THE ROLE OF THE U. S. ARMY NATICK LABORATORIES IN DEFENSE OPERATIONS

Proceedings of a Conference from Research to Technical Data Package

17 April 1969

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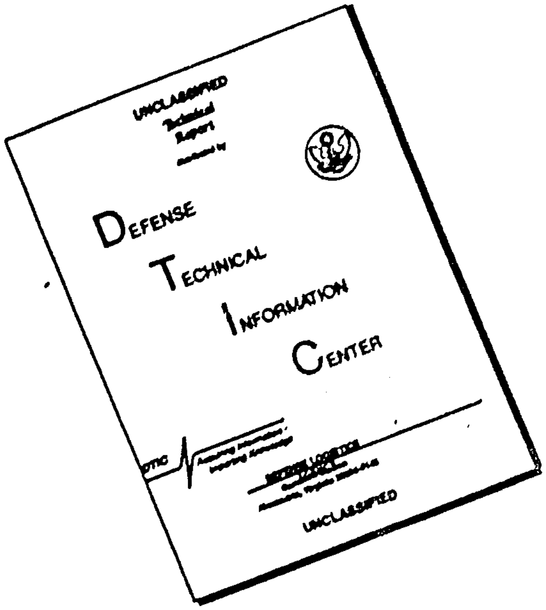

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TECHNICAL REPORT
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THE ROLE OF THE U. S. ARMY NATICK LABORATORIES IN DEFENSE OPERATIONS

Proceedings of a Conference
From Research to Technical Data Package
17 April 1969

June 1969

Quality Assurance Office
U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts 01760

INTRODUCTION

The function of the U. S. Army Natick Laboratories in defense operations was the theme of this conference held at Natick on 17 April 1969, with the end product of NLABS' efforts - the Technical Data Package - receiving special emphasis.

The purpose of the conference was to inform NLABS mission program participants of the critical interdependence of all technical programs and to demonstrate how their cumulative efforts fill the role of these Laboratories in defense operations.

Laboratory directors, an associate laboratory director and the head of one division within a laboratory presented instructional briefings on their technical operations. The interrelationship of each technical effort from basic research to specification writing was offered as the connecting link from which sound technical programs lead to equally successful data packages.

Briefings on the management aspects of the DOD Standardization and Item Entry Control Programs were presented by representatives from the Office of the Assistant Secretary of Defense (I&L).

Acknowledgement is gratefully extended to the U. S. Army's Natick Laboratories Training Committee for its efforts in promoting this conference and for the assistance in the many details that accompany most meetings.

GERALD C. MacDONALD
Chairman
U. S. Army Natick Laboratories Conference

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ABSTRACT

The role of the US Army Natick Laboratories in Defense Operations was defined during proceedings of a conference which covered the steps leading From Research to Technical Data Package. The conference was held on 17 April 1969.

The subjects presented included presentations on the Department of Defense Standardization Program Management.

The mission of the Army's Natick (Mass.) Laboratories - from research to technical data package - was described as the end product of science, engineering, technical services - the fusing of all skill levels and interests. Areas covered which contribute to the preparation of the technical data package for which the Natick Laboratories is responsible included specifications for clothing and textiles, earth science research in military applications, airdrop engineering, basic research, general equipment and packaging, and rations research.

WELCOMING REMARKS

Brigadier General Felix J. Gerace
Commanding General, US Army Natick Laboratories

It is my pleasure this morning to welcome both our visitors and our local personnel to this experiment in interdisciplinary research.

Tech data packages, the end result of science, engineering and technical and business arts, are built at these Laboratories by commodity organizations acting almost wholly independent one from the other. The quality of these packages can be improved when all available skills are called upon to contribute. Because communication of information between skill levels and interests does not occur spontaneously, a way must be found to establish and operate these necessary lines of communication.

Today's conference is an experiment in communication. It is based on the work of the Natick Laboratories Training Committee, and particular credit is due Bill Held, Dick Elwell, Bob Kuder, Herb Hollender and Ken Dobelbower who formulated the initial plans. I know that an experiment of this type is critically dependent on audience participation. I encourage each of you, visitor and employee alike, to join in discussions with the speakers to insure the success of this conference.

CONFERENCE OBJECTIVE AND BACKGROUND INFORMATION

James H. Flanagan
Deputy Scientific Director for Engineering

General Gerace, distinguished visitors, and fellow laborers. This conference is for the purpose of telling it like it is. Lest anyone think that I have found a way to cross over to the other side - of the generation gap - let me say that if a la-bor-atory isn't a place for laboring, then people haven't been telling it like it is, and the gap is in fact a chasm.

We all labor here; each in his own specialty, each according to his own skills, and each is motivated in his own private way. Our specialties, our skills, and our motivations are not what we are really here to discuss; rather, our subject is this Laboratory which as an entity produces a primary product. That product is the tech data package.

A tech data package is the technical element of a supply procurement package. It is a technical description of the item wanted and is a critical element of the procurement package. Without it most military supplies could not be bought under the laws of this country. The package itself is simple. It consists only of words, numbers, and pictures; however, decisions must be made as to which words, which numbers, and which pictures are to be used. Those decisions are what our labors are all about. Every effort we make can contribute to those decisions. Those efforts must contribute if we are to produce a superior product.

I will now show several figures to quickly reacquaint you with the organizational position of these Laboratories, the job we are built to do, the production lines we work on, the way we assemble and deliver our product, the agencies who use it, and conclude by asking for your help in solving a crucial problem of today and the immediate future.

In Figure 1, NLABS is shown at the lower left as one of several R&D laboratories supporting all of AMC. In fact, however, we operate as a full service laboratory in support of a non-existent commodity command, something like the R&D complexes that support the commodity commands shown in the center of the figure.

Figure 2 is a block diagram of the Laboratory. It's a "gozinta" and "comesouta" circuit. Requirements, both formal, such as qualitative materiel development objectives and qualitative material requirements and less formal, here lumped and called spontaneous, are the inputs to the black box. The output is supply procurement support. The laboratory directors who will speak during this conference will, by example, show how the circuit operates within the black box; how the left half which is the hardware side, and the right half which is the soft or information side, exchange, modulate, amplify, and complement each other to produce the output.

A summary of the separate production lines in conventional terms is shown in Figure 3. It is not complete. It is biased, but only because it was originally used for a prior purpose and not redone for today. The words art and science are missing from the title. My reason for not changing it was to give me the opportunity to say that the word engineering should describe the way in which we work and not be used in the classical sense of what is performed. Not so very long ago, there were practitioners of the medical arts and today there are medical doctors. The situation in engineering is analagous; however, engineering is still changing and I believe that in time the profession will include food and clothing as it now does machines and bridges.

Figure 4 shown our specific production programs. The right half describes in conventional terms the comptroller jargon shown on the left. The research programs 6.1 and 6.2 are shown at the bottom because they should serve as the foundation on which all else is built.

Figure 5 is again a block diagram. The circuit shows the flow of tech data packages from the producing laboratories at the top center to the using procurement agencies on the three rows immediately below. Approximately 80% of the packages are used at the DSA row, 15% by the Army Centers shown on the next row below, and the remaining 5% by the Post Office and GSA as examples.

ORGANIZATIONAL POSITION of NLABS in AMC

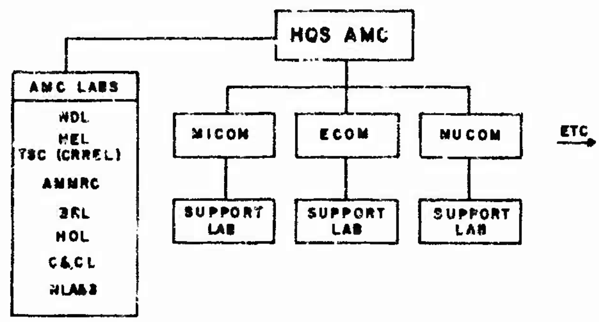


Figure 1

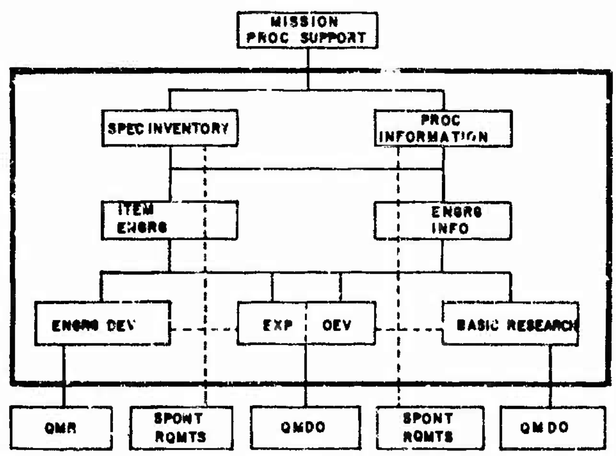


Figure 2

ENGINEERING AT NLABS

MAINTENANCE of a 3,000 procurement document inventory - *Standardization.*

IMPROVEMENT of items in the inventory — *Production Engineering.*

ADDITION of new items to the inventory — *Engineering Development.*

CREATION and perfection of principles and processes in support of design — *Exploratory Development.*

Figure 3

5-6

ELEMENTS of TECH DATA PKS & ENGINEERING SUPPORT PROGRAMS AT NLABS

BP		
2210.3	STANDARDIZATION	SPECS, PDs, STUDIES etc
2210.8	AE	PROD ENGRG / PRODUCT IMPROVEMENT
4700/4900	PEMA ENGRG	
5400/5600 (6.41)	ENGRG DEV	NEW ITEMS & DESIGNS
5400/5600 (6.21)	EXPL DEV	NEW DESIGNS/PRINCIPLES
5000 (6.11)	BASIC RES	PRINCIPLES/RATIONALE

Figure 4

TECHNICAL DATA PACKAGE - INPUT - OUTPUT

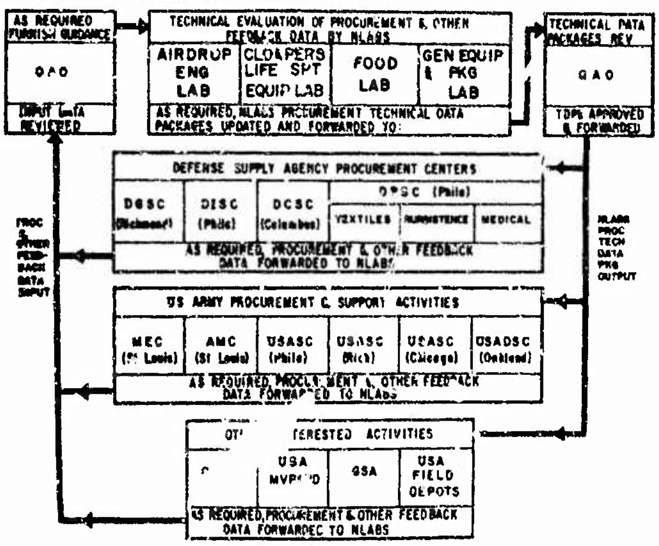


Figure 5

The PROBLEM - PEOPLE

Adapting the old artisans to the new technology

Adapting the new technologists to the old arts.

