development contracts. If appropriate, contracts for research or exploratory development contain requirements for the contractor to establish and implement a quality assurance program tailored to fit the given situation. Checklists used by the laboratory to develop procurement requests contain an item associated with quality assurance, which serve to ensure that quality aspects of the pending procurement are considered. In general, however, there are no formalized procedures in the laboratories related to a quality assurance program for in-house work or for contracted efforts.

There are no quality assurance engineers, technicians, or managers assigned to the laboratories. However, there are laboratory engineering and technical personnel knowledgeable in the area of nondestructive testing (NDT) who are available and provide consultation and QA support to program offices. The Air Force Materials Laboratory (AFML) is the USAF focal point for developing new or advanced NDT equipment.

Quality assurance training courses, offered within the DOD, are available to laboratory personnel. However, lab personnel have generally not availed themselves of such training opportunities. Training on non-destructive inspection equipment and techniques is presented by AFML personnel to AFSC and AFLC personnel, on a request basis.

Typical laboratory contracts for research or exploratory development work result in final reports, analyses, or recommendations; not hardware. Where an item of hardware is required, it is usually one of a kind. The contractor generally has sole responsibility for the end item. In-process inspection, testing, or final acceptance, under a formal quality assurance program are not accomplished.

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B.   Product Divisions

        Each AFSC Product Division has taken action to
implement AFSCR 74-1, Quality Assurance Program, which
requires the quality assurance function to be actively
involved in all phases of the system acquisition process.
Although approaches and effectiveness vary among divi-
sions, each has assigned a Quality Assurance Manager
(QAM) to its larger programs, and each has provided
for some degree of staff support for the QA functional
area. As a group, the QA leaders at each product divi-
sion are supporting efforts of the command Quality
Assurance Office (AFSC/PMN) to improve the effective-
ness of QA through activities such as the "Quality 79"
management objectives program and the preparation of
guidebooks for QA management and for application and
interpretation of MIL-STD-1520A, Corrective Action and
Disposition System for Nonconforming Material, and
MIL-STD-1535A, Supplier Quality Assurance Program
Requirements. This group is also involved in the im-
provement of QA-related specifications, standards, and
acquisition regulations. Through these activities the
AFSC quality assurance community has been working
cooperatively to increase the positive impact of QA
disciplines on the acquisition process.

        SAMSO has a centralized QA staff of 5 in
the Directorate of Manufacturing and Quality Assurance
within the Deputy for Contracting and Manufacturing.
There are additional full-time and part-time QA Managers
(QAMs) or points of contact in the program offices for
a total of 2 full-time equivalents. SAMSO contracts
with Aerospace Corporation for 31 product assurance
personnel (6 QA, 11 Reliability and 14 Parts Control)
and TRW Systems for 21 product assurance personnel
(4 QA, 9 Reliability and 8 Parts Control). This
supplemental support provides specialized skills
to the SAMSO product assurance management and staffs.
The ICBM Program Office, SAMSO's largest SPO, has
located its QA function in the Acquisition Management
and Systems Support Directorate. The QAM is part of
the Reliability and Quality Assurance Division of
that Directorate and is supported by the full-time
TRW QA personnel included above.

        The ADTC QA function is in the Manufacturing
and Quality Assurance Directorate within the Deputy
for Contracting and Manufacturing. There are 14 QA
manager/engineer positions which support armament
systems acquisition and 4 QA specialist positions

involved in administration of secondary delegations. ADTC also has 8 QA technicians in the Test Wing who perform technical surveillance of range operation services. The responsibility for reliability, maintainability, test, configuration management, program management and engineering is assigned to the Deputy for Armament Systems.

The ASD QA focal point is the Quality Assurance Division in the Directorate of Manufacturing within the Deputy for Contracting and Manufacturing. The QA Division is the responsible staff office for QA management using the ASD matrix management concept. The quality engineering function at ASD is matrixed out of the Engineering Specialities Division within the Deputy for Engineering. ASD has 29 full-time QA positions authorized, of which 8 are designated as QA Engineers (QAEs). In ASD, collocated QAM and QAE personnel work under the direction of the senior collocate, such as Chief of Manufacturing or Chief Engineer, and therefore are an integral part of the program organization. The staff offices in this arrangement provide resources, policy guidance, and assistance to collocated personnel.

At ESD, the quality assurance focal point is one individual located in the Systems Engineering Directorate within the Deputy for Technical Operations. A second full-time QA specialist is assigned as the QA manager for the E3A and E4 programs. Remaining QA activities are accomplished by part-time personnel.

C.   AFCMD

The basic mission of AFCMD is to support Program Directors by performing the standard contract administration functions of DAR 1-406 and additional functions contained in Memorandums of Agreement per DAR 20-703. Historically, AFPRO activities have provided QA appraisals to the program office through their in-plant presence, control, and visibility. In the early 1970s, it became obvious to AFCMD management that many program problems which absorbed a great deal of problem-solving manhours and dollars were caused by basic deficiencies in contractor management systems. In an effort to do a better job with less resources, AFCMD embarked on a program to change the alignment of their mission so as to emphasize management systems evaluation.

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The Contractor Management System Evaluation Program, CMSEP, treats contractor management as a system, and, in an orderly way, evaluates the system for existence, for adequacy, and for compliance. At each AFPRO, CMSEP is a continuous process of testing the management system and sampling its outputs. The program tasks which each AFPRO continues to perform in support of the Program Director thus become a part of the CMSEP continuous evaluation process.

CMSEP has affected the AFCMD quality assurance function in a number of ways. First, since CMSEP is oriented to prevention of problems, it changed the balance between QA appraisal effort and QA prevention effort. More manhours are directed at procedural issues and quality planning matters and less effort on direct inspection of products and processes. Secondly, CMSEP caused quality assurance responsibilities to be allocated to other functional AFPRO elements including Manufacturing, Subcontract Management, and Engineering. With this reallocation of responsibility, the QA element diminished in size and in stature. On the other hand, all AFPRO functions now have an active part to play in achieving QA objectives, and have a better appreciation for the QA requirements and their contribution to program success.

The current AFCMD QA work force strength is 1,184. This total includes all manpower positions in the QA function at the Headquarters and at the Detachments. Since 1968, AFCMD manpower has been reduced by 15% from 3,993 to 3,389, while the quality assurance work force has been reduced by 32% from 1,741 to 1,184. Of the total AFCMD reductions (604 manpower positions), 92.2% (557 manpower positions) were in the quality assurance function. This magnitude of reduction has caused AFCMD to move from a concept of individual defect detection to a systems survey approach with more reliance placed on the results of the contractor's inspection efforts.

The majority of the employees assigned to the quality assurance function do not have college degrees. Thirty percent of the employees have some college education (less than a Bachelor's degree) and 15% have a Bachelor's degree or higher. This mix of education is a direct reflection of the type of functions performed by the quality assurance specialists in the past.

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Forty-two percent of AFCMD's effort, based on contract dollar value, is in support of non-AFSC contracts, principally NASA and the Navy. NASA procurement regulations require that they use the DOD component that has been assigned plant cognizance. DOD Instruction 5030.42, "Performance of Contract Administration Services and Contract Audit Services in Support of NASA Contracts", contains the NASA/DOD Agreement that DOD CAS personnel will accomplish Procurement Quality Assurance for NASA. This support is normally the direct inspection of product parameters deemed important by NASA. While there is a certain amount of benefit to NASA as a result of CMSEP, normally NASA desires only mandatory product inspection. When AFCMD has plant cognizance, it provides the same quality assurance program for Navy contracts as for USAF contracts.

D.   HQ AFSC

The current AFSC quality assurance organization was established in October 1977 by Maj Gen Stansberry as a result of the Quality '77 Study. The Quality Assurance Office reports directly to the DCS/Contracting and Manufacturing who reports to the Commander, AFSC. The office is authorized five professional spaces and one clerical space. The current chief is a Lt Col (an 0-6 is authorized). The office is primarily responsible for establishing AFSC quality assurance policy. The policy is contained in AFSCR 74-1. The office operates primarily in a management by objectives mode. AFSC quality assurance objectives are published and distributed to all first level field AFSC quality assurance organizations. Field organizations are assigned actions to support AFSC objectives. Examples of ongoing efforts are: training, career development, software quality assurance, quality technology program (Q-TECH), quality assurance program for ranges and test centers, programs for laboratories and for base contracting, incorporating quality assurance requirements into appropriate regulations and handbooks and asserting pressures to increase quality assurance manning. The Quality Assurance Office has no responsibility for reliability, maintainability, configuration management, test or other functions which have a direct effect on product quality. These functions are assigned to other organizations in AFSC.

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IV. STUDY OBSERVATIONS

A. Organization/Manning

Organizations for quality vary considerably
as do organizational titles. Titles range from Quality
Control to Quality Assurance to Product Assurance to
Product Effectiveness to Systems Effectiveness and
others. The organizations varied depending upon cus-
tomer requirements, product line and responsibilities
considered important by management. For example, if
customer requirements include reliability, there would
be a reliability organization, often integrated with
the quality organization. As the product line becomes
more sophisticated, there are more quality engineers,
reliability engineers and other professionals in the
organization. As product liability, product criticality,
cost, warranty provisions and customer expectations
increase, organizations for field support increase.

One U.S. firm, in direct competition with
Japanese industry in a high technology product line, has
been able to capture and maintain a significant share of
the market. They attribute much of their success to the
synergistic effect of combining the assurance disci-
plines at the top management level. Similar successes,
based on similar organizations, were observed in other
U.S. commercial firms. There appears to be a trend
throughout industry and the Government toward combining
many of the functional disciplines into the same organi-
zation to take advantage of their related influences on
product quality and reliability. Those industrial firms
and Government agencies organized in this way felt that
it provided a much better utilization of resources
since the same individual could perform several related
tasks that were previously fragmented among different
functional disciplines. They also felt it resulted in
a program-oriented attitude rather than the compart-
mentalized thinking that the old fragmented organiza-
tional structure encouraged.

The study team observed that no two AFSC
Product Division organizations are organized the same.
In fact, there is not even any similarity between the
HQ AFSC organization and that of the Product Divisions.
Consequently, the assurance discipline organizations
receive guidance from a variety of HQ AFSC staff offices.
This fragmentation contributes to the lack of a strong
voice in making program decisions and hinders the
development of a unified product assurance position

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that would maximize program benefits. Figures 1 thru 5
show the organizational placement of those functional
disciplines in the AFSC Product Divisions and AFCMD
that are often included in an integrated organization
such as product assurance. These Figures emphasize the
multiple lines of communication that exist between HQ
AFSC and the division levels.

CURRENT ORGANIZATION

HQ AFSC		INSPECTOR GENERAL	DCS SYSTEMS	DCS CONTRACTING & MFG	
		SYSTEM SAFETY	RELIABILITY MAINTAINABILITY STANDARDIZATION CORROSION CONTROL	MANUFACTURING QUALITY	

HQ AFCMD	DIRECTOR OF SUBCONTRACT MGT	DIRECTOR OF SAFETY & FLT OPS	DIRECTOR OF ENGR	DIRECTOR OF MFG OPS	DIRECTOR OF QA
	QUALITY (GSI)	SYSTEM SAFETY	RELIABILITY MAINTAINABILITY STANDARDIZATION CORROSION CONTROL	MANUFACTURING	QUALITY RELIABILITY (TEST)

FIGURE 1

CURRENT ORGANIZATION

HQ AFSC		INSPECTOR GENERAL	DCS SYSTEMS	DCS CONTRACTING & MFG	
		SYSTEM SAFETY	RELIABILITY MAINTAINABILITY STANDARDIZATION CORROSION CONTROL	MANUFACTURING QUALITY	

HQ ADTC		DEPUTY FOR SAFETY	DEPUTY FOR ARMAMENT SYSTEMS	DEPUTY FOR CONTRACTING & MFG	
		SAFETY	RELIABILITY MAINTAINABILITY STANDARDIZATION	MANUFACTURING QUALITY CORROSION CONTROL	

FIGURE 2

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FIGURE 3

FIGURE 4

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CURRENT ORGANIZATION

| HQ AFSC | | INSPECTOR GENERAL | DCS SYSTEMS | DCS CONTRACTING & MFG | |
| | | SYSTEM SAFETY | RELIABILITY MAINTAINABILITY STANDARDIZATION CORROSION CONTROL | MANUFACTURING QUALITY | |

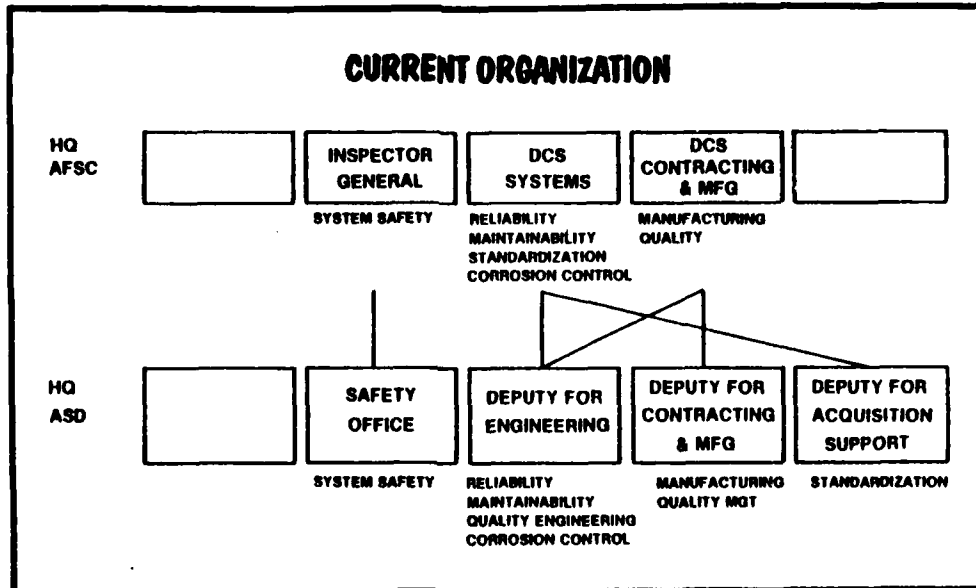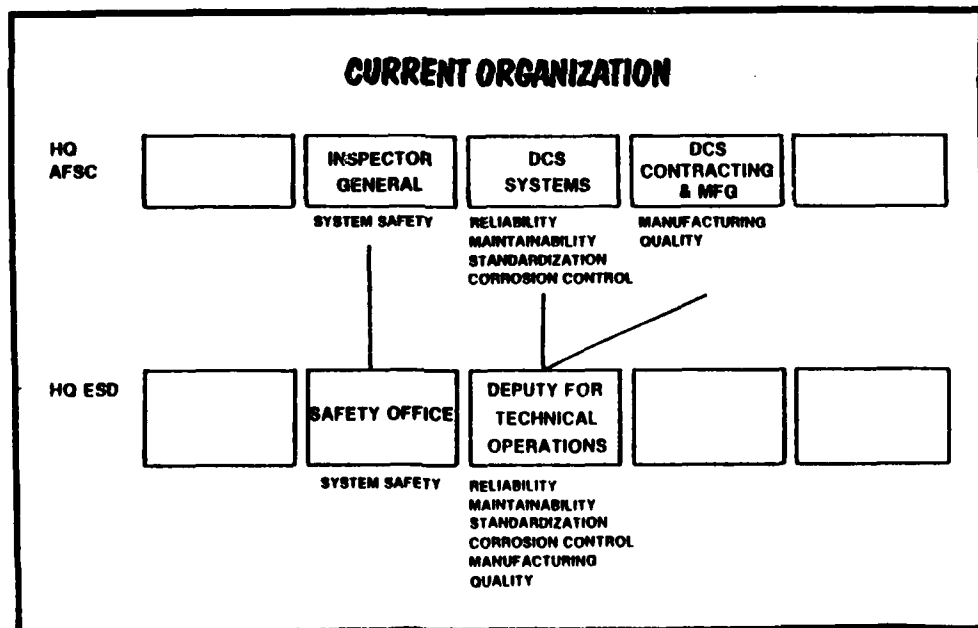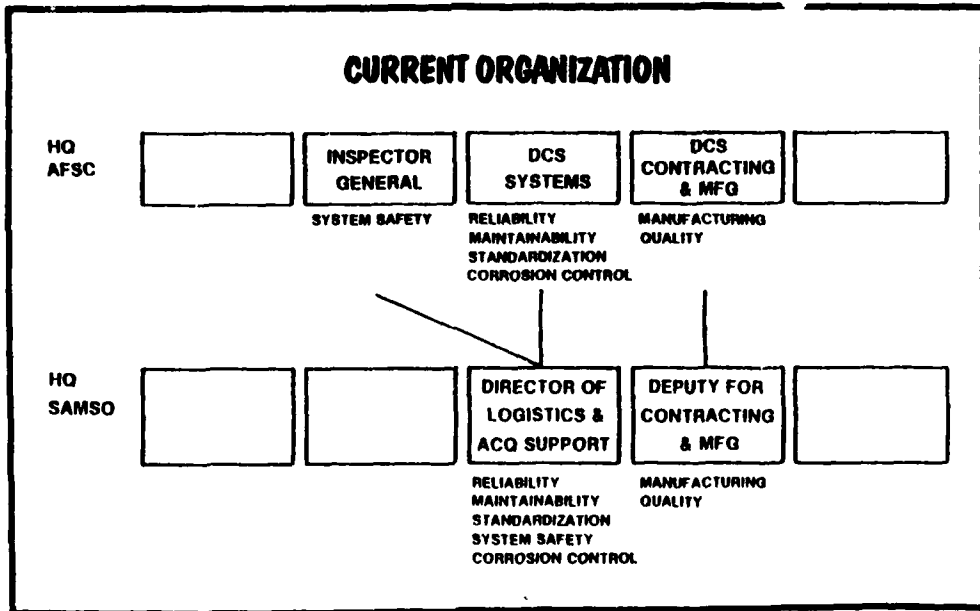| HQ SAMSO | | | DIRECTOR OF LOGISTICS & ACQ SUPPORT | DEPUTY FOR CONTRACTING & MFG | |
| | | | RELIABILITY MAINTAINABILITY STANDARDIZATION SYSTEM SAFETY CORROSION CONTROL | MANUFACTURING QUALITY | |

FIGURE 5

Table 3 shows the total number of personnel currently involved in product assurance disciplines in AFSC. These numbers represent those portions of the listed organizations that actually perform product assurance functions as defined in Section 5.

CURRENT PERSONNEL INVOLVED IN PRODUCT ASSURANCE

	HQ AFSC	ADTC	ASD	CMD	ESD	SAMSO
Manufacturing	31	24	149	70	50	22
Quality Assurance	6	14	29	1184	8	12
Engineering	7	18	55	190	13	23
System Safety	8	13	19	0	4	2
TOTALS	52	69	252	1444	75	59

GRAND TOTAL - 1951

TABLE 3

In most industrial organizations, where top
management felt quality was important, quality manage-
ment reported directly to the top operating official.
In U.S. defense contractor organizations, quality is
independent of the manufacturing organization and
reports directly to the top operating official.

In Government agencies visited in the United
States, the quality organizations and their level in
the overall organization also varied. In the Naval
Material Command (NAVMAT) (Figure 6), the Deputy Chief
of NAVMAT for Reliability, Maintainability and Quality
is a GS-16 and reports directly to the NAVMAT
Commander (0-10). Each of the Naval Systems Commands
below NAVMAT has a quality organization. At that level,
the organizations are not uniform. A matrix concept
is utilized. There are several GS-15s in the various
Naval Systems Commands quality organizations. There are
over 7,200 personnel in the Navy's quality career
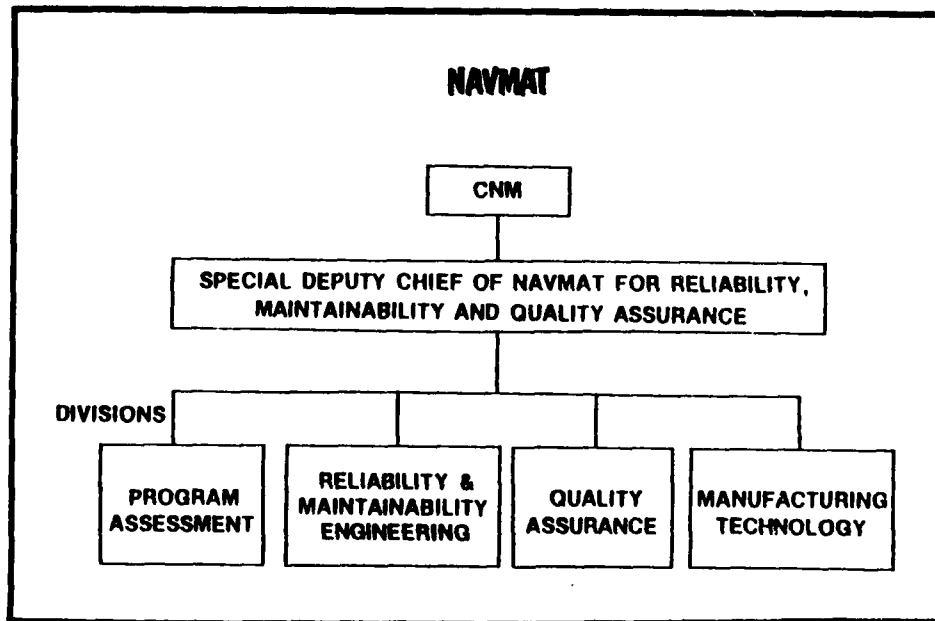program, of which 6,200 are in NAVMAT.

FIGURE 6

The Army has a strong and disciplined organization for quality. It is headed by a GS-16 who reports to the Commander (0-10) of the Development and Readiness Command (DARCOM) (Figure 7). Each subordinate product command has a quality assurance organization for development and another for readiness, generally headed by a GS-15. The quality assurance work force in DARCOM is over 5,600 people. They too, are matrix managed. DARCOM's product oriented Development Commands and Readiness Commands use the program manager concept like AFSC. There are, on the average, four to five quality assurance personnel assigned to each program office. The Chief of Quality Assurance in larger program offices is a GS-15. In smaller program offices, the position is generally a GS-14. Quality Assurance in DARCOM includes the reliability function. Quality is organized to assure/assess quality at all phases of the acquisition cycle including deployment.

DARCOM

COMMANDING GENERAL

DIRECTOR OF QUALITY ASSURANCE

DIVISIONS

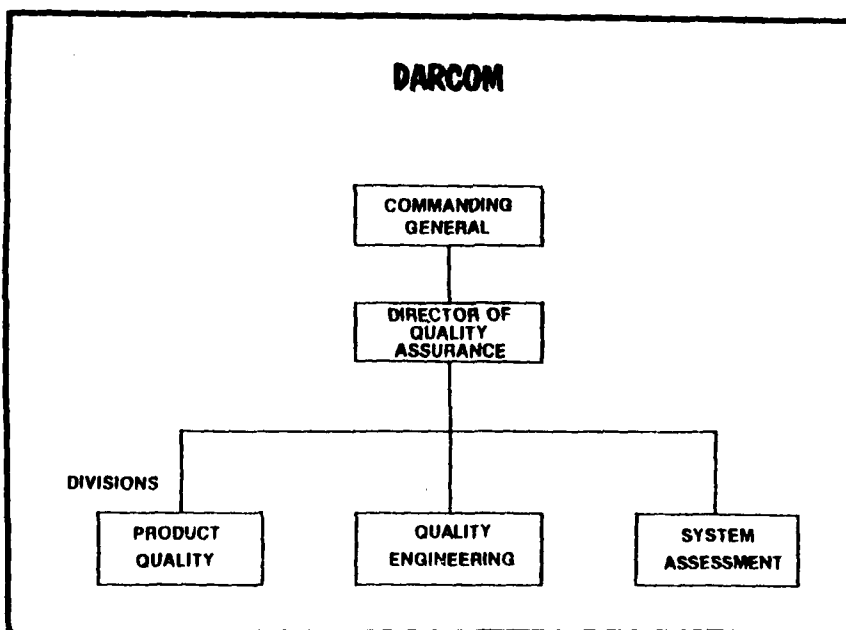| PRODUCT QUALITY | QUALITY ENGINEERING | SYSTEM ASSESSMENT |

FIGURE 7

NASA's Johnson Space Center (JSC) has a quality organization which includes reliability and safety. There are 365 personnel in this organization which include 199 contractor support personnel. The Director of Safety, Reliability and Quality Assurance is a GS-17 and reports directly to the JSC Director. JSC is also matrix managed.

DCAS is organized somewhat differently since their function is solely contract administration. The quality assurance organization has about 6,500 people. The Executive Director of Quality Assurance is a Major General with a GS-16 Deputy. Regional Quality Assurance Directors are Colonels or GS-15s.

In contrast, HQ AFSC has a small quality assurance staff of five professionals headed by a Lt Col (Col position authorized). This staff is two organizational levels below the AFSC Commander. Most of the quality assurance personnel in AFSC are in AFCMD. The quality assurance organization in AFCMD is headed by a Lt Col (Col position authorized) who reports directly to the Commander. There are 1,184 quality personnel in AFCMD. The grade level of the AFPRO Quality Assurance Division Chiefs is GS-13 or GS-14. In all AFSC Product Divisions, except ESD, the quality organization is three levels below the Commander reporting to the Deputy for Contracting and Manufacturing. At ESD, quality assurance is also three levels below the Commander but under the Deputy for Technical Operations. Quality assurance manning authorized in program offices and product division staffs is: SAMSO - 8; ASD - 29; ADTC - 14; and ESD - 5. ASD and ADTC are matrix managed. The typical grade of a quality assurance manager assigned to a major program office is a GS-12/Captain. Some program offices do not have full-time quality assurance personnel assigned. The top quality assurance individual in the Product Divisions is a GS-13 or GS-14.

There appears to be a direct correlation between the influence of the quality assurance organization on management/program decisions and the grade of the quality assurance individual and his level in the organization. In U.S. companies, quality considerations are voiced; however, the final decision is usually a matter of negotiation and trade-off between cost and schedule. In Europe, quality appeared to be more influential and would normally not be sacrificed for schedule considerations. In Japan, quality factors normally dominated management decisions. The Japanese often sacrifice schedule and cost to attain high quality.

Quality assurance in the Army and NASA have
an independent and equal voice with other functional
organizations in program decisions. In AFSC, the QA
organizations are normally too low in the overall
organization to be influential. Quality assurance
has neither an equal nor independent voice in program
decisions because of their low organizational placement
at the branch level (occasionally division level).

Although the QA capability in product divi-
sions has been increasing over the past two years, it
is not at a level sufficient to ensure that acquisition
strategies and requirements trade-offs which generate
program quality risk are given appropriate considera-
tion prior to program decisions. Contributing to this
are a lack of resources - both numbers and capabilities,
the organizational location, and program management
attitudes towards quality assurance.

Table 4 shows the typical quality assurance
staffing of the various locations visited. Table 5
indicates how U.S. and foreign governments are manned
in contract administration organizations to perform the
quality assurance function. Tables 6 and 7 summarizes
the organizational placement and grade levels of quality
assurance organization in U.S. and foreign government
agencies.

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                         QA STAFFING
U.S. CONTRACTORS

    GENERALLY AROUND 10% OF WORKFORCE
          - INSPECTION AND TEST
    LESS THAN 1% FOR SUBCONTRACTING

U.S. GOVERNMENT AGENCIES

    APPROXIMATELY 10% OF CONTRACTOR's QA STAFFING
    APPROXIMATELY 35% OF CAS STAFFING - ALL CIVILIAN
    PRODUCT DIVISION VERY LIMITED (LESS THAN 1%)
          - OFTEN ADDITIONAL DUTY

FOREIGN CONTRACTORS

    APPROXIMATELY 10% OF WORKFORCE
          - INSPECTION AND TEST

FOREIGN GOVERNMENT AGENCIES

    APPROXIMATELY 10% OF CONTRACTOR's QA STAFFING
    FROM 25% TO 100% OF CAS STAFFING
    MULTIPLE RESPONSIBILITIES
    SOME ARE ALL MILITARY
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TABLE 4

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              DEFENSE QUALITY ASSURANCE STAFFING
                   (PERCENT OF CAS PERSONNEL)

U.S. (DCAS, AFPRO, NAVPRO)        35%  (ALL CIVILIAN)
JAPAN (CPO)                       40%  (MOSTLY MILITARY)
GERMANY (BWB)                     25%  (ALL CIVILIAN)
DENMARK (AMC)                    100%* (ALL MILITARY)
NORWAY (DCMA)                     53%  (ALL CIVILIAN)
BELGIUM (BAF/CAS)                100%* (ALL MILITARY)