Figure 6

The problem is given in Figure 6. You are all aware of it and particularly of the first situation cited. I call your attention, however, to the second statement. We have as our mission, the solution of some of the most difficult and most satisfying problems known to man. Young people just now coming from our universities must be challenged and motivated by these problems. Unless we challenge and motivate them, production of superior tech data packages based on the integration of all levels of available technical skills will stop. We must evolve a solution or disappear as another of Darwin's victims. This is what the generation gap is all about.

DEFENSE STANDARDIZATION PROGRAM MANAGEMENT

CPT J. P. Carr, JR., USNR

I have been asked to talk to you today on the management aspects involved in the Defense Standardization Program. My guess is that I am here because I am the Staff Director of the Standardization and Specification Management Division within the Directorate for Technical Data, Standardization Policy and Quality Assurance. That Directorate is lodged within the Office of the Assistant Secretary of Defense for Installations and Logistics and reports directly to the Deputy Assistant Secretary of Defense for Logistics Management Systems and Programs. We have the overall management responsibility for the Defense Standardization Program. This discussion of that responsibility and all of its evolved policies is directed at providing an insight and an appreciation for the program to those of you involved in the workings of Research and Development.

You might wonder at this point why a man from I&L is asked to talk to R&D people. My location in I&L is only an accident of organization. The fact that standardization is really a discipline exercised across the full gamut of DoD interest - operational requirement to disposal - is recognized by lodging overall policy responsibility in the Technical Data & Standardization Policy Council. The Council is co-chaired by the Assistant Secretary of Defense (I&L) and Director, Defense Research and Engineering, and consists of the Military Department Assistant Secretaries for I&L and R&D as well as the Director, Defense Supply Agency.

To begin the discussion, let me first state the objectives of the Standardization Program. They are: the improvement of operational readiness of the Military Services; the conservation of money, manpower, time, facilities, and natural resources; the minimizing of the variety of items, processes and practices; and the enhancing of interchangeability, reliability and maintainability of military equipments and supplies. We seek to achieve these objectives through management and engineering actions required to establish and effectively implement standardization agreements and decisions; by establishing and maintaining uniform and technically adequate records of the engineering definition of equipment and supplies; by promoting the re-use of records of engineering definitions in support of procurement, maintenance, supply and future design; and by prescribing the format and procedures for coordination, quality of documentation and procedures for collating and disseminating specifications, standards, drawings and other standardization associated documentation.

Most of what I have just said is taken directly from DoD Directive 4120.3 and those of you involved in the business, I'm sure, have heard or read these words on many occasions. Now let's get down to the basic meaning of the words and the dirty-gritty of getting the job done.

We have, through our directives, instructions, policies and procedures, sought to develop, establish and maintain a comprehensive and integrated system of technical documents in the support of design, development, engineering, procurement, manufacturing, maintenance and supply. Effective standardization must operate through the performance of these related functions. In this connection, it is important that we address the remaining part of this discussion to the standardization project, its purpose and goal, its planning and programming, and finally, its accomplishment and benefit.

When we speak of a standardization project, we are talking about a programmed action motivated by a functional requirement and terminated in a specification, a standard, a handbook, or a report of study. For example, the engineering community determining a need for the documentation of standard test procedures provides the impetus for a standardization project that ultimately results in a coordinated Book Form Military Standard or as it is commonly referred to, a MIL-STD. Similarly, supply management may determine a need for a simplification study which results in reducing the variety of items already stocked, stored and issued. How does all this come about? And what are the mechanics and channels for communicating needs?

First, the Office of the Secretary of Defense in January of each year issues the Standardization Program Guidance. This guidance is a compilation of functional input from all OSD program directors and contains the technical and administrative instructions to be used by all levels of participation in the Standardization Program. It provides goals and priorities for the overall effort; it cites important work areas, objectives, and in some cases provides specific project direction. It is intended primarily to assist standardization activities such as Assignees, Assignee Activities and Preparing Activities in the development and updating of the Defense Standardization Program as applied to their own commodity interest and also to provide to the planners, an insight regarding the attitude and objectives of the OSD functional managers. Coordination of the program guidance is effected at the Assignee level only to assure that the technical objectives are within the feasible range of accomplishment. In short, it provides Standardization Assignee Activities with the broad goals and objectives, priority of projects, and special instructions pertinent to specific functional areas, all of which are vital to planning and effectively managing a successful program.

Simultaneous with the issuance of Standardization Program Guidance is the development of technical standardization plans which are referred to as Program Analyses. These are developed annually by Standardization Assignee Activities in coordination with their counterpart Participating Activities, and identify work required in the FSC area of assignment. The Program Analysis provides a narrative evaluation of the condition of the

Federal Supply Class from a standardization viewpoint and a summary of the work required to be accomplished to achieve a practical degree of standardization. When conditions exist that preclude achievement of a higher degree of standardization, a recommended course of action necessary to overcome the restrictions and to improve the situation, should be included. The Program Analysis covers a five-year period and is updated on a yearly basis. Although we have never anticipated radical changes in goals and objectives from year to year, the updating of the Program Analysis is a decided opportunity for the injection of new ideas, approaches and techniques so vital to the success of the overall program.

In the preparation of the Program Analysis the four categories, upon which the Standardization Program Guidance is based, are used as the means to describe the degree of standardization both feasible and desirable. Those four categories are: (a) direct support of procurement; (b) support of engineering development and production; (c) support of supply management; and (d) support of other related activities. Simply stated, procurement difficulties may dictate specification coverage necessary to achieve unrestricted competitive procurement; or engineering problems may call for provision of a standard for use in design of all new equipment and systems. In short, a Program Analysis for a given Federal Supply Class is a technical evaluation of that class. It sets forth the engineering problems which require solution, identifies the potential for achieving standardization and identifies, by function, the new segments of work which are to be included in the Program. It sets a goal, within practical limits, consistent with the aim of the Defense Standardization Program.

The principal source document for collecting data for use in the management of the standardization effort is the Standardization Project Report (DD Form 1585). The report currently is being submitted only by preparing activities to OSD, but it is circulated in hard copy to other interested activities. This report is prepared by the Preparing Activity for a project and provides the pertinent project planning information to other interested activities. The report provides project data relative to identification, management, status (both scheduled and actual), custodians, and manpower (both committed and expended). The reports are used to schedule projects and to report changes in the status of projects.

Data obtained by processing standardization project reports are compiled annually and quarterly. These data for each Federal Supply Classification (FSC) Class reflect the efforts by project to achieve the goals and objectives in the coordinated Program Analysis for the FSC class.

Preparing activities coordinate standardization projects with designated custodians of other departments and agencies within the Department of Defense. As stated earlier, they terminate in specifications, standards, handbooks or reports of study. When interest in a given project has been registered by at least two Military Departments, they result in coordinated documents. Coordination is accomplished through all of the communication media available to the engineer and include the telephone, the mails and the eye-to-eye contact of meetings where strong differences are usually reconciled.

Procedures for effecting coordination are selected dependent upon the urgency of need and the commodity involved. They may involve the working group method, the special procedures for expediting coordination of specifications and standards or rely on the mails to exchange comments and adjudicate differences. Differences that cannot be resolved at the Preparing Activity level go through successive levels of command in an attempt at resolution. Assignees for given Federal Supply Classes have decision power in this area and the activity against which the decision is made has the right of appeal to my office.

All of the policies, procedures and instructions governing this process, as well as all facets of the program, are contained within the Defense Standardization Manual 4120.3-M. It is a handy document to have in the top right-hand drawer of your desk.

Let me digress for a moment and reflect on what I've said thus far. I've briefly mentioned the objectives of the Defense Standardization Program and the means by which those objectives are achieved. I've given you a look at the programming and planning required to make this a viable program and the tools that have been developed for use both by the Manager and the Technician involved in the program. We in the Office of the Secretary of Defense believe that we have developed a system for Standardization Programming designed to stimulate new ideas and concepts, give visibility to the total program, create rapid reaction to shortfall, and increase interest in the program of all functional areas. The last of these brings me to the final phase of this talk and is one that I consider of great importance.

I have tried to infer throughout the talk that the benefits of standardization are derived through the functional areas of design, development, engineering, procurement, maintenance and supply. I want to state emphatically that standardization does not select items in research and development, it does not decide what items must be procured, nor does it perform the supply discipline responsibility of supply managers. On the contrary, standardization provides engineering service and support to the functional areas and is the prime reason that the office that I represent coordinates the responsibilities of all of the functions that share responsibility for the achievement of standardization objectives. Since this installation is essentially a Research and Development activity, I cannot overemphasize that the successful achievement of standardization objectives is critically dependent upon the preparation of authoritative engineering data in the development process. Whether we are talking of complex missile systems or salt and pepper shakers, the absence of adequate documentation at the development stage makes exploitation downstream a total impossibility. Gentlemen, the tools have been provided, the policies established and the goals set -- the rest is up to you.

DOD ITEM ENTRY CONTROL PROGRAM

T. W. Graves
Director, DoD Item Entry Control Office
Office of the Assistant Secretary of Defense (I&L)

Gentlemen: Participation in your conference is an honor and a privilege. I appreciate the opportunity to tell you about the item entry control program.

The theme of this conference is the interdependence of our programs to achieve the cumulative effect of better logistics management. As Armed Forces Management put is recently, logistics "is the biggest business within the world's biggest business", consuming from one-half to three-fourths of the defense budget. There is an intimidating quality about the vastness of this enterprise --- we may sometimes be inclined to feel that our part is insignificant, that the system is too big to feel our influence. We need to remind ourselves that no matter how economically and effectively the logistics job is being done now, that opportunities for improvements are always present due to sheer volume and continuous change. These opportunities knock for all of us because we are involved, we are a part of the system. And because we are a part of the system, we can take pride in the accomplishments that Mr. Morris, the Assistant Secretary of Defense (Installations and Logistics), spoke of in his testimony last year before a subcommittee on government operations.

During the period of major buildup from 1961-1967, investment in major weapons has increased 40%. At the same time, supply system stocks have actually reduced 2%, from $44.3 billion to $43.5 billion. The ratio of stocks required per dollar of weapons and equipment has decreased in this period from 65 cents to 46 cents, or a 30% reduction (Chart #1).

With regard to the federal catalog system, Mr. Morris stated that one of the most important uses of the catalog is to prevent the addition of unnecessary items to our inventories as new weapons -- with their thousands of spare parts -- are developed. The centrally managed catalog has opened a new era in our standardization and item simplification programs by making it possible to rapidly classify and compare items to eliminate duplicates and to continuously purify the catalog. As a result of these techniques, the catalog has expanded by only 5% since 1961, from 3.8 to 4 million items. Without this common language and the new disciplines it has brought to bear, it was estimated that the growth might well have been over 50%, and that we would be spending at least $130 million each year in clerical and warehousing costs to manage these duplicate items, quite apart from the investment in unneeded stocks.

I am sure you will agree that achievements such as these are only possible through a totally integrated effort. With this background, I would like to describe the item entry control program and the objectives we are trying to accomplish.

DoD INVESTMENT IN SUPPLY STOCKS IN RELATION TO INVESTMENT IN MAJOR WEAPONS AND MILITARY EQUIPMENT

(DOLLARS IN BILLIONS)

	JUNE 30, '61	JUNE 30, '67	PERCENT CHANGE 1967 - 1961
MAJOR WEAPONS AND MILITARY EQUIPMENT (THESE ARE SHIPS, PLANES, AND MISSILES, PRIMARILY)	$68.0	$95.5	+ 40
SUPPLY SYSTEMS STOCKS	44.3	43.5	- 2
STOCKS REQUIRED PER DOLLAR OF WEAPONS AND EQUIPMENT (MONEY IN CENTS)	65	46	- 30

Chart #1

OBJECTIVES

ITEM ENTRY CONTROL (IEC) IS A CONCEPT TO FOCUS MANAGEMENT ATTENTION ON DISCIPLINES NEEDED TO ACHIEVE RELATED DoD PROGRAM OBJECTIVES

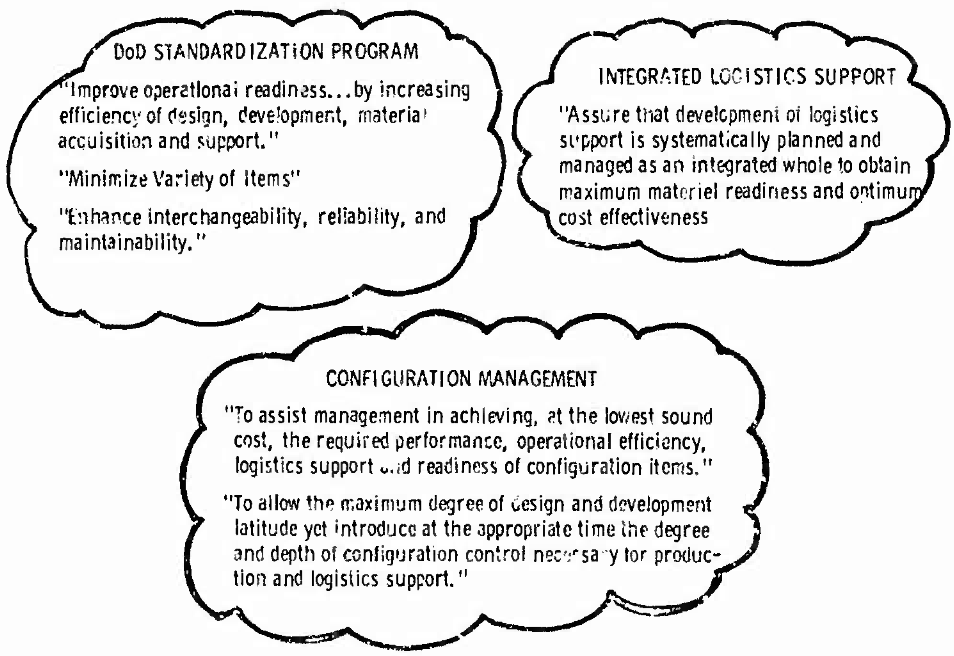


Chart #2

My presentation will be divided into four parts:

1. General Trends and Objectives.
2. Item Entry Control in Design and Development.
3. Defense Technical Review Activities.
4. Item Reduction.

PART 1 - GENERAL TRENDS AND OBJECTIVES

The Item Entry Control Program is now a little more than five years old. Alarming circumstances faced by DoD in 1962 and 1963 prompted the establishment of a DoD item entry control office. During the five-year period ending June 30, 1963, more than one-half million item identifications were added to the federal cataloging system each year. In spite of extensive efforts to reduce and delete nonessential items from the inventory, the number of item identifications continued to increase at a net average annual rate of more than 116,000 items. Large scale reduction programs such as the "Accelerated Item Reduction Program," which earmarked 468,000 items for elimination and cost us $20 million, were not keeping pace. The military were alerted to the upward trend and each started to focus attention on new item proliferation. One of the actions taken by the ASD(I&L) was to establish an "Item Entry Control Office" with the broad mission to provide DoD-wide council and leadership in the development of programs and systems for the control of entry of new items into the defense supply system. The original concept of the office has remained essentially unchanged. However, in 1967 policy direction and supervision was changed from DSA to the Office of the Secretary of Defense. I report to Mr. John Riordan, Director, Technical Data, Standardization Policy, and Quality Assurance in OSD, although the office is located at Cameron Station for administration. The Item Entry Control Office remains as at its inception, a small staff of professionals working on a project basis developing ways to improve the effectiveness of the existing system.

Item Entry Control is regarded as a concept to focus management attention on disciplines needed to achieve related DoD program objectives. The objectives of the DoD Standardization Program to improve operational readiness, minimize the variety of items, and enhance interchangeability, reliability and maintainability, find their counterpart objectives, for example, in the "Integrated Logistics Support" Directive, and the Configuration Management Program. An important aspect of our work is to keep in mind the integration of projects required to achieve these common goals (Chart #2).

Item entry trends over recent fiscal years are illustrated on the accompanying chart. New item entry hit a low of 210,936 in FY 65 and a high of 319,990 in FY 67. As you might expect, the most active category is piece parts, with electronics constituting about 1/4 of the total, and hardware approximately 1/10. This is why our overall approach to the problem of item entry control has stressed the parts area, and the electronics and hardware classes in particular (Chart #3)

With this coverage of general trends and objectives, I would like to turn now to some of the more specific program efforts.