       *FIELD PERSONNEL PERFORM MULTIPLE FUNCTIONS

   NOTE:  AFSC PRODUCT DIVISIONS - LESS THAN 1%
          OF TOTAL WORKFORCE
```

TABLE 5

QUALITY ASSURANCE ORGANIZATIONAL PLACEMENT		
UNITED STATES	LEVELS REMOVED FROM TOP MANAGER	COMPARABLE GRADE
HQ AFSC	TWO	COL
PRODUCT DIVISIONS (STAFF)	THREE	LT COL/GS-14
SPOs (ADDITIONAL DUTY)	TWO TO FOUR	CAPT/GS-12
CMD	ONE	COL
DCAS	ONE	MAJ GEN
ARMY	ONE	GS-16
NASA/JSC	ONE	GS-17
NAVY	ONE	GS-16

TABLE 6

QUALITY ASSURANCE ORGANIZATIONAL PLACEMENT		
OVERSEAS	LEVELS REMOVED FROM TOP MANAGER	COMPARABLE GRADE
JAPAN (CPO)	ONE	SUPERGRADE
GERMANY (MOD)	FOUR	SUPERGRADE
DENMARK (AMC)	TWO	GS-14
NORWAY (DCMA)	ONE	GS-14
BELGIUM (BAF/CAS)	ONE	COL

TABLE 7

B.   Quality Planning

        It was observed that quality planning for
commercial products begins by developing design criteria
which is often published in company handbooks or proce-
dures manuals which supplement industry standards.
These efforts reflect experiences, lessons learned and
proven techniques for assuring the inherent reliability
and quality of the design. A significant aspect of this
early involvement for design assurance is the use of a
parts, materials and processes (PMP) standardization and
control program. The more complex and critical the
product, the more disciplined the use of PMP tools and
techniques such as derating, parts application review,
etc. A rational application (tailoring) of these tools
is used and is based on program requirements as needed
to support a cost effective program and the business
strategy approach selected.

        One commercial firm was able to reduce the
number of rejects during the manufacture of its product
from twice per item to less than 10 rejections per 100
items manufactured. They did this by management demand-
ing a disciplined approach to quality planning. For
example, the parts count was significantly reduced;
derating criteria used; parts, subassemblies and assem-
blies screened and tested at each level; and labor
intensive operations automated.

        AFSC organizations generally do not have as
disciplined an approach to assuring design quality.
One notable exception is SAMSO, who relies on contracted
support in this area. SAMSO feels very strongly that an
effective PMP standardization and control program con-
tributes more to product reliability than any other
factor. They contractually impose quality planning
factors such as derating criteria, parts application
reviews, critical item and baseline controls. Even then
their experience has shown that extensive monitoring and
review of the contractor's efforts in these areas are
required to prevent catastrophic problems. Through their
close technical involvement with the contractors they
are able to minimize cost, schedule and performance
impacts. SAMSO's efforts in this area closely parallel
the study team's observations of successful industrial
firms producing comparably complex equipment. SAMSO as
well as many commercial firms have experienced serious
quality and reliability problems when the application
of these tools and techniques has been lax or omitted,
e.g., the Minuteman weld problem, TITAN booster failure,
etc.

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The other AFSC Product Divisions have not tended to impose these same contractual provisions, nor do they have the same expertise, e.g. parts engineers to develop or monitor their contractors' performance in these areas. Thus, they are forced to rely upon contractors to develop their own programs, design criteria, et cetera. Even then the program offices and CAOs are limited in their ability to monitor the contractor's performance in achieving these goals (not requirements) due to the lack of skilled manpower in these disciplines.

An often neglected quality planning function in AFSC has been the early involvement of quality engineers. Quality engineers influence design by assuring that the design accurately reflects the requirements, that lessons learned have been incorporated, that the design is repeatedly producible, and that meaningful inspections and tests are both possible and planned. Many companies, expecially the Japanese, perform these tasks and feel they provide a very cost effective defect prevention function.

Another important aspect in assuring the reliability and quality level of the product is to freeze the baseline when the design has been proven. After the baseline is established any changes can be completely analyzed or hardware retested to determine possible impacts on quality and reliability. During initial design analysis, contractors in the commercial sphere thoroughly evaluate vendor designs to determine the level of involvement and controls that will be needed to assure vendor performance. AFSC program offices often are not manned with sufficient or trained personnel to perform this effort.

In the commercial sector, firms tend to rely on evolutionary product improvements. Quantum changes generally occur only when technology advances have been proven. Product improvements are generally made to correct specific problems in the design or manufacturing processes, and the impact of these changes on reliability and quality are evaluated. Extensive preproduction testing is performed to assure that the design is producible and will perform as intented in the field environment.

Whenever specific product quality and reliability levels are required by the customer, verification testing is considered almost sacred. Only by such testing at all levels; i.e., part, subassembly, subsystem and system level, can a manufacturer have confidence

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that the design will perform as intended. They recog-
nize that design is an iterative process and seldom
if ever will they produce a perfect design the first
time even though they incorporate all currently known
techniques. Unexpected problems can occur and may
not be detected until the item reaches service. Thus,
every attempt is made to subject the design to the
anticipated worst case stresses to promote test failures.
These failures are then analyzed to determine the cause
so that preventive actions such as redesign, derating,
circuit protection, etc., can be taken. Successful
commercial organizations have found that numerous field
failures are the direct result of failing to perform
these vital functions adequately. Therefore, the prod-
uct does not enter production until the manufacturer is
confident that it is suitable and reliable.

In contrast, because of operational require-
ments, AFSC tends to push state-of-the-art advances in
many areas simultaneously. Not only does AFSC require
and support significant advances in performance with
each new product, but tries to use the most advanced
technologies and materials in manufacturing these prod-
ucts. As a result of these simultaneous learning curves,
problems not only in performance and producibility occur,
but major deterrents to quality are introduced. First,
failure modes are introduced by not having fully matured
the manufacturing process or by not understanding the
problems such a process introduces. Thus, these failure
modes are not recognized until equipment starts failing
in the field. Problems in perfecting these new techni-
ques and materials cause schedule delays and cost impacts
which often result in cancelling the preproduction test-
ing that could have identified these problems. The irony
is that when these inherent problems are not identified
and eliminated early, then the schedule and cost impacts
tend to be even greater. Such schedule and cost impacts
further encourage shortcuts and the introduction of even
more problems, and the vicious circle continues. Thus,
the more a new product advances technology and perform-
ance, the greater the need for the application of product
assurance principles and techniques, yet the more likely
they will not be used due to cost and schedule consider-
ations.

Directly related to quality planning is accom-
plishment of the various program technical and management
reviews. Those companies and government organizations
that have been most successful have placed heavy emphasis
on these efforts. Industry performs extensive analyses

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of their manufacturing capabilities to assure that
these capabilities are compatible with the requirements.
They strive to balance the inherent capabilities and
requirements by either improving the capability or
reducing the requirements to an achievable level to
assure that risks have been minimized. Program
management is kept apprised of the evaluation results
from which they can make program decisions based on
risk assesments. Also included in their manufacturing
capability and design analyses are the identification
of critical aspects of manufacturing processes and
procedures. These critical features either receive
additional design analyses or controls are developed to
assure that the manufacturing process will consistently
result in a conforming product. This same attention
is given to those aspects determined to be cost drivers.
Inspection points including mandatory requirements are
also determined during these analyses. Although all
AFSC programs have similar reviews, such as critical
design and production readiness, they are often per-
formed by untrained and inexperienced personnel and in
an undisciplined manner.

One aspect that is peculiar to the AFSC organi-
zation is the interface between the product divisions and
the contract administration organizations (CAOs). Man-
power limitations and organizational parochialism have
often prevented the program offices and CAOs from de-
veloping a full and complete mutual understanding of the
contract requirements, interrelationships, and a detailed
and specific memorandum of agreement. Thus, CAOs often
do not realize the program office's requirements or can-
not support them with either skills or manning resources
by the time these requirements are finally known. The
program offices likewise are unaware of the unique
capabilities of the supporting contract administration
offices. Consequently, each organization independently
works its own problems rather than mutually developing
a team spirit in support of the program. Effective
communications can be hindered and the contractor could
end up receiving conflicting guidance or direction.
Directly related to this is the unjustified establishment
of mandatory product inspection requirements. These are
often imposed by the program offices without any coordi-
nation with the CAOs. This could result in requiring
needless inspections, omission of important requirements,
or the inability to participate in various design reviews
due to manpower limitations.

As seen in the commercial sector, industry's overall emphasis in the design area is on early failure analysis and defect prevention. AFSC programs invariably end up in a defect detection mode. The only way to avoid this is by early involvement by skilled quality, reliability, parts, etc., personnel concerned with product assurance requirements that will satisfy user's needs. These people must assure that the proper tools and techniques have been effectively and efficiently tailored and incorporated into the contract. This effort and the subsequent monitoring of the contractor's performance requires an appropriate level of manning and funding. Failure to assure an adequate level of manning and proper training invariably results in a reactive mode of problem tracking rather than failure prevention.

C. Quality Measurement

Measurement of quality begins by determining the contractor's quality of design, his capability to produce the product as specified and the effectiveness of his quality assurance program to assure conformance. Industrial firms engaged in development of commercial products tend to concentrate on these functions with their suppliers, recognizing that a vendor's capability and expertise truly determine the end product quality, reliability, schedule adherence and product cost. Their evaluation of a vendor is an in-depth, in-plant analysis by a team of specialists skilled in this function. They evaluate the vendor's total capability for producing and controlling the product's conformance to the requirements. They also consider a vendor's past performance as a strong indication of how he will perform on future contracts. Industry tends to select the best performers even though they may not be the lowest in initial cost.

AFSC has tended to place more emphasis on the lowest cost proposal due to the potential for protests, although more emphasis is being placed on past performance criteria of late. AFSC evaluations of a contractor's capability, quality assurance system and quality management are often performed only by evaluating the contractor's Quality Assurance Program Plan during source selection. Often the leverage to incorporate needed changes to the contractor's system is lost because these problems are not detected while still in a competitive environment. This results from a failure to fully evaluate the actual system because of a lack

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of skilled personnel to perform the evaluation. After
contract award, such changes are difficult to implement
even though the contractor's system is obviously
deficient and the change will result in improved quality
and contractor efficiency.

Industry measurement of quality in the commer-
cial market area is achieved in many ways. Vendor's
rejection rates are tracked, i.e., incoming inspection,
failures during assembly, costs of rejects, etc. They
also measure the product's performance in the field
(e.g., maintenance delays, aborts, in-flight shutdown,
warranty returns, spares usage rates, etc.). These
problems are not only analyzed for cause and failure
trends, but they are also fed back to the vendor and
corrective action is required.

In AFSC there is no primary system or respon-
sible organization for collecting quality data. The
CAOs are responsible for reviewing yield rates, excessive
reworks, etc. and can identify the need for corrective
action, yet the program office usually retains the au-
thority to direct the contractor to make changes. Even
if the CAOs provide the program office with visibility
as to pre-acceptance quality performance levels, the
information is generally untimely for corrective action.
Field quality data is collected under several different
and unrelated systems by different organizations. Qual-
ity deficiency reports are completed by the users on
field equipment and submitted to the appropriate Air
Logistics Center which usually does not have the author-
ity to direct the contractor to do a failure analysis
or take corrective action. During RDT&E, these defi-
ciency reports are submitted to the program offices, but
not necessarily to the CAOs. Spares usage rate reporting
is also the responsibility of AFLC. Post acceptance
aging and surveillance as well as reliability data are
generally the responsibility of the program office.

There are significant differences between the
way industry and the government deal with their suppliers
who are having problems. Both send in teams to work
the problems with the manufacturer. Industry tends to
emphasize problems and their performance requirements,
whereas the Government tends to direct how to resolve
the problem and how to achieve the performance.
Industry feels this causes unnecessary costs, denies
them design latitude, relieves them of responsibility
and makes the Government a direct party to any subse-
quent problems. Many government personnel feel that

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this is a more economical approach, especially on
cost type contracts in that lessons learned can be
incorporated and standardization benefits realized.
Both positions have some merit. Of major interest is
the difference in the manner in which problems are
worked by these two different approaches. In the com-
mercial environment, industry seems to accept the fact
that unforeseen difficulties may arise and that omissions
and errors will be made. Therefore, they join forces to
resolve the problem and prevent recurrence. The vendor
is motivated to be cooperative in order to retain his
market with the prime and the prime is motivated to
retain a capable and experienced vendor. Their objec-
tives are to assure customer satisfaction and make a
profit.

Several industrial firms felt that the atmos-
phere in the DOD environment with respect to joint
government-contractor problem resolution seems to be
adversary. Each party seems more concerned with estab-
lishing blame and liability than achieving the proper
problem resolution. This adversarial relationship is
created in part by a success-oriented attitude and
unrealistic expectations that do not recognize or allow
for cost or reliability growth.

Since commercial enterprises often assume
responsibility for product quality in the field environ-
ments through warranties, customer expectations, or
product liability, they develop whatever data system is
required to fulfill these needs. Their data systems
range from sampling surveys to complete traceability
depending on product complexity and the information
required to make management decisions.

A common complaint heard from all sectors is
that AFM 66-1, Maintenance Management, and T.O. 00-35D-54,
USAF Material Deficiency Reporting System, data is inade-
quate for problem detection or corrective action. This
results from the data not being accurate or timely; nor
was it intended for that use, e.g., AFM 66-1 data is for
maintenance management. Some organizations have augmented
these data systems to obtain specific data needed on
critical systems and subsystems. When taken in the aggre-
gate, it appears that the AF data systems are generally
as good as those observed in industry considering that
both must tailor existing systems to their needs. AFSC
data use is restrained, however, by the fragmented col-
lection systems used and the absence of a centralized
focal point for all data. Thus, no one organization
appears to use all the data actually available to it.

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The exceptions are when specific data requirements have demanded total tracking and management is willing to fund this additional effort. Two specific cases where AFSC does not appear to take full advantage of the data available are: contractor data and trend analyses are often not provided to the program offices, nor are they always evaluated by the CAOs; CMSEP generates a wealth of valuable information but this information is generally not provided to the program offices unless the condition has resulted in a cost and/or schedule impact. Prior knowledge of contractor trends could permit preventive actions or better planning by the program offices. This lack of information flow tends to be detrimental to a teamwork approach. If the program office has not been kept apprised of potential problems and the CAO's handling of them, then they tend to overreact when advised of the cost and/or schedule impacts or when they uncover the problem themselves. Conversely, when kept properly informed as to CAO actions, the program office's confidence in the CAO is generally better and thus more conducive to mutual problem resolution rather than assigning blame. Likewise, CAO positions with the contractor are often overridden by the program office, e.g., a demand for corrective action or refusal to accept a nonconforming article. These program office decisions may be correct; however, if the CAO is not a party to the decision process or kept apprised of other factors influencing the decision, then animosity and frustration are created.

In the commercial environment, industry makes extensive use of field technical representatives for data feedback. This is particularly true during the preproduction testing, field testing and early deployment stages so that accurate and timely feedback is available for product evaluations, improvements and accelerating of product maturity. AFSC has successfully used contractor technical representatives for this purpose in some instances. However, when the AF does not have contractor personnel perform this vital function, there is a definite deficiency in our normal data system and neither AFSC nor the contractor gets adequate failure data for use in determining timely or necessary corrective actions nor for reliability or quality measurements.

Industry management generally requires quality and reliability reports to be made to them in great detail so that they are able to continually assess their company's and vendor's quality performance and make trade-off decisions based on risk and cost analyses.

Air Force managers are generally interested in hearing about quality only on an exception basis, i.e., whenever there is a quality problem that impacts cost, schedule or performance. Reliability tends to be of a little more interest in that higher headquarters requirements demand reporting this factor, but only with respect to whether the goals have been attained and seldom for program decisions.

An area of quality measurement that was criticized by both industry and government as being deficient was that of automated test and inspection equipment. Many advances are being made in computer controlled manufacturing techniques and technical processes. However, the conformance verification of the products manufactured by these methods is often more time consuming and less sophisticated than their manufacture. Both industry and the government are faced with a cost dilemma in this area. Both appreciate the value to be received in developing automated or improved test and inspection equipment. However, the defense industry has no incentive to fund such research since the average historical inspection costs are normally allowed as a percent of direct manufacturing labor costs on new proposals. Also, the uncertainty of new government business precludes assurance of repayment of such major investments. In addition the government has several problems related to this issue. There is often a lack of awareness of the specific needs or likelihood of achieving the technology needed. There is also a general reluctance to fund research for equipment in light of the competing pressures for RDT&E funds more directly related to mission requirements. Thus, it appears that the government must motivate industry and participate with industry in these development efforts by providing seed money for such programs. In the long run, such capital investments will enhance product quality and improve inspection productivity, thus reducing acquisition and life cycle costs.

D.   Education/Training

U.S. industry generally provides work related technical training to their employees. Equipment and system training is also available. Training in management and supervisory disciplines is not as readily available. Career development training is rare. College tuition assistance programs are generally provided for white collar workers. Some companies are reluctant to provide extensive training due to high personnel turnover rates.

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All types of training are generally available and required in Japanese industry. New employees generally received extensive training. One year of technical training is common with emphasis on quality assurance. All company employees normally receive some training in the quality discipline regardless of their position or functional assignment. Training in quality is also provided to top managers. Training in Japan is considered to be a normal and necessary part of doing business and a good investment. Life-time employment, common in large Japanese companies, is an incentive to provide training.

Training and training programs in the U.S. military services and agencies range from extensive to almost non-existent. FSC falls into the latter category. The Defense Contract Administration Service (DCAS) has an extensive training program. In addition to the training that is available from DOD schools (e.g. AMETA), DCAS has two excellent quality assurance training programs. One is an individual certification program whereby quality assurance specialists are certified in one or more commodity areas. Not satisfied with the availability of courses from DOD schools, DCAS has developed an in-house capability to provide 37 courses on-site. Many of these courses were developed by DCAS. Qualified instructors are trained in each regional office and many sub-offices. In FY78 alone, DCAS taught 432 in-house courses and trained 4,741 students. About 78% of all DCAS quality assurance specialists are certified in one or more commodity areas. The second DCAS training program is a formal intern program. This program provides a continual input of well-qualified, motivated, high potential personnel to fill various quality assurance positions as they become vacant. The program is designed to output staff specialists, in-plant specialists, quality engineers and safety specialists. The intern program is three years in length and consists of both classroom and on-the-job training. The program costs about $57,000 per intern which includes salary, travel and moving expenses for the three years. Formal training is mostly provided by AMETA. DCAS inputs about 60 interns a year.

The Army has three quality assurance intern programs: one for quality assurance specialists, one for quality engineers and one for ammunition specialists. The Army's programs are the oldest in DOD. The Army graduates about 60 quality assurance specialists and quality engineers each year. These programs are also three years

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in length and consist of classroom and on-the-job rotational training. The specialist and engineering program classroom training is provided by the Army's own school, AMETA. These programs are similar to the DCAS program but tailored to the Army's needs.

The Navy also has a quality intern program. It is for quality engineers only. It, too, is three years in duration and consists of six months of classroom training and two and a half years of on-the-job training at several Navy activities. The Navy program is the newest of all the intern programs. They input about 25 engineers each year. The unique feature of this program is that most of the training effort is accomplished by contractors. NAVMAT developed training outlines tailored to their needs and contracted for course development, course materials and instructors.

AFSC has neither an intern program nor a formal training program. Quality assurance training in AFSC is obtained by requesting training allocations through the AFSC personnel office. Training spaces obtained this way are few and far between. The Hq AFSC Quality Assurance Office has been attempting to establish a quality engineering intern program for over a year. Lack of manpower spaces have frustrated this attempt. As a result there is very little quality assurance training in AFSC.

There is an AFSC intern program in the Contracting and Manufacturing organization known as Copper Cap. These intern spaces are restricted to contracting and manufacturing functions. Although quality assurance in AFSC is generally a part of the Contracting and Manufacturing organizations, no spaces have been allocated to quality assurance interns.

The educational level of workers in quality assurance organizations in industrial firms varies considerably. This variation is generally related to product complexity and criticality. The inspection work force is generally comprised of technicians and mechanics. As complexity and criticality increase, quality engineers, reliability engineers, statisticians and other professionals are added to the quality organization. In U.S. commercial firms manufacturing sophisticated equipment, professionals make up as much as 25% of the quality assurance organization. In some U.S. firms producing defense or space hardware, professionals comprise as much as 40% of the quality assurance work force. These firms are producing some of the most

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complex and sophisticated equipment in the world. The
AFPRO quality assurance work force is responsible for
monitoring the efforts of the contractors' work force
and for assuring compliance with contract technical
requirements. The AFPRO quality assurance work force
includes about 15% professionals. (24% of all AFCMD
civilians have college degrees.) Some of the defense
contractors felt that the difference in professionalism
between the AFPRO work force and their industrial coun-
terparts contributes to the adversary relationship which
often exists. They expressed concern that untrained CAO
personnel are evaluating the efforts of their highly-
skilled and technical work force. Since some CAO per-
sonnel are unable to make meaningful findings due to
their lack of technical expertise, contractors allege
that they sometimes resort to being highly critical but
often in insignificant areas. This becomes a source of
severe irritation to the contractor's personnel and
often results in needless costs. Figure 8 displays the
percent of college graduates in the quality assurance
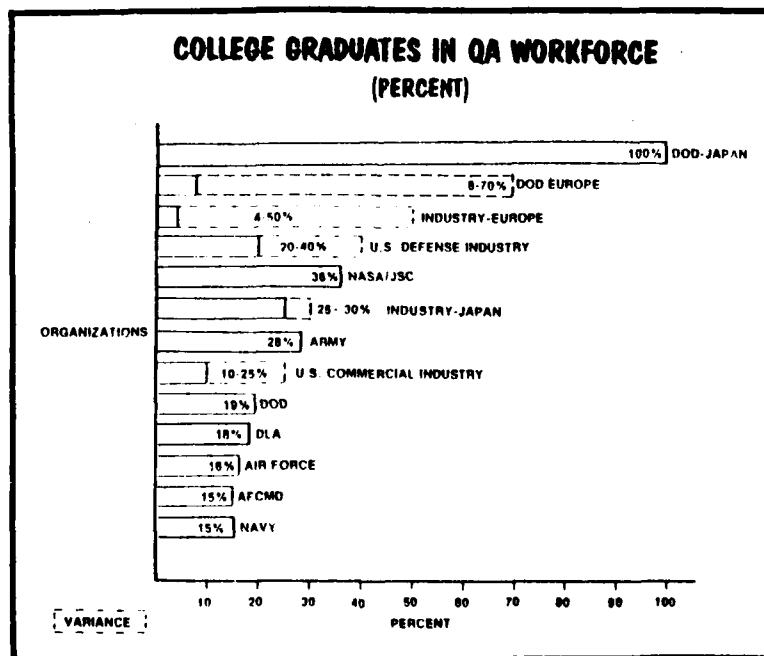work force in the various activities and countries
visited.

COLLEGE GRADUATES IN QA WORKFORCE
(PERCENT)

FIGURE 8

E. Contract/Subcontract/Warranty Arrangement

The Quality Horizons study team observed almost as many different "commercial practices" as commercial firms. Many of the different techniques appeared to be simply variations on a theme, however, and there are a number of observations that can be made and conclusions drawn.

First of all, commercial contracting arrangements are mostly firm fixed price and are negotiated before work commences, except for off-the-shelf items. Commercial firms use redeterminable contracts on occasion, where new development or a new product is involved, or even where quantities are uncertain making firm pricing difficult. But incentive arrangements in the commercial environment are the exception, not the rule, both in the United States and in the other countries visited by the Quality Horizons Team.

Commercial firms are able to deal firm fixed price, even on relatively complex items, for many reasons. Some of the most important are competition, vendor specification control, no "changes" clause, commercial pricing techniques, and the market place in general. They base their requirements on current technology, and take advantage of advances in the state-of-the-art only after they are proven; thus technical risk is generally low.

Competition is a strong driver when a vendor is to be chosen for a new program because vendors know that, for the most part, once they have the business, they will keep it. In almost all cases, commercial firms stay with a vendor once the vendor has produced a quality product. When a problem arises, the company and the vendor work together to try to resolve it. This is true throughout the United States and Europe, and is especially true in Japan. When large production quantities are involved, companies will dual or even triple source and maintain continuing competition that way. Even in those cases, vendors perceive the commercial business base as more stable than the Government's. One major consumer goods firm in the U.S. expressed extreme reluctance to change vendors. They stated that their success was first and foremost a result of long term relationships with their suppliers, and emphasized the difficulty and expense of introducing a new vendor to their requirements and business methods.

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Specification control by the manufacturer is an important aspect of the commercial business environment. Performance specifications are called out, with the "how to" left to the vendor. The performance requirements are generally well defined and even if it is found that customer demands are different than expected, changes are controlled by the manufacturer. Firms will accept customer specified equipment, but may disclaim any responsibility for that equipment. In the case of consumer goods, customer satisfaction is more important than specification compliance. In other words, is the product suitable for its intended use? One company expressed it this way: DOD is devoted to specification requirements; commercial customers are devoted to results.

Customers have no unilateral right to direct changes in commercial contracts. This means that changes must be negotiated technically, and priced, before they are made. This allows the vendor more stability in his planning and manufacturing, and thus contributes to the ability of vendors to establish firm prices for work that the Government would buy using an incentive arrangement. One U.S. firm told the team they would accept more FFP Government contracts if the "Changes" article were omitted.

Commercial pricing is done more on the basis of market value and competition than cost plus profit. A vendor can include whatever contingencies he feels the traffic will bear, knowing that he can price himself out of the market if the competition provides an equal quality product at a lower price or a better quality product for the same price. The low bidder is not always the winner in the commercial world. Almost all the firms interviewed were willing to pay a higher price to deal with a vendor they were confident would satisfy their requirements, provided they were not gouged. Customer demands for quality are increasing, and industry has perceived that customers will pay more for a quality product.

Past performance ranked high in their criteria for selection of a source. In fact, it is the dominant factor in many cases. A major aircraft manufacturer repeatedly told the team that the only way to achieve quality is to find a way to exclude the marginal performer from future business. Vendor rating systems are a vital part of the overall business strategy of the firms visited. The systems in use by the companies vary in sophistication with the

complexity of equipment and amount of subcontracting involved, but they all serve to exclude the unacceptable vendor, and flag the questionable one so that suitable controls can be imposed. By regulation, the Government must buy from the low bidder unless he can be shown to be non responsive or his technical approach does not fully satisfy the contractual requirement. The burden of proof, in a protest, is on the Government. Experience has shown that it is difficult to sustain a determination of non-responsibility or technical superiority. The low bidder rule is often cited as the reason the Government must stay fully engaged with its contractors. When cost analysis is used in commercial buying, the negotiators are often industrial engineers, or other technical experts knowledgeable about the product, rather than the accountants or financial experts the Government generally uses.

The general perception by a commercial firm is that the market is elastic to quality performance as well as price. They can make a determination of what the market will be and accomplish long range planning accordingly. They maintain they cannot make such determinations regarding the Government market. Government rules about competition and component breakout, along with the annual appropriations process, are cited as the primary reasons.

The teamwork aspect of the commercial company and its suppliers provides an interesting comparison with the relationship between the Government and its suppliers. Before award, the commercial firm is much tougher than the Government would be; using negotiation tools prohibited by our procedures, such as auction techniques. Once a vendor is selected, the relationship becomes a cooperative one, in pursuit of a common goal. The Government negotiating team, on the other hand, has generally cooperative arrangements before award, becoming adversarial after. In most cases, problems exasperate this adversary relationship, so that when the parties most need to be pulling together, they are likely to be engaged in a tug-of-war, where the solution to the problem takes a back seat to placement of the blame. Commercial firms tend to work a problem with industrial engineers and quality specialists, where the Government would use lawyers and accountants. Stable technology (commercial) vs advanced State-of-the-Art technology (Government) is a contributing factor to this situation.

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Commercial warranties in the United States, Japan, and Europe tend to be relatively straight-forward and non-complex, applying to materials and workmanship only (not design or processes) for a specified period of operating time or calendar time. Warranty terms are usually established by competition, and firms try to get warranties from vendors consistent with the warranty they offer the consumer. In a number of cases, though, warranty costs are not charged back to the vendor unless they reach some previously established threshold of financial pain for the company. In several instances, this threshold was 3% of cost of sales. In some cases, the warranty is not even specified in the purchase order, but simply an understanding on the part of the vendor as to what level of quality is expected. Clearly in the commercial world both within and outside the United States, it is not the contract guarantee that drives quality, it is company policy and the promise of future business.

Firms that do a high volume of business in a product line generally have historical data to price warranties, but this becomes almost irrelevant at times, because the competition sets the terms of the guarantee. Often, firms decide to assume responsibility for correction of a defect on the basis of the cost of the correction and the predicted loss of customers if they do not make good, even though they have no legal obligation to do so.

The Quality Horizons team also observed a wide variety of contracting techniques, including warranty approaches, in the AFSC Product Divisions and the other Government agencies visited, both U.S. and foreign. All agencies used some firm fixed price and some form of cost reimbursement contracting. Cost-plus-a-percentage-of-cost (prohibited by law in U.S.) is still used to some extent in Germany, while Japan uses cost-reimbursement contracts with a ceiling arrangement which the supplier exceeds at his own risk. Fixed price was the preferred form in all locations. In Europe and Japan, one year warranties are used, covering materials and workmanship. In the U.S., DOD contracts range from CPFF to FFP, with a wide variety of incentive and warranty arrangements.

One incentive technique employed by DOD that is widely accepted as effective is Award Fee. This provision is generally used where there is inadequate information to prepare detailed specifications, where emphasis is subject to change during the life of a contract, or

where an item of special importance to the Government is of only peripheral importance to the contractor. Award Fees are useful where warranties would not be, and they keep the communication channels open between the seller and the customer. At both NASA, Houston, and a DOD contractor in California, an Award Fee allocation to Quality Assurance increased the stature of the QA organization by assuring visibility and emphasis by program and company management to the quality requirements. Thus, their participation was solicited commencing in the early design phase. Both Government and contractor program managers recognized a new emphasis on quality. The Quality Assurance manager of the California firm stated that with several hundred thousand dollars riding on quality he became an important part of the program management team.

The Navy's lease satellite program is the closest emulation of the commercial environment by a Government buying activity encountered. This satellite is to provide secure communications with ground stations for five years. All financing of this program is done by the contractor, with payments beginning when services begin, in orbit, in October 1981. A performance specification is used, and commercial time sharing is permitted. While the Navy will exercise close technical surveillance, design control remains with the contractor.

In all the AFSC Product Divisions, there is increasing emphasis on the use of warranty provisions; such as Reliability Improvement Warranties (RIW), Correction of Deficiencies (COD), and some limited use of standard commercial warranties. Unfortunately, use of a RIW or other guarantee has not generally resulted in reduced in-plant surveillance, or changes in contract quality management system requirements. Thus, the Government may be conducting needless contractor monitoring and paying additional costs. Whether the increasing use of these provisions has improved quality or whether they are cost effective is hard to judge at this point. It is generally agreed that RIW provisions are serving to improve the feedback of information to the manufacturer to assist in the correction process. Whether an effective warranty can be negotiated depends in large measure on the competitive nature of the purchase. The Government is generally able to include warranties in competitive contracts. In sole source situations, the contractor tries to establish a price that is prohibitive, or so emasculate the provision as to render it worthless.

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In summary, there are more than enough tools available to the contract negotiator, but none of them are foolproof. There is no substitute for intelligent assessment of the government's objectives and selection of a business strategy consistent therewith. Ideally, the best contract would be referred to the least and the best warranty would never be referred to at all. Specific strategies for an acquisition should be tailored to the program and the contractor, keeping in mind that no form of assurance is free, and that the objective should be to get the most for the taxpayers' money.

F. Motivation

One could postulate a "hierarchy of needs" for the American worker, and at its base would be job continuation. A majority of the United States firms visited rely primarily on the promise of future work to motivate their work force. Many companies in the United States have such high worker turnover, or such heterogeneity in the work force, or both, that training programs or other motivational programs have been futile. Thus, job continuation as a motivator is augmented only by negative motivation (discipline).

Where the labor force is more stable, there are some motivation programs in operation in the United States. QC Circles, upward mobility programs, and other, generally ad hoc, programs are used to encourage quality and productivity. Employee recognition programs tend to be noncompetitive; that is, everyone can win, and they offer nominal rewards like coffee cups or T-shirts. The programs are considered effective, but need constant rejuvenation. The study team heard mixed reactions to QC Circles in the United States; some firms are using this approach with some success, others without any success, and still others say the notion is only a gimmick and will not work in this country because of the cultural differences and the heterogeneous work force.

One large firm told the team that their system of promotion sorted out the self-motivated people so well that there was no need for any other program of job enrichment. Other firms told the team that the professional workers, e.g., engineers were self-motivated, and that management emphasis improved quality more than any other factor. The design engineer will resolve cost and quality problems if they are presented as requirements equal to other performance considerations. Top management attitude is the key to improvement in this area.

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In Japan, Zero Defects Programs are still
effective. However, the main motivator is QC Circles,
which originated in Japan about the same time that
Zero Defects got its origin in the United States.
Zero Defects and QC Circles both emphasize elimination
of defects. Zero Defects, however, centers on the
individual while QC Circles center on groups of workers.
QC Circles are a form of participatory management in
which workers, usually 6 - 10, form a group which
periodically meets to review their responsibilities,
problems encountered and to suggest ways to improve
work performance. The suggestions may cover any area
which will improve productivity, quality or the work
environment. One company reported savings of approxi-
mately $250 million every 6 months as a result of this
suggestion program. High worker morale is achieved
because the workers accept their responsibility for
product quality and are proud of their achievements.
The Japanese workers are further motivated by a bonus
system. The workers may earn bonuses of 40% to 60% of
their salary depending upon their individual and group
performance and the company profits. High levels of
training, low turnover rates and the paternalistic
attitude of management also contribute to high
worker morale.

In Europe, the team observed the beginning of
QC Circles, but the primary motivator seemed to be
upward mobility programs based on employee performance.
They also have recognition programs using certificates
and awards. Representatives of several European firms
talked about the de-motivating aspects of overly