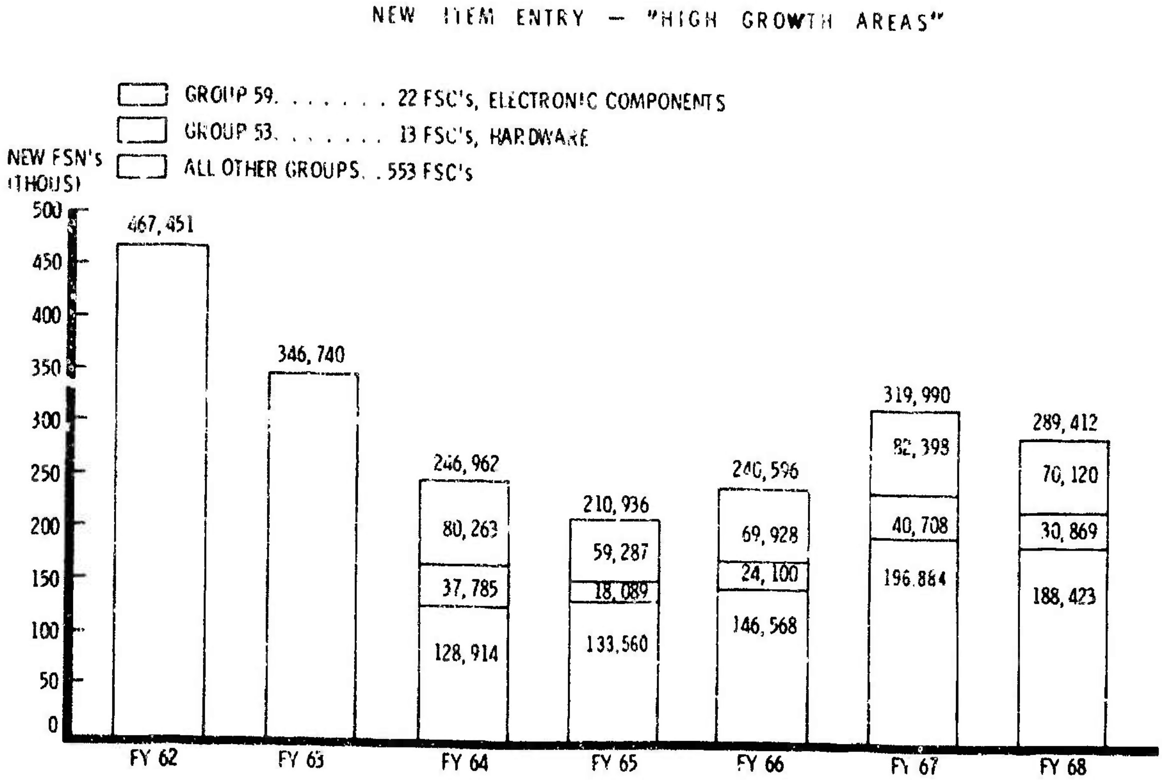
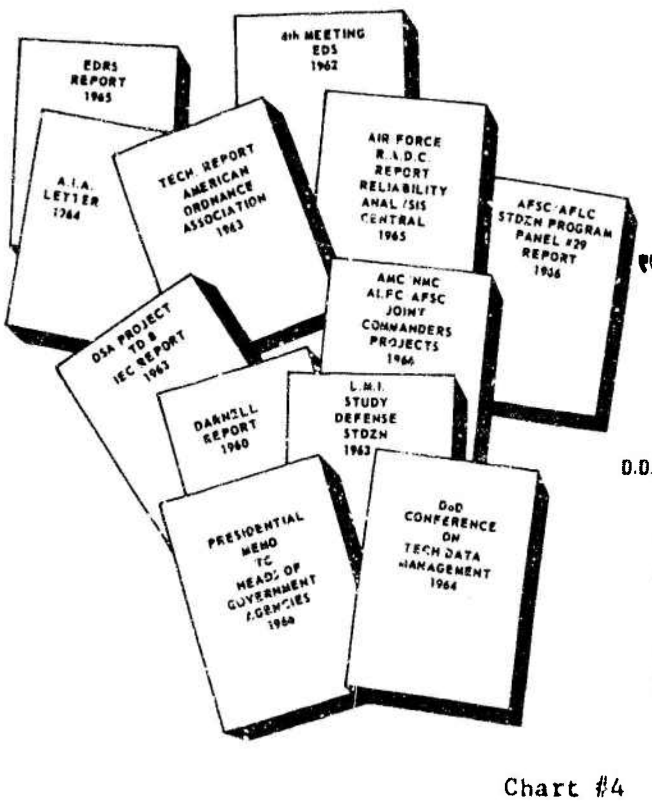


Chart #3



CONSENSUS

"Optimize IEC During Design"

THIS REQUIRES:

D.O.D. DESIGN BASE OF SELECTED PREFERRED PARTS!

WITH

JUSTIFICATION FOR USE OF NONSTANDARD ITEMS

MAINTENANCE OF DESIGN BASE WITH "STATE OF THE ART"

DISPLAY OF DESIGN BASE PREFERRED BY DESIGNERS

CONTRACTUAL INCENTIVES FOR USE OF DESIGN BASE

Chart #4

First, I would like to address the matter of controlling new item entry at the design stage.

PART 2 - ITEM ENTRY CONTROL IN DESIGN AND DEVELOPMENT

Fundamental to the task of minimizing the number of new items entering the inventories is extension of standardization philosophy back into the Research and Development stage. Here is where the decisions are really made to add new items to the supply system, and consequently, these decisions are rarely undone at the supply support stage. Each time a new weapon enters the inventory, it brings with it thousands of new items, spares, and support equipment. That is why any serious attempts to reduce the number of different items in our logistics system and thereby reduce logistics costs must begin in the Research and Development stage. This was the gist of testimony given by the Secretary of Defense to the Joint Economics Committee in 1965 and is still a good expression of our guiding philosophy.

This theme has been repeated in a number of high level studies and statements throughout the years. To carry this philosophy out, a total system is required which provides:

1. A design base of selected preferred parts listing those standard and preferred items which we would like to see selected by design engineers.

2. Justification for use of nonstandard items in the form of a monitoring system tailored to the weapon.

3. Maintenance of the design base with the state-of-the-art.

4. A communications scheme which will display the design selection base of preferred items to the design engineer in a practical form, easy to use.

5. Finally, proper incentives which will assure use of the design base.

These objectives are shown in Chart #4.

The objectives of Item Entry Control go hand-in-glove with the objectives of Reliability and Standardization Programs when it comes to selecting the right part in new design.

Chart #5 (adapted from a presentation made by the Naval Avionics Facility at Indianapolis) illustrates that the wrong part, that is, the untested part, the poor quality part, is the weak link in the chain between reliability goals and equipment performance.

As we all know, equipment fails because parts fail, and parts fail because of any one of a number of reasons, including misapplication, unknown part capabilities, and others too numerous to mention.

Ideally, the process of selecting the right part is judicious and discriminatory.

It is sort of an optimum concept where all requirements have a value in relationship with each other. As an example, reliability strives for conservative application of high reliability parts with low failure rates, while standardization dictates maximum use of the same part.

This concept is being applied in several of the military departmental programs. I would like to cover a few brief examples.

In the Air Force F-111 Program, there was a great deal of concern over the failure of electronic parts. The majority of equipment failures were due to unreliable electronic and electrical-mechanical equipment. These common piece parts make up about 75 percent of the parts population.

Problems in reliability, maintainability, and logistics support were due to the factors outlined in Chart #6.

The Air Force parts control board concept grew out of their experiences with the F-111. Under this concept, the prime system contractor forms a working group of parts experts of the many vendors and subcontractors. Through negotiations, agreements are reached on the use of standard and reliable components. The Air Force has had significant success with this approach and has since applied it to the C-5A and a similar effort is being made on the 407L (Tactical Air Control System) and the Short Range Attack Missile.

To illustrate how this concept works, let us consider transistors for the avionics package for the F-111A. There were 20 contractors involved in the design and development of the avionics package. When their original needs for transistors were first made known, there were 140 different types and styles listed. After the contractor parts control board met and the parts experts exchanged intelligence on transistors, the number of types and styles was reduced to 77 (about a 50% reduction). The final impact is that 92% of the total number of transistors used (7,500) were identified to only 20 types and styles.

The Air Force Systems Command plans to use this approach through a parts control operating group to build up an AFSC "Master List of Parts Preferred for New Design." This Master List would be used as a starting base for the design and development of all new systems. The AFSC feels that the driving force in the program must be toward increasing the reliability of parts and using the most reliable parts to the exclusion of many other types and varieties. Common usage in all new systems and equipments would then lead to reduced proliferation and would contribute to lower costs through better maintainability and more interchangeability of parts.

Army Missile Command Preferred Parts List

The Army Missile Command has been a leader for a number of years in the development of data retrieval, standardization, and item entry control systems and techniques. A noteworthy example of the work being carried on by the Army is the MICOM preferred items list. MICOM has had developed, in two volumes, a publication depicting the preferred items for use in the

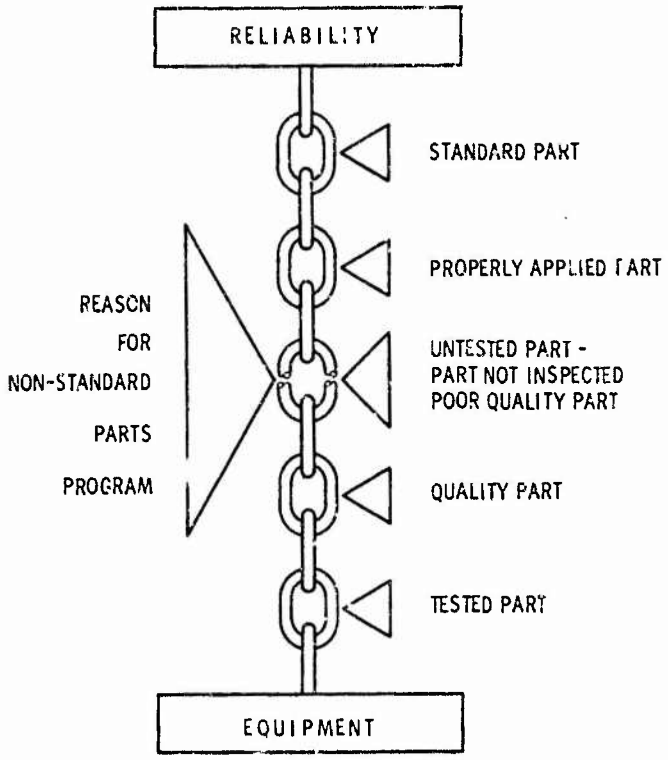


Chart #5

CONCLUSIONS FROM
STUDY OF WEAPON SYSTEMS FAILURE
BY
GENERAL DYNAMICS CORP., IN FT. WORTH DIV.
IN
F-111 PARTS CONTROL AND
STANDARDIZATION PROGRAM REPORT

- MAJORITY OF FAILURES DUE TO:
  - UNRELIABILITY OF ELECTRONIC AND ELECTRICAL-MECHANICAL EQUIPMENTS.