detailed procedures and also of the difficulty in get-
ting the worker to take responsibility for his work
when an inspector is looking over his shoulder each
step of the way. Bonus payments in Europe, like in
Japan, are common. Traditional craftsmanship is also
a factor in Europe with the satisfaction of having
done a good job the primary motivator.

The issue of motivation is a difficult one.
Programs of all types seem to work, for a while, but
experience would indicate that they are difficult to
sustain. The programs that have endured are "tradition"
in Europe and QC Circles in Japan, but they still re-
quire sustained management emphasis. Where management
was slow to respond to worker needs, failed to adequa-
tely consider worker comments or failed to continue
support of the motivation programs, the programs

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ultimately failed. While no panacea was observed, it
was generally found that large organizations need
simple and sincere motivation programs to foster pride
in workmanship and a sense of belonging. While these
programs are not universally successful, within each
company some form of motivation did seem to contribute
to employee concern for the company's image as manu-
facturer of quality products.

G.   Field Services

        The field service support provided by indus-
trial firms is dependent on the customer (consumer,
industry or government), the complexity of the product,
and the warranty provided. Products sold to consumers
are generally serviced by sales and service centers or
returned to the factory. The primary concerns of the
producer are to minimize warranty expenditures, to main-
tain user satisfaction and to remain competitive. With
products sold or leased to other industrial firms, the
producing firm normally does not get paid until the unit
is proven acceptable to the buyer. These products are
generally more complex than consumer products. Field
service costs for commercial items are included in the
purchase price while field services for military systems
are separately priced. Field services are generally not
used on military systems unless no other alternative
appears to exist for a specific problem such as untrain-
ed personnel.

        Field service in the companies visited was
located in various organizations. These included
engineering, manufacturing, quality and marketing. In
some firms, the field service organizations were sepa-
rate profit centers if they provided field services for
all corporate products.

        Some of the basic functions performed by field
service organizations are technical assistance, analysis
of field complaints, training, and accurate and timely
feedback of failure data. The field service representa-
tive may perform or advise the user in performing main-
tenance on the system. In addition, since the field
service representative generally has a direct line of
communication to the manufacturer, the response time
necessary to provide technical assistance for resolution
of maintenance problems or customer complaints is greatly
reduced. A field service representative may also provide
technical assistance through a purely advisory role.

Accurate and timely data feedback and analysis of field complaints provide the manufacturer with the information necessary to improve customer satisfaction and determine trends in performance and/or reliability. A universal complaint that the study team heard was that data available to the contractor on system performance of military systems is not timely, accurate or complete. In most non-military situations the primary measure of quality is the cumulative in-service reliability of all field units of a particular product. Complaint analysis and data feedback provides the manufacturer with the data necessary to mature the system.

The policies for providing field services are varied and dependent on several factors. Of prime concern is the customer's requirements. Field service provided to the consumer is generally limited to the sales and service centers which provide warranty as well as post warranty maintenance or replacement. If the customer is another industrial firm, field services provided are dependent on the warranty specified by the terms and conditions of the contract and the pressures of competition. In some European countries, field service is often not a distinct entity because the national laws require all products to be warranted. Therefore, the law levies on the producer the repair responsibility. However, some firms have extensive field service organizations because they do not receive final payment until their product is installed and operating as specified. It was noted that the military, in the countries visited, separately contracted for maintenance and field support except for products that were covered by warranties. Where items were covered by warranties, the product was returned to the factory for repair. In Germany, if the item was commercial or a commercial derivative, the item could be taken to the commercial sales and service outlet for repair. Where field service was required in Germany, it was separately priced but often provided at cost.

The warranty duration was also a driving factor in companies' decisions to provide field services. In product lines which had long service lives such as telephone systems purchased by European companies, there were extended warranties. In the United States, the manufacturers of telephone equipment assign representatives to the operating companies who in turn lease the equipment to the customers. Whether purchased or leased, equipment must meet specified reliability requirements; otherwise,

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excess maintenance costs are passed back to the manu-
facturer. Field service personnel are invaluable in
identifying and helping resolve problems and minimizing
total systems costs.

The commercial portion of the aerospace indus-
try in the United States provides field service support
for a specified period of time after delivery of the
last aircraft of a certain model or as long as there
are a certain number of that aircraft in service. Sev-
eral factors favor the use of field service personnel
on the commercial side of the aerospace industry. The
first is competition. Even though an airline may have
a considerable investment in one manufacturer's equipment,
they have the option of purchasing similar equipment from
another manufacturer. Aerospace companies must provide
service to insure a high degree of customer satisfaction.
The second factor is that the aerospace companies have
design flexibility and responsibility. The aerospace
firms can, and must by FAA direction, make design changes
if a safety problem is discovered. To a large extent
they can also change the design to increase product
reliability or performance or decrease manufacturing
costs without prior customer approval. When changes
other than those directed by the FAA are made, the air-
lines have the option of incorporating the changes in
the aircraft already in service and are generally pro-
vided modification kits at a low cost. Field service
representatives provide much of the data necessary to
make design changes. A third factor is the method of
contracting. Commercial contracts are relatively
short and specify the what-when-where and how the
customer is purchasing. This includes delivery dates,
warranties, performance and special equipment that the
customer wants. All services which will be provided
both before and after delivery are included in a
single price. Usually when the airline performs main-
tenance covered by warranties, the producing firm is
charged for all or part of the expense involved. Field
services in this case verify that the work was in fact
warranty work. The final factor is technical support
during early organic maintenance. The airlines, much
like the Air Force, start providing maintenance as
soon as the system is in operation. Field service
representatives assist in the maintenance of the air-
craft and training of personnel.

H. Government Involvement/Surveillance

The study team evaluated the FAA involvement in the commercial aircraft industry. In this area the FAA is regulatory in nature since the Government (FAA) is neither the buyer nor the user of the equipment. The FAA certifies the aircraft (airworthiness) and the manufacturer's production plan, methods and techniques (Production). The Airworthiness Certificate is basically awarded as the result of design analysis and testing in accordance with the applicable Federal Air Regulations (FARs). The Production Certificate is based on the actual manufacturing of the article.

The FAA makes extensive use of Designated Manufacturer Inspection Representatives (DMIRs) to perform surveillance of the manufacturing processes. They are company employees who are intimately knowledgeable of the manufacturer's processes and procedures as well as the FAR requirements. DMIRs are selected by the company and approved by the FAA's Principle Inspector for the facility. They actually wear an FAA hat while on the company's payroll in assuring that the company procedures, inspections, etc., are in accordance with the FAA requirements and are adequately performed. The FAA's Principle Inspector for the facility monitors the performance of the company's DMIRs. Those FAA and company representatives interviewed felt that DMIRs have no conflict of interest. They indicated that DMIRs would not hesitate to reject a nonconformance regardless of the impact it might have on the company's delivery schedule or cost. The reason given was that DMIRs consider their positions very prestigious and thus are self-motivated to maintain their status. They do not receive extra pay for this position; however, they are usually senior employees and the position provides additional job security.

The FAA assigns a Principle Inspector and occasionally additional representatives to a manufacturing facility. The FAA Principle Inspector is responsible for conducting surveillance to assure that the manufacturer remains in compliance with FAA requirements. Primary functions include:

1.   Approval/evaluation of QC data.

2.   Evaluation of inspection/quality assurance of manufacturing and special processes.

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3. Conducting compliance/conformity inspections of products.

4. Training, supervising and monitoring the DMIR activities.

5. Investigation of in-service difficulties.

6. Investigation of regulatory violations.

7. Assurance that effective corrective action is taken for all unsatisfactory conditions.

Periodically, the FAA (regulatory) conducts a Quality Assurance System Analysis Review (QASAR). A team of highly trained FAA personnel conduct an in-depth review of the manufacturer's conformance to the FAA approved plans and procedures upon which the Production Certificate was granted. The contractor's incentive to maintain compliance with the approved plans and procedures is the threat of losing the Production Certificate which is essential to certify the aircraft as airworthy. An additional impetus that encourages contractors to comply with FAA regulations is the threat of civil penalties such as large fines or imprisonment and the notoriety such actions receive through the media.

The FAA in the role of customer (FAA uses the equipment) performs much like that of a program office during system acquisition. The FAA first reviews the contractor's manufacturing and quality programs for acceptability. If acceptable, the contractor's Quality Plan is certified; then, any changes desired by the contractor must be submitted to the FAA for approval. Subsequent to Quality Plan approval, the FAA maintains minimal representation within the plant. Many FAA contracts require the installation and checkout of the system before payment. This provides additional assurance that the system will function satisfactorily before relieving the contractor of his responsibility.

The U.S. Army (DARCOM) involves the quality assurance organization in each phase of an acquisition life cycle: conceptual, validation, full-scale development, production and deployment. The Army designs much of the equipment they purchase. Most of their equipment is manufactured by contractors under the cognizance of DCAS. Extensive use is made of the Letter of Instruction (LOI) by the Army. Through the LOI the procuring offices can direct the activities of the in-plant

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government agency. The Joint Service Regulation for Procurement Quality Assurance Programs (DLAM 8200.1) is used at those contractor locations under cognizance of the Army as well as those under DCAS.

DCAS has used the concept contained in DLAM 8200.1 since it was published in 1962 and recently developed the Contractor Assessment Program (CAP) as Appendix D of DLAM 8200.1. This program is currently being tested at carefully selected locations. The agreement signed by the contractor (DLAM 8200.1, Appendix D, Fig 6) contains the following elements that are not required by MIL-Q-9858A: (1) obtain government concurrence prior to changing identified key elements of the company's quality control program; (2) audit product inspection after normal company inspection is complete; (3) evaluate the company's quality procedures through periodic compliance reviews; and (4) report the results of monitoring and reviewing actions to the government.

CAP requires the contractor to accomplish most of the activities that were previously accomplished by the government QAR. This permits the contractor's workforce to maintain a more consistent and efficient flow of work, since they do not have to wait for DCAS inspections (except for established mandatories) before moving parts or materials from one work station to the next. More of the DCAS QAR's effort is spent on assuring that the contractor's quality assurance system is properly controlling the manufacturing processes, that the contractor's system is detecting nonconformances preventing them from being built into products or going into inventory and assuring that corrective action is taken to prevent recurrences. This is accomplished by a more flexible inspection schedule with a more disciplined reliance upon statistical sampling and lot acceptance techniques. This not only permits the QARs to evaluate more areas of a contractor's operations, but it also allows them to concentrate their efforts in areas where problems have been detected. Once these problems are resolved, they then concentrate on other areas where sampling inspections, reviews of contractor's records or other monitoring have indicated potential problems.

Those contractor and DCAS representatives interviewed felt that the CAP system resulted in a much more effective and efficient utilization of scarce government resources. In most cases moderate reductions in the number of in-plant government inspectors were achieved. It also improved the working relationship

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between the DCAS and contractor in that the emphasis
was on the contractor's system and data, not on trivial
concerns which often create animosity. The contractor
is truly considered responsible for the quality of his
product. Contractors maintain that their management is
motivated to make sure the program works because they
are proud their company was selected for CAP. They
also indicated that their employees are motivated to
do a better job. While data is not yet available to
conclusively evaluate the CAP impact on product quality,
contractors maintain that it has not degraded product
quality and in some cases has enhanced it. The DCAS
organizations visited support continuation of the pro-
gram as a valid tool to place more quality respon-
sibility on contractors without abnormally increasing
government quality risks or reducing confidence levels.
The very limited CAP data shown to the study team did
not reflect any product quality degradation due to
withdrawal of in-plant government inspectors.

The Navy Plant Representative Offices (NAVPROs)
previously conducted the in-plant quality assurance pro-
gram specified in DLAM 8200.1. Currently, the NAVPROs
are implementing a separate Quality Assessment Program
(NAVPRO QA Procedure 4.3.4). This program establishes
product verification teams responsible for discrete
manufacturing areas. Their verification effort is
accomplished less frequently than required by DLAM
8200.1, but in more depth. The results of each verifi-
cation are formally presented to the contractor's top
management for action. This program differs from the
DCAS CAP in that the NAVPRO does more verification of
product conformance through actual inspections.

Government involvement at contractor plants
under Air Force cognizance does not vary greatly from
that of other government CAS organizations. AFCMD has
developed and implemented the Contractor Management
System Evaluation Program (CMSEP) which is designed to
accomplish evaluations using the management systems ap-
proach. The baseline for this program is the contractor
top management official's assignment of responsibilities
to his functional directors. Verification of contractor
compliance to contract requirements is assigned to the
various AFPRO functional divisions according to this
baseline. Each contractual requirement is checked by
specific condition questions (management system indi-
cators) which the AFPRO personnel use to determine the

existence and adequacy of the contractor's written instructions. Subsequently, the AFPRO personnel verify that the contractor's employees are complying with the written instructions through procedures verification monitoring and product inspection verification. The quality assurance function uses this approach for verification of both management procedures and work instruction procedures. The verification of compliance to work instructions is a continuous evaluation while the verification of compliance to management procedures is a scheduled activity.

In Japan and Europe, government involvement for defense work is very similar to that in the United States. Other sections of this report provide data concerning their efforts and manpower allocations. Generally, it was observed that in Japan and Europe the work force of government quality assurance was one representative to ten contractor quality representatives; within AFCMD the ratio is closer to one government QAR to 20 contractor quality representatives.

I.   Summary

Many managers engaged in the military acquisition process on both the government and contractor sides give lip service to quality and the "ilities". Managers generally recognize the importance of these efforts and want front end attention to defect prevention, reliability and maintainability, but only to the extent that noncompeting funds are available to support their related costs. Detracting from the level of importance given to the "ilities" is a general lack of appreciation on management's part as to the trade-off analyses that are possible in these specialities. Thus, the manager often feels confronted with "all or nothing" choices as to "ility" requirements. Often neither of these choices would have resulted from a trade-off study which included the costs of product failures caused by the omission of these requirements. To establish tailored "ility" requirements that are consistent with cost, schedule and performance constraints requires sufficient manning and skill levels. Unfortunately, these levels are generally not available. Thus, the program manager may have inadequate information upon which to decide the apportionment of limited funds for competing requirements. Another factor contributing to the early de-emphasis of the "ilities" is that the pay-off from these programs is often not realized by the manager having this decision

responsibility. The impacts of not performing these
tasks are realized much later by the manager's suc-
cessor or by the operational and support organizations.

In addition, many military and DOD contractor
acquisition managers do not take the time and effort to
fully understand the tools, techniques and benefits of
the assurance engineering disciplines and some of the
managers are also reluctant to properly man, fund or
accept the recommendations of these specialists. Ra-
tional management decisions predicated on objective
evidence of cost payoffs is emphasized. However, it
is often easier to measure the costs of failure, than
to cost success in these disciplines. Managers must
recognize that unless properly manned and funded, these
functions cannot effectively or efficiently support the
acquisition objectives nor can adequate information be
provided so that well informed management decisions can
be made.

V.   NEW APPROACHES TO AFSC PRODUCT ASSURANCE

A.   Introduction

The Quality Horizons Study Team's recommendations presented in this Section are summarized in an Action Plan. The Action Plan contained in Appendix I has been prepared and organized to facilitate review, implementation and tracking of approved recommendations. The Action Plan contains a cross reference to this section of the report for additional information as may be required.

This section is grouped into the following eight categories in order to provide for a logical and sequential development of the new approach to product assurance:

Policy

Organization

Manning

Education/Training

Contract/Subcontract/Warranty Arrangement

Motivation

Government Involvement/Surveillance

Life Cycle Product Assurance

The study team has observed that there is a common thread that permeates all successful programs, both commercial and military. That theme is that there must be a disciplined approach to planning, utilizing the assurance disciplines. Design guidelines must be developed that are consistent with cost, schedule and performance requirements. Then throughout design, development, and production phases; analyses, controls, and conformance verification must be implemented to assure that the product will perform as required in the intended environment. Quality considerations must be an inherent part of the product design, development and test.

Programs that have been most successful
have utilized these concepts extensively with signifi-
cant emphasis on the front end design efforts that
will eliminate or minimize product assurance risks.
In each case these efforts began with and were contin-
ually demanded by top management. Management estab-
lished specific program requirements and then assured
that integrated trade-off analyses were conducted in
each area to develop a program plan that would accom-
plish these objectives within cost and schedule con-
straints. Program management considered not only the
inputs of each program element but assured that each
element's input represented a coordinated and integra-
ted position. Program decisions were based on complete
information. The recommendations that follow are
designed to achieve these same results within AFSC and
meet the Quality Horizon Study objectives set forth in
Volume II, Section 4.

In order to fully recognize the scope of the
concept presented in this section, it is imperative that
the definition of PRODUCT ASSURANCE be understood. The
application of these concepts to the traditional view of
quality as only a conformance discipline will result in
misunderstandings. A new phrase rather than redefinition
of an existing term, was specifically selected to call
attention to the fact that a new approach is being
recommended for use in AFSC.

> *PRODUCT ASSURANCE is the application of
> interdisciplinary skills to accomplish the pre-
> ventive and conformance activities necessary
> to assure: that requirements are properly
> specified, that the design will achieve these
> requirements and that the ultimate product
> and/or services will perform their intended
> functions in the operational environment for
> the period specified.*

Many skills, disciplines and sciences contribute
to or have responsibility for product assurance, not just
the quality function. Quality, reliability, maintain-
ability, etc., must be designed and manufactured into the
product not just measured through inspection or tested in,
although both inspection and test are essential for verify-
ing conformance. The product assurance concept can, given
the opportunity, integrate these complimentary actions
currently fragmented within AFSC.

B.   Policy

The objective of AFSC's research, development
and acquisition programs is to provide the using commands
with products and services that fully satisfy mission
requirements and user expectations. To achieve this
objective, a combined effort is necessary to assure that
proper technical requirements are contractually specified
and that the products conform to these specified
requirements.

Top management attention by AFSC and industry
is essential to attain this goal. General Slay's
efforts, including the direction of this study effort
are well known to AFSC and industry. His direction to
implement recommendations of this study will further
support management's resolve to assure better quality
products to users. Such management actions will be
essential in order to shift AFSC's emphasis from problem
detection and correction to one of prevention as
described under the product assurance concept.

Although government/industry teamwork and
excellent management have resulted in some highly suc-
cessful programs, these effective management initiatives
must be institutionalized and used on a broader basis.
Current guidance in DOD Directives, AF and AFSC Regula-
tions in the individual functional disciplines (e.g.
MIL-Q-9858A, MIL-STD-1543, AFSC 74-1, etc.) is generally
adequate. However, since the implementation of this
guidance is often incomplete or not effective, AFSC's
and industry's top management must assure that the pro-
per emphasis is given to product assurance. To attain
this objective an AFSC Regulation that integrates the
tasks and functions defined in the current regulations,
standards, etc. must be developed. This Product Assur-
ance Regulation will not only provide for more effective
use of scarce resources by preventing duplication of
efforts, but its orchestrated approach will assure a pro-
gram orientation that minimizes program risks and achieves
the required performance at the lowest possible cost. It
will incorporate a system of checks and balances to assure
that each organizational level fulfills assigned respons-
ibilities. One such verification requirement would be to
justify to program management the inclusion (or elimina-
tion) of each specific product assurance task or function
required by this regulation. Such management emphasis
will elevate these performance requirements to a level of
concern equal to cost, schedule and other performance
considerations.

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Many managers do not recognize that the
assurance disciplines have evolved from "black arts"
to engineering sciences with proven tools and tech-
niques for their proper application. These functions
are no longer fragmented efforts but complement one
another. Their analyses, applications and evalua-
tions rely upon the same basic data, such as, fail-
ure mode analyses. Yet, many responsible and
competent individuals within these functional disci-
plines have not been exposed to the experiences of
other programs or the tools and techniques effectively
or ineffectively used by them. Effective lessons-
learned and training programs must be undertaken to
provide AFSC personnel with the opportunity to perform
to their fullest capabilities.

Expertise and experience acquired on one
program must be transferred to all AFSC organizations.
One valuable method of achieving this objective is
through a formalized lessons-learned program which will
reinforce AFSC's corporate memory. The method recom-
mended to accomplish this would be to develop AFSC Hand-
books for each functional discipline. Each handbook
would contain guidelines for applying the tools and
techniques of the specific discipline and how it inter-
acts with other assurance disciplines. The guidelines
should include a brief description of the tool or tech-
nique, how it is applied for various products and con-
tracting methods, the benefits it provides, approximate
costs associated with its specific applications and the
risks of not performing these tasks. An OPR for each
discipline must be established who will be the focal
point for lessons-learned by all organizations. The OPR
will be responsible for assuring the incorporation and
distribution of all changes. Several pamphlets, hand-
books, product division standards and office instruc-
tions have been developed with much of this informa-
tion. However, these documents have not been dis-
tributed to other AFSC organizations nor do they
always incorporate lessons-learned from other
organizations.

To maintain management emphasis on product
assurance, the visibility and knowledge of this element
of a program's performance must be of prime concern. To
do this, AFSCR 800-23 should be revised to require each
Program Manager and Air Force Plant Representative or
CAO Chief (DCAS/NAVPRO) to report on product assurance
successes and problems at each Command Assessment Review
and Program Assessment Review. Additionally, program
managers should stress to their contractors the

importance of including product assurance status, problems
and concerns in program technical and management reviews.
Reporting of product assurance requirements is already
accomplished in many forms such as data item description
submittals and functional management reviews, but
program management frequently does not receive even a
summary of these reports. Contractors and project
officers should be required to brief program management
on these items.

The suggested new approach to AFSC product
assurance is necessary to provide the methodology and
assure the consistent and disciplined application of
these policies by management.

C.   Organization

The recent trend in DOD, as well as industry
has been to combine some, or most of the assurance
disciplines into one organization, reporting to top
management. The Army (DARCOM) was the first service
to do this, followed by the Navy (NAVMAT), and the
Air Force (AFLC). There is no quantitative data to
prove that these organizational changes have resulted
in improved product quality. It would be difficult to
accumulate such data for any organizational change, but
increased attention to the assurance disciplines was
observed in the combined organizations. The Quality
Horizons' Study Team believes that a similar organiza-
tion change in AFSC would be required to maintain
and improve quality levels during the current trend
of diminishing resources.

The recommended organizational change will
eliminate the current fragmentation which exists in
the assurance disciplines by combining the primary func-
tions which impact the quality, reliability, safety, etc.,
of the product. This will facilitate communications be-
tween Hq AFSC and all subordinate levels. In addition,
this organization will promote consistent application
of the tools and techniques available to the product
assurance disciplines, optimize implementation of
lessons learned and use of manpower resources. Even
more significant is the fact that the proposed organiza-
tion will raise the level of influence that the assurance
disciplines have on program decisions in all phases.

The critical mass of personnel and centralized
focal point for product assurance attained by this new
organization will enhance their overall program orienta-
tion. The currently fragmented structure forces a myopic

view ("cultist" orientation) that often does not consider the overall program objectives or constraints. The integrated positions developed through this new organization will permit more informed program management decisions resulting in delivery of a quality product that meets user needs at the lowest possible cost.

The organization in AFSC which will be most successful in improving product quality is one which combines the assurance functions specified below. This organization should be titled Product Assurance and report to the Commander at Hq AFSC and subordinate units. While it is true that the individuals assigned to an organization have a strong influence on its success or failure, the proper organization structure will enhance the probability of mission success.

The new product assurance organization will be responsible for the following functional disciplines which are currently being accomplished by various organizations in AFSC:

1. Quality Assurance

2. Reliability

3. Maintainability

4. System Design Safety

5. Manufacturing (except at AFCMD)

6. Standardization

7. Corrosion Control

Included in each of the above areas would be all of the tools, techniques and subfunctions which support these areas such as: Man-Tech Program, Q-Tech Program, non-destructive evaluation program, quality assurance engineering, product assurance testing, metrology, software quality assurance, vendor quality assurance and producibility, derating, failure mode analysis, parts control, etc.

The main advantages to the product assurance organization are:

1. It enhances front end involvement during design and development phases.

2. It combines similar functions which are interrelated and are currently fragmented in different organizations in AFSC.

3. It provides clear and direct lines of communication by establishing organizational symmetry.

4. It reduces duplication of efforts, multiple interpretations, and conflicting direction from different activities.

5. It increases productivity and manning flexibility by combining personnel with related disciplines and overlapping capabilities. It provides for a critical mass of personnel at those organizations where manning is not adequate to support an office in each of the disciplines.

6. It overcomes the tendency for different functional disciplines to compete on an individual basis for funding and manning resources and develops a broader perspective toward total program needs.

7. It provides for continuing visibility and attention to product assurance by top management by requiring that the organization report directly to the Commander.

8. It gives product assurance an independent and stronger voice in management and program decisions so that product assurance will not be subordinated to cost, schedule or other performance requirements.

9. It improves career progression and the ability to attract and maintain highly competent people.

10. It demonstrates to contractors that AFSC thinks product assurance is as important as other performance parameters.

The primary disadvantage is that it will increase the span of control for the Commander, Hq AFSC and Product Division Commanders. On the other hand, the span of control at AFCMD will be reduced and it has the potential for reduction in program offices.

Figure 9 shows the proposed organization with its direct line of communication.

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PROPOSED ORGANIZATION

HQ AFSC

| | | DCS PRODUCT ASSURANCE | | |

MANUFACTURING
QUALITY ASSURANCE
RELIABILITY
MAINTAINABILITY
STANDARDIZATION
CORROSION CONTROL
SYSTEM DESIGN SAFETY

HQ PROD
DIV

HQ
AFCMD

| | | DEPUTY/ DIRECTOR PRODUCT ASSURANCE | | |

* MANUFACTURING
QUALITY ASSURANCE
RELIABILITY
MAINTAINABILITY
STANDARDIZATION
CORROSION CONTROL
SYSTEM DESIGN SAFETY

* SEPARATE DIRECTORATE AT AFCMD

FIGURE 9

If the above organization is not considered practical at this time, an alternative would be to reorganize in two phases. Phase one should be to reorganize and combine product assurance disciplines at HQ AFSC only. This would emphasize to AFSC field organizations the need to enhance product quality through a teamwork approach of product assurance and assure greater attention to these disciplines early in the design and development efforts. Over a period of time, an evaluation should be accomplished by HQ AFSC to determine if the early involvement product assurance concept is being effectively accomplished at the field organizations. If not, phase two should be implemented, i.e., the reorganization and combining of product assurance disciplines at all AFSC field organizations. This would institutionalize the product assurance concept and enhance its accomplishment at the Product Divisions and AFCMD.

Action should also be taken to transfer the expertise and program knowledge derived from the initial acquisition activities by the product divisions and

program offices to the contract administration offices at the contractor's plants. An effective way to accomplish this transfer of corporate knowledge is through strong communication channels between the product divisions, program offices and contract administration offices. Since a large number of AFSC contracts are administered by CAO's outside AFSC (DCASs and NAVPROs), communication with these organizations must also be strengthened. The number of AFSC contracts under DCAS administration warrants the establishment of a DLA liasion office at each Product Division to facilitate communications. This will enhance the ability of program offices to relate concerns and problems and attain confidence in the contractor's performance as reported by the CAOs. This will permit DLA to re-allocate their resources accordingly and will strengthen the working relationships between these team members, enhancing overall effectiveness.

D. Manning

It was generally observed, in those organizations where assurance disciplines were combined, that the quality assurance manning was distributed more heavily toward the front end of the product life cycle than is the case currently in AFSC. Thus, without changing the basic assumption that no additional manpower resources will be requested, (except for the possibility of an intern program which is described in V.E.), re-allocation of existing manpower is recommended. All of the manpower currently performing the assurance missions listed under Section V.C. - Organization, would form the pool for this ultimate re-allocation.

Under the product assurance concept, there will be a much greater involvement by product assurance personnel in the earlier phases of the acquisition cycle. This early emphasis on prevention will provide a greater return on existing manpower resources and investment thus allowing for the re-allocation of critical manpower within the product assurance community. The objective should be to assign current resources to those product assurance organizations where they can provide maximum benefits. Currently, there are 56 full time quality assurance personnel in AFSC program offices and product division staffs and 1,184 quality assurance personnel in AFCMD. Thus, approximately 5% of the AFSC quality assurance work force is located in the four AFSC Product Divisions.

The first step necessary to man the new
organization should be to identify those resources cur-
rently performing the product assurance functions in
Hq AFSC, AFCMD, ADTC, ASD, ESD and SAMSO and transfer
these resources to the product assurance organization
in each of these activities.

It may eventually be necessary to strengthen
the manning levels and ability for AFSC personnel to
become more involved in early design and development
efforts. This should be done by the re-allocation of
personnel and vacant positions to the systems program
offices and AFCMD activities that can best influence
design and development. While an increase in product
assurance manning within the Product Divisions is
anticipated, an independent study team under Hq AFSC
leadership should be formed to determine the most
effective allocation of product assurance resources and
skill levels within AFSC. The team composition should
include representatives from Hq AFSC, Product Divisions
and AFCMD, and work in concert with General Slay's
direction for a Workload/Manpower Baselining Study
(4 Apr 1979). When the study is completed, a plan
should be developed to accomplish the re-allocation.

There should be no reductions-in-force or
other adverse personnel actions. The initial transfer
of personnel from the AFCMD to the Product Divisions
would be on a volunteer and selection basis. Subse-
quent transfer of spaces would occur as spaces become
vacant through attrition. Not all vacated spaces
should be transferred, but this should be done on a
planned schedule until the predetermined re-alloca-
tion is complete.

In addition to the realignment of product
assurance resources, there should be a concurrent
upgrading in the professionalism of the entire work
force. Emphasis should be placed on college grad-
uates in the assurance sciences with the prerequisite
individual capabilities. Goals should be established
within AFPROs to increase the number of appropriate
college graduates in product assurance using as a
guideline the percent of college graduates in the
comparable contractor's work force. Needs of the
organization and ability to recruit college gradu-
ates should be considered in establishing this goal.

When specific skills are not available
within AFSC, a decision must be made to retrain exist-
ing resources or contract out for these specialized

skills. AFSC should establish a Command Policy to
support contracting-out where necessary.

E.   Education/Training

The new AFSC product assurance approach will
require significant emphasis on education and training
to assure that the work force remains current in the
techniques available to the product assurance disci-
plines. In comparing training available within AFSC
to that available to the Army, Navy and DCAS, it was
obvious that AFSC lags far behind. The Army, Navy and
DCAS all have well established intern programs which
concentrate on quality assurance and the related disci-
plines. AFSC has virtually no formal training programs
and does not have a quality or product assurance intern
program. U.S. industry does not normally have formal
quality assurance training; rather, they concentrate on
technical training. However, a good appreciation for
quality and/or product assurance will be a natural out-
growth of a well developed technical training program.
In Japan, there is extensive initial technical training
followed by continuous training in quality assurance.
In Europe, the emphasis is on technical training; however,
special training in quality assurance is available and
regularly used.

The percentage of college graduates in the
AFSC quality assurance work force was one of the lowest
observed in all locations visited. This lower level
of education sometimes hampers the communication
flow between AFSC quality assurance personnel and their
industrial counterparts.

Over the past few years, the Japanese have
raised their product quality level to one of the highest
in the world. A major reason for this is the fact that
managers, including top managers, receive a substantial
amount of training in quality assurance.

The Japanese made us keenly aware of the fact
that all levels of management must have a strong appre-
ciation for the benefits to be gained from a product
assurance program and they must continuously support
the program if the full value of the benefits is to be
derived. To achieve this goal, our top management
courses such as the senior service schools, Defense
Systems Management College, and the System Program Man-
agement course should be modified to devote an appro-
priate amount of time to the role of product assurance

rather than the token recognition currently given. The intent would be to instill in program directors and other top managers a sense of appreciation for the disciplines, when the approaches are best used, and the benefits from effective application of the assurance disciplines. In addition, current AFSC top managers and program directors must be made aware of the benefits they will receive from the new product assurance approach. This should be accomplished by a short, intensive, on-site program presented by an authority in the product assurance field. The investment in these training programs will be returned manyfold in improved product quality and reliability.

A concerted effort by AFSC must be made to raise the educational levels of quality assurance resources, especially in the AFPROs. This will bring the AFSC in-plant educational levels more in-line with their counterparts in the plants serviced by the AFPROs. Some adjustment in grade levels may be necessary to hire and retain the quality individual desired. However, the improvement in communications and problem solving ability would more than justify a slight increase in grade levels.

In line with raising top management appreciation for product assurance and the educational levels of the quality assurance personnel, AFSC must implement a formalized training program to upgrade the skills and capabilities of the product assurance workforce. The program must be centrally managed, adequately funded and supported by management. The resulting systematic approach will assure that AFSC personnel keep pace with industry in their areas of responsibility. The existing skill levels must be surveyed so that the need for development of specific courses for the AFSC-wide training program can be prioritized.

Developments resulting from the new AFSC Quality Technology Program (Q-TECH) may require new courses to be formulated and incorporated in the AFSC product assurance training program to keep the personnel up to date.