    [COMMON ELECTRONIC PIECE PARTS MAKE UP 75% OF PARTS POPULATION (SEMI-CONDUCTOR DEVICES, RESISTORS, AND CAPACITORS]

- PROBLEMS IN RELIABILITY, MAINTAINABILITY AND LOGISTICS SUPPORT DUE TO:
  - LARGE NUMBER OF DIFFERENT PARTS TYPES IN WEAPON SYSTEM.
  - DIFFERENCES IN SPECIFICATIONS FOR SAME PART WHEN USED BY DIFFERENT CONTRACTORS.
  - UNIQUE PROCUREMENT SPECIFICATIONS FOR EACH CONTRACTOR FOR SAME PART.
  - DIFFERENT SPECIFICATIONS FOR SAME PART FOR PECULIAR APPLICATIONS IN SAME EQUIPMENTS.

Chart #6

design of missile systems. The guided missile pil promotes intersystem standardization through the use of items selected by research and evaluation as those state-of-the-art items which have application requirements for future missile systems based on criteria such as performance characteristics, reliability, availability, costs, documentation status, usage, etc. The pil is being specifically designated as first order of precedence in the standardization section of MICOM Missile Standardization Programs. Maintenance and updating criteria are being developed, and MICOM plans publication of a handbook to cover this subject for the expanded DoD-wide guided missile pil which is to follow. A view of the publication is shown in Chart #7.

The Army Missile Command is also deeply involved in a number of projects and programs for the mechanization of data reduction, distribution, and retrieval -- for example, the Army Data Retrieval Engineering System (ADRES) is a data retrieval system utilizing microfilm cartridges. The ADRES file contains an estimated 200,000 items available for screening, including drawings, standards, and selected qualified products lists. Presently, 85 sets are furnished users, which include MICOM prime contractors and their major subcontractors. It has been made a requirement for use in MICOM contracts.

Naval Air Systems Command Program

The Naval Air Systems Command has formulated a plan for effecting increased standardization of components and equipment throughout the life cycle of its systems. This plan promises to make a significant contribution towards the objectives of Item Entry Control. NAV-AIR's objective is to bring about greater commonality among its weapons system, improve Item Entry Control, and reduce logistics support problems and costs throughout the life cycle of the system. This objective is shown in Chart #8.

NAV-AIR has promulgated a specification entitled "Standardization Program Plans," requiring large system contractors to set up an in-house standardization group and to impose requirements for standardization on subcontractors. This specification provides that the contractor shall furnish to the Government visible evidence of standardization efforts. Financial incentives or penalties are specified for contractor standardization results.

A major feature of the NAV-AIR plan is to stress initial selection of components and equipment presently in the Navy or DoD inventory. Under the system, the designer will select the component required for his design and then submit it to the Aviation Supply Office (ASO) for screening against a "Master Repair List" consisting of all reparables in the ASO files, cross-referenced between manufacturers' numbers and Federal Stock Numbers. Those components matched will be forwarded back to the designer so that he may incorporate his choice in the system design. If no match is achieved, the major characteristics of the component needed to satisfy design requirements will be forwarded in a standard format to an appropriate screening activity (either a defense technical review activity or the Defense Logistics Services Center) for a DoD-wide screening operation. The purpose of the planned feed-back procedures is to make the designers aware of existing items in the Navy or DoD inventory so that he may incorporate these to the greatest extent

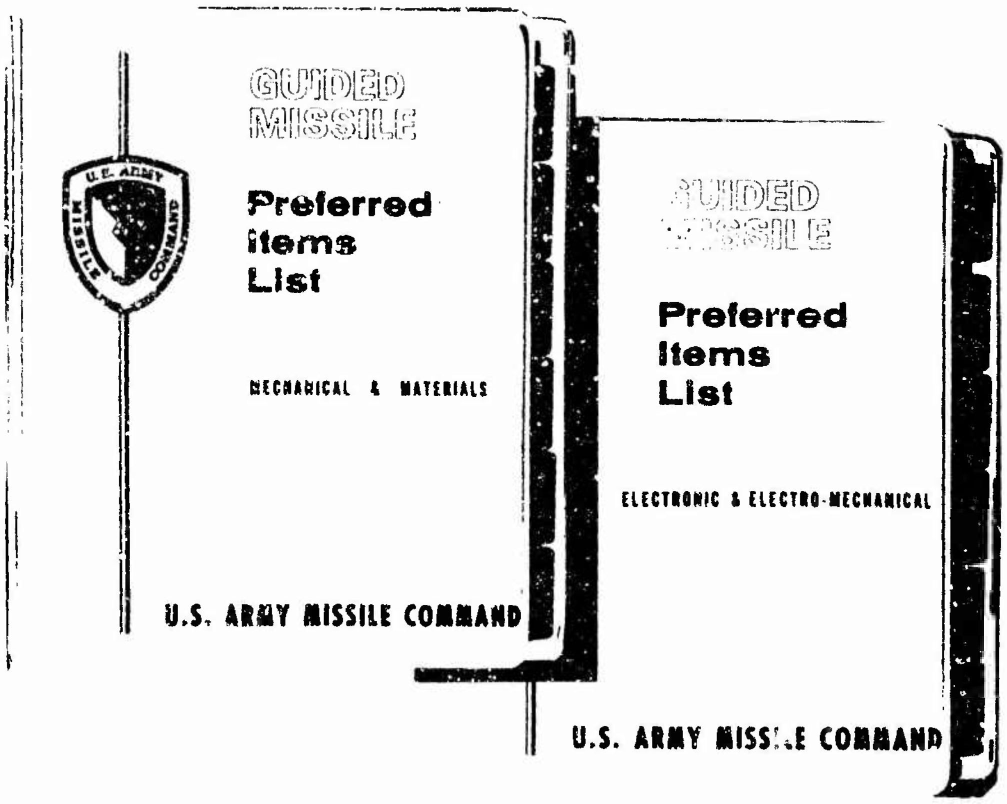


Chart #7

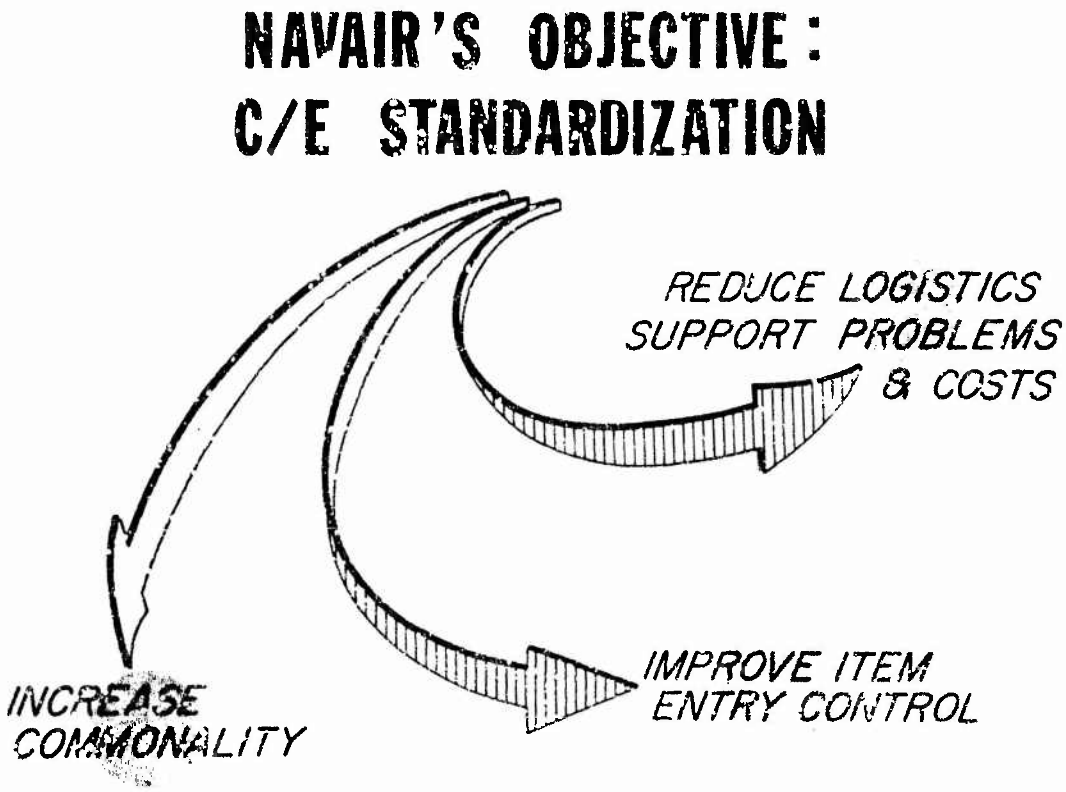


Chart #8

practicable in his design. The complete NAV-AIR plan provides for incentive awards or penalties based on performance, configuration management to maintain identicality, and procurement techniques such as life cycle costing to hold the variety to a minimum.

To summarize the treatment of Item Entry Control During Design, the essential elements of an effective parts control system are visualized as a "closed loop" incorporating a series of events which follow in logical sequence:

1. The fundamental requirement is a current baseline of standard and preferred parts -- in other words, a "menu" for the design engineer to use in the selection of the "right" part.

2. An effective communications system which will display the preferred items to the design engineer in a practical, easy-to-use manner which will encourage re-use.

3. Utilization of the design baseline by engineers developing new weapons systems.

4. Identification of parts that must be used to meet the requirement when they vary from the baseline and the full documentation of these variations.

5. A system of effective monitorship, either before the fact or after the fact, to assure that nonstandard parts usage does not unnecessarily introduce new varieties of items.

6. Where the nonstandard parts represent truly advanced technology items, they must be evaluated by responsible engineering activities.

7. Timely feed-back and rapid update of the design baseline following from the evaluation of advanced technology parts.

These elements require a great deal of integrated effort, clean lines of communication, and finally, adequate resources in the form of manpower to do the job. A joint OSD-Military Departmental Task Group was established in January of this year, charged with the task of integrating the various efforts in this field. The Task Group is meeting this week in Dayton to begin development of a plan of action and time phased implementation schedule (Chart #9).

PART 3 - DEFENSE TECHNICAL REVIEW PROGRAM

One of the earliest projects undertaken by the Item Entry Control Office was the establishment of defense technical review activities. Investigative reports had disclosed a high degree of error in catalog data files and many identical or very similar items under different stock numbers. For example, a post audit review of over 22,000 new items entering the system during a six-month period in 1963, revealed errors in catalog data recording for 43% of the items. A total of 634 actual or possible duplicates were revealed. Source documentation was not available or was not used in 53% of the cases.

ESSENTIAL ELEMENTS OF AN EFFECTIVE PARTS CONTROL SYSTEM

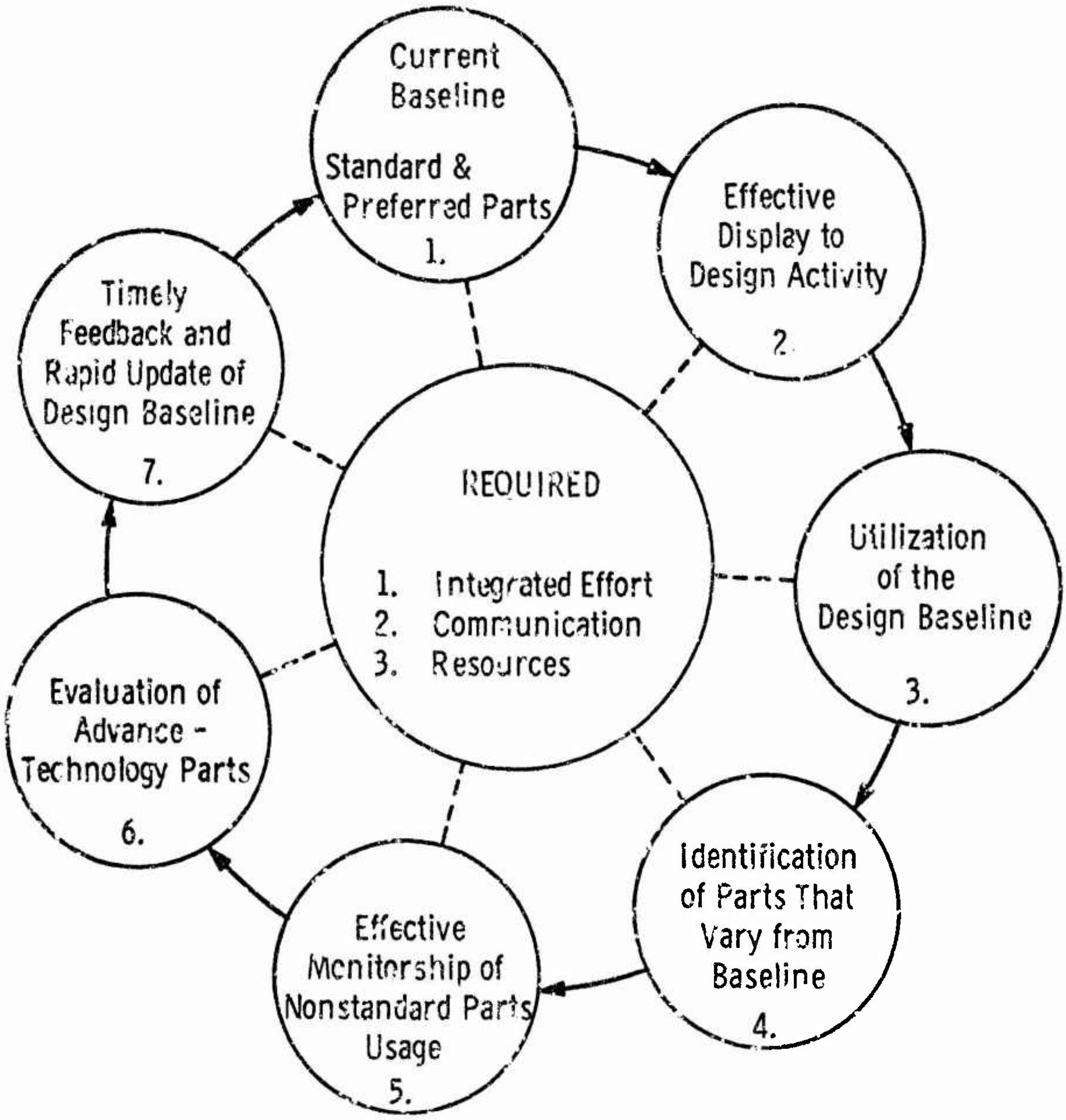


Chart #9

Before the establishment of the Defense Technical Review Activities (DTRAs), the military services were submitting applications for new federal stock numbers directly to the Defense Logistics Services Center in most instances. A pilot program was established to have these submittals routed through a DTRA to perform a technical review of the proposed new item prior to assignment of a federal stock number. After the pilot test, this concept was adopted for selected federal supply classes responsible for most of the annual new item input. Thirteen Defense Technical Review Activities were established, located at the inventory control points of the Army, Navy, Marine Corps, Air Force and the Defense Supply Agency (Chart #10).

The basic concept of the DoD Technical Review Program is to have all proposed new items for a federal supply class routed through an activity which has the technical capability to ask these questions in a meaningful way:

Is there a duplicate or replacement in the system? Is this a better item? Is there a standard item which can be used? Is the item covered by a specification? Other questions which could be shown appear on Chart #11.

Has the catalog data been properly prepared? Is the item accompanied by appropriate backup technical data for reprocurement? This review takes place after provisioning and before initial buying is made.

Summary results of DTRA processing of proposed new items are shown on the accompanying chart. The program encompasses 68 FSCs accounting for about 75% of total annual item entry. Since inception of the program, over 800,000 items have been processed through DTRA activities. The duplicates and recommended replacements returned to the submitters for adoption have totaled 220,000 or about 25%. Errors which could not be corrected by the DTRA were returned in about 9% of the cases. Total returns have been almost 35% (Chart #12). Results vary widely depending upon the commodity area involved. In the common-use piece parts area, a return of duplicates, replacements, and so forth, may be twice that of the overall average shown here, while in some of the more technical areas, it may fall below 5%. We have had a joint task group composed of military service representatives and chaired by my office reviewing this operation for the past several months. Their report will be finalized within the next 60 days.

PART 4 - ITEM REDUCTION

The final major program I would like to discuss is the Item Reduction Program. Items are reduced or deleted from the system in many ways, i.e., through inactive item reviews, etc. I am addressing here only that aspect having to do with the review of items to assign the proper standardization status codes. Our analysis of this area last year showed that we were not effectively reducing the problem. After ten years, and coding of 1.3 million items, we still had 3.3 million items to code -- a workload as big as when the program started. As a result, the entire program was streamlined and a new procedure published in Chapter VII of the Standardization Manual.

DoD TECHNICAL REVIEW PROGRAM

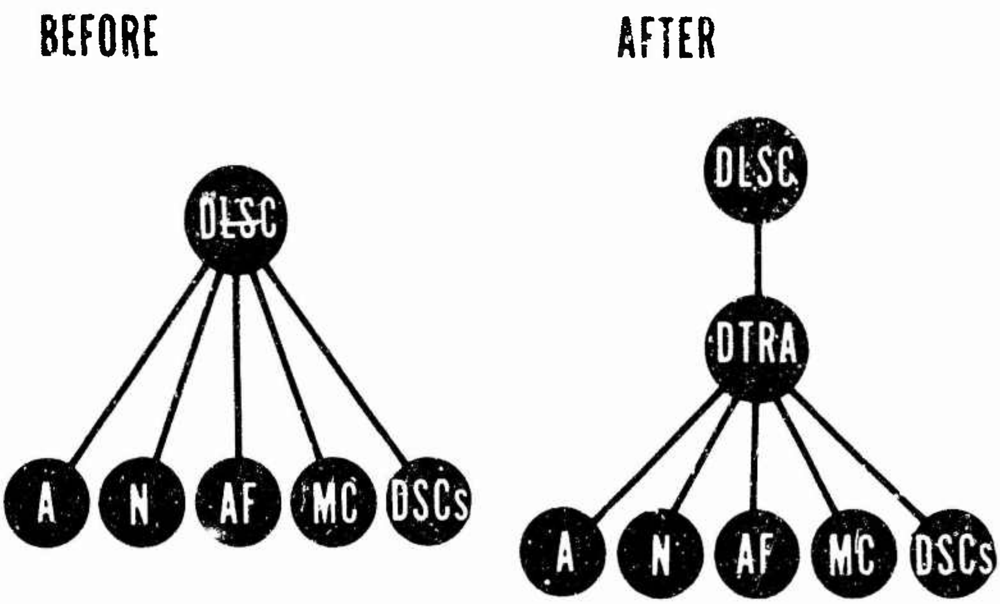


Chart #10

DoD TECHNICAL REVIEW PROGRAM

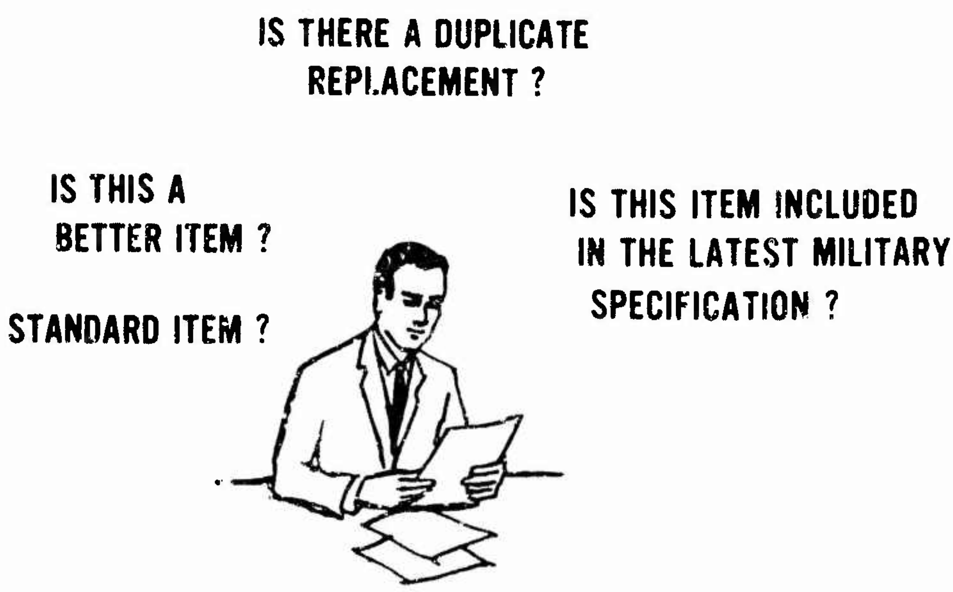


Chart #11

DIRA PROCESSESING OF PROPOSED NEW ITEMS

68 FSCs -- APPROXIMATELY 75% OF TOTAL ANNUAL ITEM ENTRY

PROPOSED NEW ITEMS PROCESSED THROUGH DECEMBER 1968: 867,615

INTERCEPTED

DUPLICATES AND RECOMMENDED REPLACEMENTS	220,025	25.4%
ERRORS....................................	79,762	9.2%
TOTAL...................................	299,787	34.6%