Another significant area which needs to be addressed is the establishment of a Product Assurance Intern Program. This program would provide a source of trained, capable and motivated people to fill the vacancies created by retirements or reassignments.

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The intern program would produce graduates who understand product assurance from an AFSC perspective. They would be able to perform effectively in Hq AFSC or any of the AFSC divisions. The main theme of the program would be to develop individuals with the technical abilities necessary to perform effectively in journeyman level positions, yet who were also sensitized to program and business management. The graduates of the intern program would form the core of our future top product assurance managers.

The intern program should be centrally managed at Hq AFSC and supported by a distinct budget so as not to be diluted by other requirements. The training should be three years in duration consisting of formal classroom training, training at several AFSC organizations and some on-the-job training in contractor or AFPRO product assurance organizations. The number of interns should be based upon a percentage of the expected attrition rate for product assurance personnel. The program could support a minimum of 25 interns per year or approximately 75 interns when the program is in its third year of operation. It is reasonable to assume that approximately 25-50% of the vacancies occurring through normal attrition during any one year of the approximately 1950 product assurance personnel could be filled by the highly qualified graduate interns. It is necessary that AFSC provide 75 manpower authorizations to support this program. The use of overage positions would be acceptable.

AFSC should also explore the possibility of establishing an AFIT Education With Industry (EWI) Program for product assurance. This program should be made available to military and civilian personnel alike. EWI programs in other functional disciplines have proven to be beneficial.

Prior to developing the individual courses AFSC should evaluate the training courses and capabilities within DOD to determine what AFSC needs cannot be satisfied. If the capability does not exist within DOD, AFSC should develop or contract for the development of the courses. In those cases where there is a limited requirement for certain courses, AFSC should consider contracting with a private institution.

The education and training programs described above are the most pressing needs in upgrading the skills of AFSC personnel involved in product assurance. These programs will also provide the basis for a career development program for product assurance employees.

The Quality Assurance Office at Hq AFSC has begun this effort for quality assurance personnel. However, this effort must be continued and expanded to include the entire product assurance organization.

F.   Contract/Subcontract/Warranty Arrangement

One of the major Quality Horizons' study objectives was to tailor and utilize commercial contracting practices to enhance product quality and support the established direction contained in AFSC/CC Policy Letter 22. Although this Policy Letter has been in effect for over one year, the Quality Horizons study team sought specific commercial practices that could further facilitate compliance with the existing policy.

An important step toward better hardware must be a better contract. Complexity and sophistication are not the ingredients that result in a quality contract. The most important ingredient is a clear set of performance specifications. The intended use of the desired equipment must be described in such a way that performance in the operational environment can be readily measured.

The statement of work should spell out clearly that performance will be measured during field use. The contractor has to know what it will take to obtain user satisfaction. The Statement of Work should then be subject to pre-Request for Proposal planning to include participation by potential proposers to assure a clear understanding of the requirement, the risks, and the responsibilities. Maximum use should be made of draft Request For Proposals and more serious consideration given to alternate proposals. Contractors should be encouraged to submit alternate proposals that define cost deltas and risks for requirements they consider to be cost drivers. Also, alternate approaches to field support, such as interim contractor support, until support equipment can be in place and operating, or full contractor support for an indefinite period should be proposed. Planning must include a careful analysis of the timing of the changeover to full organic support.

During the team's travels, it was found that incentives are not a satisfactory substitute for a well defined requirement. Complicated contractual incentives often create difficult problems and generate adversary relationships. Better results could be obtained by concentrating on the requirements. Unfortunately contracting officers spend most of their time working

with their financial and legal advisors and little with their technical support personnel. Reliability Improvement Warranties, or any other warranty provision should be applied only on a selective basis, generally in competitive acquisitions, and require a full understanding of all parties, (user, AFLC, ATC, etc.,) as to the responsibilities of the Government under the terms of the contract. The objective of the Reliability Improvement Warranty can also be achieved by doing a better job of describing the requirements, emphasizing product assurance in the beginning, and requiring the contractor to provide field support.

The AFSC/CC initiative on the use of past performance in source selections will make a significant contribution to the effort to improve product assurance. This effort should continue, and be strengthened, if possible, recognizing that it is not as easy for the Government to make the judgments that a commercial firm can make because of the emphasis placed on low bidders and the fact that, in a protest, the burden of proof would be on the Government. The rating system described under Part V.G. will emphasize the AFSC intent to use past performance to impact future awards.

To further support General Slay's efforts toward program baselining, another initiative that should be implemented, on a selective basis, is deletion of the unilateral right of the Government under the "Changes" article. This would not stop changes, but would require that they be defined and priced before they are authorized. This disciplined approach will help insure that all aspects of the change are evaluated before it is incorporated. This will also emphasize AFSC intention to hold to specification baseline and discourage contractor use of his sustaining engineering force to market changes.

An appropriate program should be selected to test a leasing arrangement similar to the Navy's LEASESAT program. At the very least, AFSC should compare the cost of a leasing arrangement to the cost of the normal acquisition procedure. This could be used on a commercial derivative, such as a mission support or trainer aircraft, ground communication gear, or on a simulator.

It is important to consider, when planning new programs with potential high production volume and low to moderate initial investment, whether substantial savings could be made by keeping two or more firms in the

production phase to maintain competition throughout the program. Authorization to do so presently exists only under Title 10 USC 2304(a)(16), which authorizes negotiation of purchases in the interest of industrial mobilization. Authorization to purchase production items from two sources would maintain competition and could result in increased quality as well as reduced prices.

Clearly there are advantages to be gained by using commercial techniques when appropriate, but there are some cautions that must be observed. First, to gain the advantages of commercial buying some aspects of the commercial environment will have to be provided to the manufacturer. For example, configuration control may have to be left to the supplier so that he has the flexibility to correct deficiencies in a timely manner. Government involvement in Material Review Boards may have to be waived, and responsibility for government furnished components will have to be clearly established between the parties. Most importantly, commercial techniques are not appropriate when pushing the state-of-the-art, or when schedule is legitimately a priority concern.

Secondly, it must be recognized that there are some aspects of the Government environment that conflict with commercial practices, over which AFSC has little or no control. A few of these environmental factors are the annual appropriations process, the requirement for synopsis, the Truth in Negotiations Act, and the requirement to buy from the lowest responsive and responsible bidder. Business strategies must take into account the social and economic programs which are mandatory for Government buying, but which may conflict with sound commercial practices.

Thirdly, commercial warranties will not go very far toward preventing or resolving our product assurance problems. Generally they cover only materials and workmanship, for a specified time, and would have been of little value in the solution of the quality problems experienced in the last few years with AFSC programs. A notable exception is found in the case of commercial transport aircraft. Warranties for these aircraft do include a provision that permits design changes to correct problems. In other cases, commercial firms will correct design problems because of product liability, customer or consumer pressure, to assure future business, but not just because of their legal obligations under the written warranty.

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In summary, the contract document must be put in its proper perspective. It will not make an airplane fly or an engine run. Management attention to product assurance and properly defined specifications are the most important influences toward improved quality and reliability. Warranty clauses or other special contract provisions are only tools to assist in obtaining improved products. Still, the Command can, and should, improve its contracting techniques to emphasize commercial procedures, where they can be sensibly used. A handbook, published by AFSC, containing commercial techniques, including warranties, will facilitate compliance with AFSC policies and assist in the goal of better quality products at reasonable prices.

G. Motivation

Although the Quality Horizons' team looked at motivation techniques at various places visited and found few that have endured; the team did discover that many of the tools already available to AFSC are not being used to full advantage. In many cases, Systems Command policy already clearly indorses the motivation techniques discussed in this section. Detailed criteria and instructions, or better information, are needed to more effectively implement Command policy.

AFSC should place more emphasis on the withholding of progress payments when a contractor is not living up to his contract promises, and withhold acceptance of items that do not conform to contract requirements. Specific criteria should be established and promulgated through policy letters or regulations, as determined appropriate by AFSC/PM. There must be a clear demonstration to industry that AFSC will no longer permit quality to be subordinated to schedule. In competitive programs, consideration should be given to omission of the progress payments provision to encourage timely delivery of a quality product.

Programs should be selected to implement a limited time, failure free warranty provision which would allow for final acceptance of a product after 60 or 90 days of field use. The contractor would be responsible for correcting all failures during the warranty period prior to acceptance and payment. Such an approach would also have the built-in advantage of providing timely and accurate failure data for the contractor's analysis which would facilitate corrective action based on knowledge of the inherent failure modes.

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The cost of money to support this planned delay in payment would have to be recognized, but the use of the technique would increase the level of attention to product assurance and thus be a very worthwhile investment.

There is almost universal agreement in the U.S. defense industry that the award fee technique is effective as a motivator. Attention to product assurance disciplines in award fee plans will result in more effective and concentrated front end efforts. Award fee contracts are being used extensively, and this use should continue. Product assurance emphasis in award fee plans should be enhanced by the organizational changes recommended. The AFSC "Guide to Award Fee" should be modified to provide guidance in the use of award fees to achieve product assurance objectives.

Contractor rating or "experience" lists have been difficult to sustain in AFSC's acquisition environment, and past performance reports could not be used as an exclusive criteria in source selection. Such a system would, however, make the buying activity aware of potential problems and risks of doing business with a particular source. This information could be used in business strategy, source selection, and other related planning forums.

The rating system should also incorporate positive incentive aspects, for example, a program of recognition through publicity, and eventually through selective withdrawal of Government surveillance, for firms demonstrating a high level of attention to quality and sustaining a record of delivery of supplies conforming to all contract requirements.

Regarding motivation programs for individual workers, the Human Resources Laboratory (HRL) in coordination with union leaders, should evaluate the need for a general program that could be tailored by contractors to their individual requirements. If the need is validated, a program should be created and implemented, to encourage contractors to recognize and reward individual worker quality performance.

H.   Government Involvement/Surveillance

The various governmental approaches to contractor surveillance emphasize a disciplined, systematic program to assure that the contractor performs to contract

requirements and delivers an acceptable product. The FAA's approach emphasizes maximum attention on defining the requirements and ensuring that the contractor fully understands them. After the contractor develops an acceptable plan and verifies his capability to perform to it, the FAA reduces their presence in the contractor's plant to the minimum number of representatives required to monitor the contractor's compliance through statistical sampling techniques.

The Army (DARCOM) and the Navy (NAVMAT) also put their emphasis on developing thoroughly defined requirements early in the acquisition life cycle. Their product assurance approach ensures that design requirements are developed and the proper controls established by the contract administration offices. To perform these controls, the NAVPROs are currently implementing a reduced verification technique through their Quality Assessment Program to monitor contractors with fewer people. While the Army performs some of their own contract administration, they rely primarily on DCAS for this function. Both the Army and DLA use the quality assurance evaluation procedures contained in DLAM 8200.1 (similar to AFCMDR 74-1).

DCAS is presently testing their Contractor Assessment Program approach to assure contractor compliance to established Government program requirements. This approach requires the contractor to accept more responsibility for product quality by performing more of the assurance tasks that previously were accomplished by the Government Quality Assurance Representative (QAR). Although there is limited CAP data available, contractor and DCAS representatives in the test program maintain that CAP is effective in attaining product quality with minimum Government involvement.

AFCMD's contractor surveillance approach is implemented through the Contractor Management System Evaluation Program (CMSEP). AFPROs use CMSEP to verify contractor compliance to the aggregate of contract requirements at each plant established by various program offices through a management systems approach. AFPRO functional divisions are aligned parallel with the contractor's, and each division monitors that functional area for all contracts. This approach relies on condition questions (management system indicators) to verify the existence and adequacy of the contractor's written instructions, worker compliance with those instructions and product inspection. The QA function uses this approach for

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verification of both management and work instruction procedures. However, the verification effort of CMSEP is only as good as the specific product requirements established by each program office. More structured and disciplined procedures must be developed and implemented to establish contract technical requirements and assure the coordination of those requirements with the contract administration office. These procedures must assure the complete understanding of the technical requirements that need special attention due to criticality or risk by product assurance personnel at all levels. Data accumulation and reporting procedures must be improved to enhance communication between each product assurance organization. Individual "lessons learned" must be collected and disseminated to all organizations to prevent problems encountered and solved at one organization from occurring at another. New methods and procedures found effective at one organization should be made available to others for consideration. Each product assurance organization must accumulate the technical expertise necessary to support the program manager and engineering staff in assuring that the desired reliability, corrosion prevention, system safety, producibility, inspectability, standardization, and maintainability requirements are attained. Product assurance personnel must assure that trade-off studies are conducted. Assessments should be made in selected instances to verify contractor product assurance involvement in the internal design process. Emphasis should be directed toward the contractor's performance of product assurance tasks with Government review of the verification data.

The recommended approach to product assurance surveillance of the contractor's contract compliance is the Minimum In-Plant Surveillance (MIPS) Program. The purpose of MIPS is to shift the nature of plant-level activity away from conformance verification, toward prevention, and to reduce the overall depth of surveillance in line with contractor product assurance performance. Any decrease in surveillance must be based on objective data and on-site analysis to determine the degree of excellence sustained by the contractor. Guidelines for reducing conformance verification effort should be included in implementing directives. Procedures must also be developed for program office concurrence in MIPS evaluations. In addition, the contractor should be encouraged to make formal application for reduced Government surveillance. Special care must be taken to provide for a fair and equitable consideration of the contractor's application.

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The nucleus of the MIPS program should include:

   1.   Criteria that must be achieved for contractors to make application for reduction of Government surveillance.

   2.   The data and format the contractor's application should include.

   3.   The delegation of the approval of the contractor's application to the AFPRO and the program office product assurance representatives.

   4.   An appeal procedure that permits the contractor to request further review of a disapproved application by the AFCMD Commander and the Program Manager.

   The MIPS program incorporates the optimum mix of the various reduced surveillance programs observed by the Quality Horizons' Study Team such as the FAA's Quality Assurance System Analysis Review (QASAR) and Designated Manufacturer Inspection Representative (DMIR) programs and DLA's Contractor Assessment Program (CAP). The MIPS program also recognizes that detection of non-conformances and in-plant problems does not appear to be manning sensitive. In other words, nominal increases or decreases in CAO quality assurance personnel in-plant does not appear to result in a significant change in the number of nonconformances found by Government inspectors. There is an obvious decrease in nonconformance detections when manning is reduced below an unde-fined threshold level where the number of inspections actually performed is very low or zero. The MIPS pro-gram would also capitalize on the contractor's intrinsic motivation to achieve greater internal control of manufacturing and inspection operations through the relaxation of government verification activities.

   The product assurance representatives of the program office, the prime contractor and the AFPRO must assure that methods and procedures are developed for attaining adequate government surveillance at subcon-tractor's plants. The Government representatives at the subcontractor's plant must understand the extent and method of their involvement in support of the acquisition. Government source inspection require-ments must be mutually developed and included in formal Memorandums of Agreement (MOAs) or Letters of Instruction (LOIs).

There also must be a special effort to take advantage of new and improved quality technologies through the AF Laboratories. Procedures need to be developed that will promote the distribution of the new and improved techniques to all AFSC product assurance organizations. The AFSC quality technology (Q-TECH) program must complement the AFSC Man-Tech program. Some of the new or improved techniques may require the development of training courses to improve the capabilities of the personnel assigned to the product assurance organizations. If training is required, it should be developed and scheduled on a priority basis.

I.   Life Cycle Product Assurance

The interviews, studies, and analyses accomplished by the Quality Horizons Team convinced the members that certain actions are necessary to improve product quality and that quality will improve if these actions are taken.