Chart #12

ITEM STANDARDIZATION CODES

	CODES	ASSIGNED BY	PROCESS	COORDINATION	MEANING
AUTHORIZED FOR PROCUREMENT	0	AEC-PA	IRS	NO	ITEM UNDER SPECIFICATION CONTROL OF AEC OR NSA
	1	PA	IRS	YES	ITEM INCLUDED IN ITEM REDUCTION STUDY - REPLACES A CODE 3 ITEM
	2	PA	IRS	NO	ITEM INCLUDED IN ITEM REDUCTION STUDY - DOES NOT REPLACE A CODE 3 ITEM
	5				ITEM NOT YET SUBJECTED TO STANDARDIZATION
	6	PA	NO POTENTIAL	NO	NO STANDARDIZATION POTENTIAL
	A	DTRA	TECHNICAL REVIEW NEW ITEMS	NO	A NEW ITEM PROCESSED THROUGH A DTRA THAT CANNOT BE REPLACED BY AN EXISTING ITEM
	B	PA	SPECIFICATION UPDATE	NO	A NEW ITEM CONTAINED IN A NEW OR REVISED SUPERSEDING SPECIFICATION OR STANDARD
	C	PA	IRS	NO	ITEM INCLUDED IN ITEM REDUCTION STUDY THAT LACKED ADEQUATE TECHNICAL DATA
	D	DTRA	TECHNICAL REVIEW NEW ITEMS	NO	A NEW ITEM PROCESSED THROUGH A DTRA THAT LACKED ADEQUATE TECHNICAL DATA
NOT AUTHORIZED FOR PROCUREMENT	3	PA	IRS	YES	ITEM INCLUDED IN AN ITEM REDUCTION STUDY - GENERALLY REPLACED BY CODE 1 ITEM
	E	PA	SPECIFICATION	NO	AN ITEM REPLACED BY NEW OR REVISED SUPERSEDING SPECIFICATION OR STANDARD

PA - PREPARING ACTIVITY FOR ITEM REDUCTION STUDIES

IRS - ITEM REDUCTION STUDY

Chart #13

The benefits of the new procedures are to: (1) Capitalize on engineering decisions without repeating the review of an item in supply; (2) Eliminate unnecessary coordination; (3) Reduce the number of items being coordinated; (4) Identify technical data deficiencies; (5) Discourage item reduction studies without pay-off; and (6) Eliminate unnecessary publications. The basis for the benefits of the new procedures is the new item standardization status coding system. The new coding system identifies those items in supply that are procureable or nonprocureable, who made the decision, and why it was made. In addition to the establishment of a new coding system, we eliminated the printing and distribution of military supply standards. This alone achieved a saving of approximately $100,000 per year. On the accompanying chart, the new coding system illustrates some of the features of the revised procedures.

Chart #13 illustrates the new standardization status coding system. It should first be noted that items are divided into two categories; that is, those authorized for procurement and those not authorized for procurement. The four basic ways an item can be coded are illustrated by the colors ---

1. Codes "0", "1", "2", "C", and "3" are assigned by means of an Item Reduction Study. The only items to be coordinated in this process are items coded "3" or nonprocureable, and their replacement. This eliminated approximately 75% of the previous coordination workload involved in Item Reduction Studies. The new alpha code "C" pinpoints those items on which a study could not be completed because of lack of adequate technical data. These items are thus earmarked for a future review.

2. New alpha codes "B" and "E" are used when engineering elements issue a new or revised superseding specification or standard whereby the new item covered has one-way interchangeability with the superseded item. These decisions made in engineering will be implemented in supply without any further coordination. This procedure applies only to groups 59 and 53; that is, the electronics and hardware areas at the present time. There are approximately 50,000 actions of this type each year which will no longer have to be coordinated in an Item Reduction Study through the use of these codes.

3. The new alpha codes "A" and "D" apply to the DTRAs only. The basic idea here is to take advantage of the DTRA technical review without filing the item away to be brought out for examination at a later date as was the case in the old system. A DTRA will assign an "A" code to an item when in the course of the technical review, with adequate technical data, it is decided that the item cannot be replaced by another item in the system. In the event the proposed new item entering the system is not accompanied by adequate technical data, the DTRA will assign a "D" code, thus earmarking the item for further review after the technical data is obtained.

4. Numeric code "6" will be used to indicate items having no potential for standardization. This code will be applied on an item name or FSC class basis. It was not intended to be applied on an item-by-item basis. This "no potential" area consists mainly of categories of items which are one of a kind and wherein an Item Reduction Study, if conducted, would have little or no potential for eliminating items from the supply system. We are trying to avoid conducting Item Reduction Studies where the anticipated pay-off would not exceed the cost of doing the job.

We have issued annual program guidance in the Standardization Program establishing DoD goals to complete all status coding of the 68 DTRA FSCs in a five-year period. These goals will cover about 75% of all items in the system. Substantial progress has been made. The percentage of items coded in these classes has risen from 19% to 36%. In the past year-and-a-half, over a half million items have been coded in these classes.

Another significant program effort is the so-called Item Name Study (Chart #14). Approximately one and one-half years ago the DoD Item Entry Control Office prepared a staff study on the problems created as a result of federal cataloging rules which allowed many items of homogeneous families to be classified with the Federal Supply Class of the next higher assembly instead of the "Home" Federal Supply Class specifying the approved item name.

Some of the examples of these common use items which were being proliferated throughout the federal supply classification structure are shown on this chart. Spur gears, constituting over 34,000 federal stock numbers were classified in 106 different Federal Supply Classes; the item name, bearing sleeve, with almost 25,000 federal stock numbers, appeared in 209 Federal Supply Classes; there were many other similar examples. As a result of the recommendations growing out of this staff study, a joint task group was organized and a sample study made of selected item names. On the basis of this very limited study, it was concluded that the potential for item reduction reclassification of coding for integrated management was significant and that a program should be initiated to correct this situation. Consequently, the federal catalog rules have been changed on 196 item names so that any item having these item names will be classified only in the home FSC. It is estimated that this will involve about 450,000 items, 300,000 of which are under military service management and will be subjected to item management coding for integrated management. There are 39 item names still under consideration for this treatment.

This project dramatically illustrates how the management improvement project initiated in one area can have wide ranging impact on other areas of logistics management. While our primary motivation in initiating the staff study had to do with controlling new item entry and item reduction, it is obvious that the final outcome will be a major shift in logistics management responsibilities and a substantial cleaning up of the Federal Supply Classification System.

ITEM NAME STUDY

PROBLEM: MANY ITEMS OF HOMOGENEOUS FAMILIES ARE BEING CLASSIFIED WITH FSC OF NEXT HIGHER ASSEMBLY INSTEAD OF THE "HOME" FSC SPECIFYING THE APPROVED ITEM NAME.

EXAMPLES:

APPROVED ITEM NAME	#FSNs	% IN HOME FSC	NAME APPEARS IN
GEAR, SPUR	34,514	39	196 FSCs
BEARING, SLEEVE	24,884	36	209 FSCs
TERMINAL BOARD	19,581	51	154 FSCs
WASHER, THRUST	6,000	28	141 FSCs

FINDINGS: BASED ON A SAMPLING OF SIX ITEM NAMES

- ITEM REDUCTION POTENTIAL - 6.8%
- RECLASSIFICATION POTENTIAL - 75%
- ITEM MANAGEMENT CODED FOR INTEGRATED MANAGEMENT POTENTIAL - 64%

Chart #14


TOTAL PARTS SELECTION POTENTIAL
DEVELOPMENT - PRODUCTION
MILITARY DESIGNED MATERIEL DISCIPLINES
• Military Specifications/Standards
• Non Standard Parts Approvals
• Preprovisioning Screen
• Design Screen (Engr. Data Retrieval)
RESIDUE
• Std Parts
• Non-Standard Approved Parts
LOGISTICS MANAGEMENT DISCIPLINES
• Provisioning Screen
• Logistical Central Bank
• Def Tech Review Activity
RESIDUE
• Net New-Item Input

Chart #15

In summary, management disciplines are needed to control the flow of new items into the inventory, as dams are used to control and regulate the flow of water in a stream (Chart #15).

Upstream, disciplines applicable to military designed materiel are required to keep the logistics system from being inundated with all the varieties of items available in the total economy. Modern, up-to-date specifications and standards, backed up with appropriate screening techniques, are essential to stem the tide at this point.