Top management attention to quality, and the willingness to sacrifice schedule to achieve it, is a must. A disciplined approach to planning, utilizing the assurance disciplines, is common to all successful programs. Also common to many organizations, both commercial and government, is the trend toward organizational change to recognize the interrelated aspects of the assurance disciplines and give them the potency of an integrated, top level organization. The combined effect of the foregoing is a front end emphasis on quality that may not eliminate, but will minimize, surprises in the field environment.

Contracting techniques need to be improved. There are commercial techniques that should be used in more AFSC procurements. Improvements in business strategy planning, in the direction of product assurance, should be made. A better job of motivating the producer can and should be done, both through contractual provisions and other programs.

As the recommended programs begin to take hold, and reduced government surveillance becomes possible, additional manpower can be applied to the front end efforts to increase quality, and the program will gain momentum toward the proper balance of product assurance throughout the life cycle. Only through continuous involvement throughout the life cycle can AFSC assure the delivery of top quality products to the using commands.

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Figure 10 lists the major systems acquisition tasks to be performed by the new product assurance organization and illustrates when these tasks should be performed in the life cycle. This Figure is not intended to be all inclusive nor totally precise. Further refinements will have to be made after the new organization is established. However, the intent is to show that HQ AFSC must orchestrate a systematic life cycle approach to make the concept viable.

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LIFE CYCLE PRODUCT ASSURANCE PROGRAM REQUIREMENTS

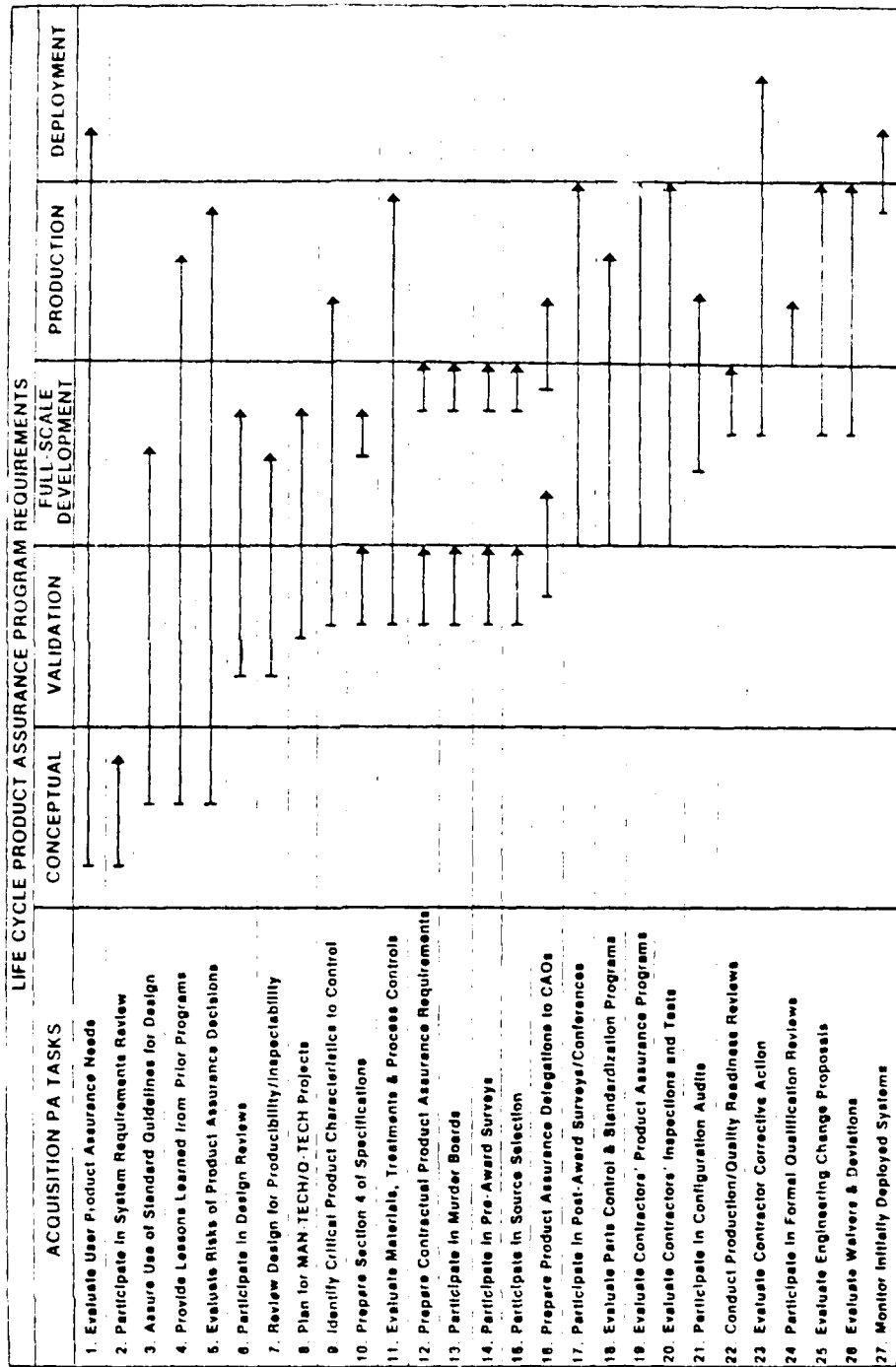| ACQUISITION PA TASKS	CONCEPTUAL	VALIDATION	FULL-SCALE DEVELOPMENT	PRODUCTION	DEPLOYMENT
1. Evaluate User Product Assurance Needs					
2. Participate in System Requirements Review					
3. Assure Use of Standard Guidelines for Design					
4. Provide Lessons Learned from Prior Programs					
5. Evaluate Risks of Product Assurance Decisions					
6. Participate in Design Reviews					
7. Review Design for Producibility/Inspectability					
8. Plan for MAN-TECH/O-TECH Projects					
9. Identify Critical Product Characteristics to Control					
10. Prepare Section 4 of Specifications					
11. Evaluate Materials, Treatments & Process Controls					
12. Prepare Contractual Product Assurance Requirements					
13. Participate in Murder Boards					
14. Participate in Pre-Award Surveys					
15. Participate in Source Selection					
16. Prepare Product Assurance Delegations to CAOs					
17. Participate in Post-Award Surveys/Conferences					
18. Evaluate Parts Control & Standardization Programs					
19. Evaluate Contractors' Product Assurance Programs					
20. Evaluate Contractors' Inspections and Tests					
21. Participate in Configuration Audits					
22. Conduct Production/Quality Readiness Reviews					
23. Evaluate Contractor Corrective Action					
24. Participate in Formal Qualification Reviews					
25. Evaluate Engineering Change Proposals					
26. Evaluate Waivers & Deviations					
27. Monitor Initially Deployed Systems					

FIGURE 10

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VI. IMPLEMENTATION

Many of the industry executives interviewed by the Quality Horizons Study Team expressed an attitude that things will not change in the government contracting arena. While they were supportive of the study objectives, they did express concern that the findings would not be accepted nor the recommendations implemented. They felt that the team would not be able to generate enough emphasis to overcome the inertia of the bureaucracy. Therefore, it is most important that AFSC/CC implement selected changes and give those changes the widest possible publicity, perhaps through a video tape discussion. This would be a positive motivator, not only for product assurance, but for other AFSC initiatives. In addition, a letter should be sent to the field commanders to implement the product assurance program, and emphasize that schedule may be traded-off for quality, reliability and/or user needs.

The Quality Horizons Report identifies new and revitalized approaches to enhance the product assurance of hardware in the hands of the user. Essential to the successful outcome of many of these recommendations will be the continuous implementation, tracking and follow-up of the action line items presented in Appendix I (Action Plan) of this report. Following the consideration of these recommendations by the AFSC Council, and selection of those to be implemented by the Commander, it is recommended that a General Officer Steering Group (GOSG) be formed including both field and Headquarters members, to meet and track progress on a quarterly basis for the first year and semi-annually thereafter. The Commander, AFSC should be given progress reports within 15 days after each GOSG meeting.

It is recommended that this joint GOSG be made up of persons occupying the following positions:

a. AFSC/CV (Chairman)

b. DCS/Systems, Hq. AFSC

c. DCS/Contracting and Manufacturing, Hq. AFSC

d. Commander, AFCMD

e. A Program Manager from a major weapons system program to be selected by AFSC/CC.

The Chief of the Quality Assurance Office,
Hq AFSC (PMN) will function as the permanent secretariat
and recorder for this GOSG, and a member of the Quality
Horizons Study Team should serve as an advisor.

To continue the line of communication with
representatives of key industrial associations, it is
recommended that a representative from the National
Security Industries Association and one from the Aero-
space Industries Association be designated as advisors
to this group and participate in appropriate sessions.
It is further recommended that one of these representa-
tives have a strong background in Product Assurance and
the other in the Contracts area.

APPENDICES

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APPENDIX   1

ACTION PLAN

QUALITY PLANNING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION*
1.1	Product Assurance Regulation	Develop a composite AFSC Regulation that defines the integrated tasks and inter-relationships among the functional disciplines required to implement the product assurance concept and stress preventive efforts early in design rather than through emphasis or conformance inspection during production.	V.B.	AFSC/SD	AFSC/PM	6 months
1.2	Corporate Memory Handbooks	Develop AFSC handbooks that provide specific guidance for tailoring and applying the available tools and techniques in each of the functional disciplines listed below. This guidance will include the benefits provided by these tools and techniques as well as the risk of omitting them and cost trade-off guidance. The OPRs will act as command focal points in assuring that lessons learned are incorporated in revisions.

Quality Assurance
Reliability
Maintainability
System Design Safety
Corrosion Prevention
Manufacturing
Standardization | V.B. | AFCMD/QA
ESD/RADC
ASD/EN
ASD/SE
AFML
ASD/PM
SAMSO/LG | ESD/TO
SAMSO/MN
ADTC/SD
ADTC/SE
ASD/EN
ESD/TO
ASD/AM | 9 months
9 months
9 months
9 months
9 months
9 months
9 months |

*After action item approval by AFSC/CC

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ACTION PLAN (Continued)

GOVERNMENT INVOLVEMENT/SURVEILLANCE

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
2.1	Introduction to Product Assurance	Develop a briefing to present the concept of Product Assurance to AFSC Product Divisions, AFCMD, HQ DLA and NAVMAT. Briefing to include definition of Product Assurance, Quality Horizons Observations, and approved recommendations; e.g. MIPS. Emphasize prevention tasks by Program Office and specific support required of CAO, and the interrelationships between these organizations.	V.B.	AFSC/PM	AFSC/SD	5 months
2.2	Introduction to Product Assurance	Present the briefing.	V.B.	AFSC/PM	AFSC/SD	12 months
2.3	Minimum In-Plant Surveillance Program	Develop an AFSC regulation to establish the MIPS Program. The program will provide criteria and procedures for contractors to apply for reduced in-plant surveillance by supplying objective data of sustained quality performance. AFPRs/SPOs will have approval authority. Contractors may escalate adverse decisions to AFCMD/CC and program managers.	V.H	AFSC/PM	AFCMD/QA	6 months
2.4	Minimum In-Plant Surveillance Program	Implement program by AFSC/CC letter to contractor top management to motivate contractor to apply for MIPS.	V.H.	AFSC/PM	AFCMD/QA	7 months

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ACTION PLAN (Continued)

ORGANIZATION

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
3.1	Product Assurance Organization	Combine product assurance disciplines (e.g. reliability, maintainability, quality, corrosion control, standardization, system safety, manufacturing) into one separate staff organization at HQ AFSC, AFCMD, AFPROs, Product Divisions and Program Offices. The new organization is to report to the Commander. Revise organization and functions documents and applicable position descriptions.	V.C	AFSC/MO	AFSC/PM	6 months
3.2	Alternate Product Assurance Organization	If the above action is not supported implement two phased reorganization. Phase I - Combine product assurance disciplines at HQ AFSC to gain field attention and emphasize the need for enhanced product quality through design efforts. Withhold further implementation pending evaluation as to whether reorganization at field activities is necessary to achieve the proper attention to product assurance and to institutionalize concept. Phase II - Combine disciplines at Product Divisions/AFCMD as determined by evaluation results of Phase I.	V.C.	AFSC/MO	AFSC/PM	Phase I 6 months Phase II 18 months

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ACTION PLAN (Continued)

MANNING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
4.1	Initial Manning for Product Assurance	Identify AFSC manpower performing product assurance functions. Transfer manpower to new organization at HQ AFSC, AFCMD, APROs, Product Divisions and Program Offices if Action Item 3.1 is approved. If Action Item 3.2 is approved transfer manpower at HQ AFSC only. Transfer manpower at other organizations based upon evaluation and decision reached as a result of Action Item 3.2.	V.D.	AFSC/MO	AFSC/DP	6 months if Action Item 3.1 is approved. 6 months for HQ AFSC if Action Item 3.2 is approved and 18 months for other organizations.
4.2	Policy Statement on Contracting-Out	Issue Policy Statement to encourage contracting-out for those product assurance skills not available in AFSC.	V.D.	AFSC/PM	AFSC/JA/MO	8 months
4.3	Re-allocation Study	Study Product Assurance manning levels and tasks to determine optimum levels of manning at HQ AFSC, Product Divisions, and AFCMD.	V.D.	AFSC PMAG	AFSC/MO	9 months
4.4	Personnel Transfer Plan	Develop and implement plan to transfer personnel to achieve optimum manning levels in accordance with Action Item 4.3.	V.D.	AFSC/DP	AFSC/PM	8 months develop plan. 18 months to complete implementation.

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ACTION PLAN (Continued)

EDUCATION/TRAINING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
5.1	Intern Program	Develop, provide manpower for and implement a formal intern program to provide continual source of qualified personnel. Program to provide 3 years of formal and on-the-job training and output a minimum of 25 graduates per year.	V.E.	AFSC/DP	AFSC/SD/PM	10 months
5.2	Educational Levels	Determine the educational level of the contractor's product assurance organization where there is an AFPRO. Establish a goal of educational comparability between AFPRO and contractor. Develop plan to achieve this goal.	V.E.	AFCMD/QA	AFSC/PM	9 months
5.3	Workforce Training	Determine skills necessary to accomplish product assurance functions. Inventory skills existing in workforce. Develop and implement formal training program to upgrade and maintain required skills.	V.E.	AFSC/DP	AFSC/PM	6 months
5.4	Contracting-Out Training	Evaluate training programs and capabilities available within DoD and contract-out for those which are unavailable.	V.E.	AFSC/DP	AFSC/PM	9 months

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ACTION PLAN (Continued)

EDUCATION/TRAINING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
5.5	Top Management Training	Assure that Product Assurance Training is included in Professional Military Education programs and other executive courses. Training objectives to emphasize Product Assurance benefits and risks due to omission of Product Assurance tasks.	V.E.	AFSC/DP	AFSC/PM	9 months
5.6	Education With Industry (EWI)	Study the benefits of establishing an EWI pprogram for both civilian and military personnel in product assurance and consider expanding the total EWI program to include civilians. Establish program if warranted.	V.E.	AFSC/DP	AFIT/CI	18 months
5.7	Civilian Career Program	Develop an AFSC regulation to establish a product assurance career program to provide for career counseling, appraisal and progression (similar to the Procurement and Manufacturing Civilian Career Development Program, AFSCR 50-5).	V.E.	AFSC/PM	AFSC/DP	12 months

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ACTION PLAN (Continued)

CONTRACTING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
6.1	"Changes" Clause	To further support and emphasize AFSC/CC policy regarding baselining, prepare a modified "Changes" Article, omitting the unilateral right to make changes. Obtain ASPR deviation to permit trial use. Include modified clause in selected contract(s) to emphasize government intention to hold to specification baseline and discourage contractor use of sustaining engineering force to market changes.	V.F.	AFSC/PM	AFSC/JA	7 months
6.2	Field Acceptance	Develop provisions for equipment acceptance at the operating location after field use - i.e. 30, 60, or 90 days. A short term failure free warranty to assure operational suitability. Select candidate programs and implement.	V.G.	AFSC/PM	AFSC/JA	12 months
6.3	Progress Payments Omission	Select competitive programs at each Product Division for omission of Progress Payments clause. Omit clause in selected programs to encourage timely delivery of quality products.	V.G.	AFSC/PM	AFSC/JA	8 months
6.4	Progress Payment Withholding	Establish criteria for withholding of Progress Payments with emphasis on Product Assurance problems, and publish as AFSC policy.	V.G.	AFSC/PM	AFSC/JA	4 months

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ACTION PLAN (Continued)

CONTRACTING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
6.5	Dual Sourcing	Establish criteria for programs with potential savings if production dual sourced; such as high volume items requiring low to moderate capital investment. Select candidate programs and request SAFGC/SAFAL interpretation for negotiation authority (other than 10 USC 2304(a)(16) (Industrial Mobilization) to continue at least two sources into production. Implement program.	V.F.	AFSC/PM	AFSC/JA	10 months
6.6	Motivation Program	Evaluate the need for and develop in co-ordination with union leaders and Human Resources Lab, an umbrella motivation program that could be tailored by contractors to their individual requirements. Contractors would be encouraged to recognize and reward worker quality performance.	V.G.	HRL	AFSC/PM AFCMD	15 months
6.7	Award Fee	Develop Award Fee policy to recognize Product Assurance as an element of Award Fee plans. Modify AFSC "Guide to Award Fee", PMPS, Dec 77, to include specific examples for the use of Award Fees to motivate enhanced product quality throughout the acquisition cycle.	V.G.	SAMSO/PM	ASD/PM	3 months

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ACTION PLAN (Continued)

CONTRACTING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
6.8	Leasing	Select candidate programs where commercial leasing techniques or lease-purchase arrangements would be appropriate (i.e. simulators, trainer aircraft, etc.). Implement the program; collect and publish lessons learned.	V.F.	AFSC/PM	AFSC/JA	12 months
6.9	Commercial Warranties/ Practices	Prepare handbook containing commercial contracting techniques, negotiation strategy and tactics, and criteria for application of the clauses, warranties and techniques. Purpose of the handbook is to facilitate proper use of commercial techniques and to promote, with specifics, current AFSC policy.	V.F.	ASD/PM	AFSC/PM	6 months
6.10	Business Strategy	Revise AFSCR 70-2 to define Product Assurance considerations so that AFSC can capitalize on commercial approaches to enhance product quality early in the acquisition phase.	V.F.	AFSC/PM	AFSC/SD	4 months

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ACTION PLAN (Continued)

TOP MANAGEMENT ATTENTION

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
7.1	Management Emphasis	Include emphasis on product assurance objectives to industry/AFSC top management in next AFSC/CC video tape.	VI.	AFSC/PM	AFSC/OI	9 months
7.2	Management Emphasis	Prepare and distribute AFSC/CC letter to all AFSC field commanders to implement product assurance program and emphasize willingness to trade-off schedule for quality, reliability and customer satisfaction.	VI.	AFSC/PM	AFSC/CS	2 months
7.3	Management Appreciation of Product Assurance Approach	Develop training program and present to top management in all organizations. Training objectives to emphasize product assurance benefits and risks due to omission of product assurance tasks.	V.E.	AFSC/DP	AFSC/PM	12 months
7.4	Program Reviews	Revise AFSCR 800-23 to have Program Managers/AFPRs present product assurance status (accomplishments and problem areas) during PAR/CAR briefings.	V.B.	AFSC/SD	AFSC/PM	6 months
7.5	Program Reviews	Develop and distribute policy guidance using applicable data items and military standards to require contractor presentation of product assurance status during program technical and management reviews.	V.B.	AFSC/SD	AFSC/PM	6 months

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ACTION PLAN (Continued)

MISCELLANEOUS

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
8.1	General Officer Steering Group (GOSG)	Establish a General Officer Steering Group consisting of representatives from HQ AFSC, Product Divisions and AFCMD to provide a balanced view toward Product Assurance. The GOSG will provide direction and track the Quality Horizons Study recommendations selected for implementation by the AFSC/CC.	VI.	AFSC/CS	AFSC/PM	2 months
8.2	Data Systems Guidance	Develop AFSC pamphlet to enhance the use of the product assurance data available in existing Air Force data collection systems e.g. AFM 66-1 data by the program offices and contractors. The pamphlet should identify the type of data, strengths and weaknesses, and the method of obtaining the data in each system.	V.H.	AFSC/SD	SAMSO/MN	10 months
8.3	Quality Technology (Q-TECH)	Establish guidelines for prioritizing Q-TECH projects and funding to assure that Q-TECH remains parallel and abreast of the Manufacturing Technology Program. Disseminate results of Q-TECH projects throughout AFSC.	V.R.	AFSC/PM	AFSC/DL	18 months

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ACTION PLAN (Continued)

MISCELLANEOUS

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
8.4	Quality Technology (Q-TECH)	Develop training programs to assure that product assurance personnel remain current with emerging quality technologies.	V.B.	AFSC/DP	AFSC/PM	18 months
8.5	DLA Liaison Offices	In consonance with DLA, establish DLA liaison offices at each Product Division to facilitate communications, problem resolution, and emphasize Product Assurance in design and development phases.	V.C.	AFSC/PM	ESD/TO	12 months

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APPENDIX 2

QUALITY HORIZONS
STUDY APPROACH

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STUDY OBJECTIVES

- EVALUATE AFSC APPROACH TO QA

- IDENTIFY CHANGES WITH POTENTIAL TO:

  - IMPROVE END ITEM QUALITY

  - MAKE CONTRACTORS MORE RESPONSIBLE FOR THEIR PRODUCTS

  - MAKE MORE EFFECTIVE USE OF RESOURCES

  - APPLY APPROPRIATE COMMERCIAL PRACTICES

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CURRENT CONCERNS

- CURRENT TECHNIQUES

  - LITTLE CHANGE IN 20 YEARS
  - AF IN-PLANT PRESENCE HIGH
  - LACK OF STRONG POSITIVE/NEGATIVE INCENTIVES
  - LITTLE APPLICATION OF PROVEN COMMERCIAL PRACTICES

- AFSC QA WORK FORCE

  - NUMEROUS RETIREMENTS PENDING
  - LIMITED EDUCATION
  - NOT KEEPING PACE WITH NEW TECHNOLOGY

- AFSC QA SYSTEM

  - PERHAPS EMPHASIS IN WRONG PLACES—AF INSPECTION NOT ALWAYS THE ANSWER
  - AFSC MANAGEMENT ATTENTION TO QA VARIES
  - LIMITED APPLICATION OF LESSONS LEARNED

KEY STUDY AREAS

● EXAMINE WAYS TO EFFECTIVELY INCENTIVISE CONTRACTORS FOR A BETTER PRODUCT

- BETTER APPLICATION OF CURRENT TOOLS
- COMMERCIAL PRIME/VENDOR RELATIONSHIPS
- RFP, SPECIFICATIONS, PAST PERFORMANCE
- AWARD FEE, WITHHOLD PAYMENTS

● EXAMINE WAYS TO RESTRUCTURE AF IN-PLANT QA PRESENCE

- CERTIFICATION PROGRAM
- COMMERCIAL PRACTICES—FOREIGN & DOMESTIC
- DLA, FAA, NASA, FOREIGN GOVT EXPERIENCE

● EVALUATE CURRENT QA WORK FORCE AND IDENTIFY NECESSARY CHANGES

- EDUCATION/TRAINING
- RECRUITMENT
- NUMBERS AND SKILLS REQUIRED

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KEY STUDY AREAS (CONT'D)

- IDENTIFY REQUIRED POLICY AND ORGANIZATION CHANGES

  - CONTRACT POLICY/MANAGEMENT

  - ROLES OF HQ AFSC, HQ AFCMD, PRODUCT DIVISIONS, IN-PLANT OFFICES AND SPOs

  - PERSONNEL REQUIREMENTS/EDUCATION

  - PRODUCT ASSURANCE (QA + ILITIES) OFFICE

  - AFSC MANAGEMENT ATTENTION TO QA

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STUDY ACTIVITIES

- REVIEW PREVIOUS STUDIES AND RECOMMENDATIONS

- VISIT OTHER GOVERNMENT AGENCIES SUCH AS NASA, FAA, DLA, NAVY, ARMY, DOD AND DEFENSE DEPARTMENTS OF GERMANY, NORWAY AND JAPAN FOR IDEAS

- VISIT COMMERCIAL FIRMS IN U.S., EUROPE AND JAPAN IN AUTO, ELECTRONIC, AIRCRAFT, AND OTHER INDUSTRIES TO EXAMINE COMMERCIAL AND CONTRACTUAL PRACTICE/TECHNIQUES

- VISIT DEFENSE AND COMMERCIAL SUBCONTRACTORS TO UNDERSTAND QA INSTRUCTION AND CONTRACTUAL RELATIONSHIPS WITH PRIMES

- VISIT AFIT AND AMETA TO DEVELOP QA EDUCATION PROGRAMS

- UTILIZE INDUSTRIAL ASSOCIATIONS AS A SOUNDING BOARD FOR CONCLUSIONS AND RECOMMENDATIONS

- OBTAIN PRODUCT DIVISION AND AFCMD COMMANDERS' INPUTS ON RECOMMENDATIONS PRIOR TO PRESENTATION TO COMMANDER, AFSC

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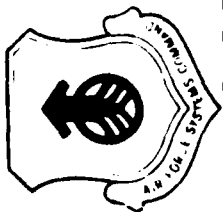
STUDY TEAM

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SECRETARIAT: CAPT RAYMOND R. HONAKER, ASD/PMD
CAPT JOHN McNALLY, ASD/PMD

ADVISORS

CONTRACT LAW: CAPT C. B. GRESHAM, AFLC/JAN

INDUSTRIAL FEEDBACK: NSIA/AIA COMMITTEES ON QUALITY AND CONTRACTS

QA OPERATING OFFICIALS ADVICE: PRODUCT DIVISION QA DIRECTORS

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