Further downstream, logistics management disciplines at the provisioning and cataloging stages are essential to assure that the residue of new item entry is only those items that are essential for support of the operational forces.

BASIC RESEARCH - A CONTRIBUTOR AND USER

Dr. S. D. Bailey
Director, Pioneering Research Laboratory
U. S. Army Natick Laboratories

We visualize our role in the Pioneering Research Laboratory as both a contributor and user of basic knowledge: that is, to provide an interface with this knowledge to orient it in the direction of Natick and Army interests. This oriented research is then, ideally, carried to the point where development programs are able to pick it up and bring it one step closer to engineering and finally to a prototype, or incorporated into a specification for procurement. Before leaving this subject I would like to point out that there is a frequent spin-off from one project or research area into areas of interest to the military in rather unexpected ways and in completely unrelated areas. In the example chosen for this discussion I will point out one such spin-off.

In general, however, it can be said that the more basic a study in a given field of science, the greater the number of technologies which will eventually benefit from these results. One could cite the case of the fundamental discovery that the nucleus of the atom can be either fissioned or fused to produce enormous quantities of energy, leading to technological advances which have had a major impact on our lives, both for good and bad.

One could raise the logical question why do this research in-house? Why not rely on university or industrial research to provide this pool of basic knowledge for the military? I have attempted to answer these questions as follows:

We do basic research in-house:

1. To provide a critical mass of trained personnel with the skills and knowledge to do significant research in direct support of Army problems,

2. To provide an interface with academic and industrial research programs and scientific literature in general, to give early recognition to those advances in science which can be used in the solution of Army wide problems, and

3. To provide consulting services and instrumental measurements for other programs at Natick.

If this capability were not available in-house we would be dependent in large measure on what our contractors tell us, rather than having a capability to evaluate and make valued judgments on the research which we purchase under contract.

Before leaving this subject I should also like to point out the results of Project Hindsight, of which I am sure many of you have heard. This was a study performed within DOD, to determine where the greatest return was realized in developing military hardware; that is, under contract or in DOD Laboratories. The conclusion to this study was that the federal military laboratory, which had a mission orientation, produced more for the resources expended than when the work was done under contract.

A full compliment of basic, applied, development and engineering capability in a single organization oriented to the solution of recognized problems important to the military, seems to be the best arrangement for providing the modern technical support for our Armed Forces. These capabilities are supplemented when necessary with academic and industrial contracts where the need for skills required on a short term basis, exceed those we can provide in-house.

Now I would like to discuss in some detail a research program which I hope will illustrate the general theme of this symposium, that is the relationship of all that transpires at Natick to a procurement document.

We asked the Food Laboratory, when they were in Chicago, what was one of their tough problems in providing acceptable food to the soldier. The answer which we received, and which is still valid today, is the retention or restoration of flavor in processed foods. The Pioneering Research Laboratory, as a result, engaged in a three-pronged study to provide information to resolve this problem and hopefully to achieve at the same time more objective methods for the evaluation of foods for procurement in large quantities for the Army. The three approaches used were: (a) the isolation and identification of volatile compounds in food; (b) the separation and characterization of the non-volatile components which could be associated with the origin of the volatile components; and (c) the biochemical events relating these two.

In tackling the first part of this program, that is, the study of the volatile composition of a food, we selected a food from which we were quite sure of getting some positive results. That is cabbage. When this work was initially undertaken the techniques of gas chromatography and mass spectroscopy were just being adopted by the analytical chemist to determine the composition of matter. Our laboratories were one of the first to apply these techniques to food problems. This has developed to a point where a coupling has been achieved between the gas chromatograph and the mass spectrometer so that each separated component as it is eluted from the gas chromatograph is introduced into the mass spectrometer and the fragmentation pattern of that compound provides the analysis. We have recently acquired a high-resolution mass spectrometer with a gas chromatograph attached in which we plan to convert the signal of the molecule being analyzed into a computer and obtain a print-out of the number of carbon, hydrogen and other atoms in each fragment, and from which it will be possible to reconstruct the molecule in question.

However, to return to my story on cabbage, in one gas chromatogram using a sample of the head space over a freshly prepared sample of cabbage, one peak predominated over all others under the conditions of this experiment.

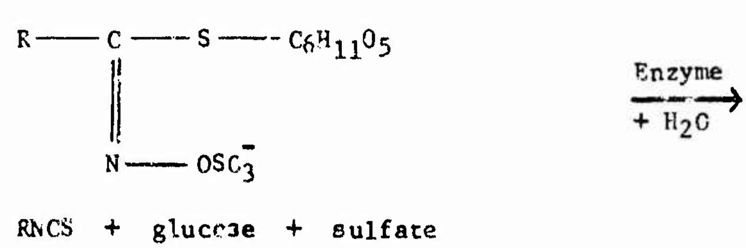
It has been identified as allyl isothiocyanate, and represents one of the major components found in fresh cabbage contributing to the characteristic odor of cabbage.

With this information it was now possible to see what happened to this and other volatile compounds when cabbage was subjected to a processing treatment, as for example, dehydration. The gas chromatogram of the dehydrated products clearly showed the loss of volatile allyl isothiocyanate. Thus, much of the aroma of the cabbage has been removed in this processing treatment.

While this work was going on in our laboratories biochemical studies, largely under contract to Natick, suggested that possibly enzymes could be used to restore lost volatiles in such processed foods. When this dehydrated sample of cabbage was then reconstituted with an enzyme and water, the allyl isothiocyanate was restored as found in the fresh product. The principle of regeneration of fresh flavor note to a processed food seems to be generally applicable to all plant products.

While this phase of the work was going on the organic chemists, studying the non-volatile compounds in cabbage, were able to show that thioglucosides were the flavor precursors involved; at least as far as the isothiocyanates were concerned. The proof of this was to take the pure chemical and treat it with the required enzyme. This reaction, Equation I, is shown in the general form to cover all the isothiocyanates which might be formed.

Equation I

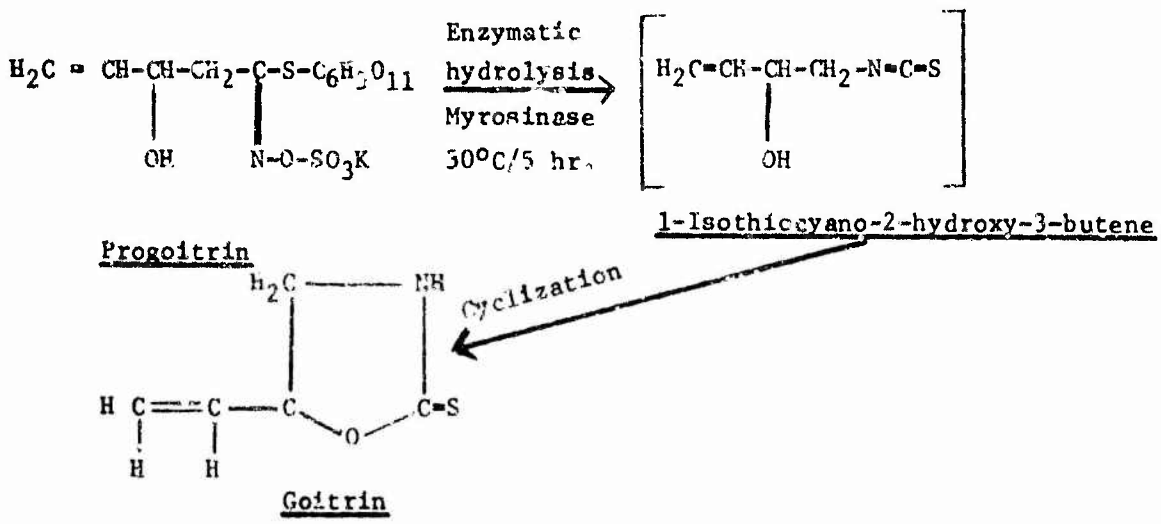


In the case of the most prominent of these, the R refers to the allyl radical.

As a direct result of this research, but in an entirely different area of interest, it was possible to show the formation of goitrin, Equation II, an active principle in certain foods that produces goiter.

Equation II

ENZYMATIC HYDROLYSIS OF PROGOITRIN TO GOITRIN



(1-5-Vinyl-2-thiooxozolidone)

The goitrin was shown to be produced through enzymatic hydrolysis from progoitrin in the same manner as the isothiocyanates since progoitrin is also a thioglucoside. And since progoitrin was found to be present in cabbage leaves in appreciable quantities, it has been proposed that goiter in humans may result from eating cabbage, where cabbage or other members of this family are a major item in the food diet. The physiological activity of the enzyme produced compounds in food, in addition to their flavor and aroma properties, may be considered a spin-off from this research. The generation of goitrin is only one such example. Since this is a relatively new field, we believe many other enzyme important reactions and products will be found in the future.

A number of plant materials as well as dairy products appear to be amenable to the enzyme-flavor concept as shown in Table 1.

Table 1

PROCESSED FOODS IMPROVED IN FLAVOR BY ADDITION OF ENZYMES

Celery	Carrots	Oranges
Cabbage	Onions	Strawberries
Mustard	Garlic	Pineapples
Parsley	Milk	Raspberries
Horseradish	Tomatoes	Radish
Spinach	Bananas	Watercress, etc.

However, additional basic and applied research, as well as development will be required before we know the chemistry involved and how best to control the reactions leading to enhanced flavor in each of these. For example, for these reactions to be used commercially, it would be necessary to have a source of cheap enzymes, possibly extracted from waste biological material or from some other source. Fortunately, in the case of cabbage our microbiologists were able to show that the fungus Aspergillus sydowi, may be such a commercial source of the enzyme thioglucosidase, i.e. the enzyme which specifically breaks down thioglucosides. Similarly, other enzymes may be found to produce other flavor notes from appropriate flavor precursors. Additionally, it is not sufficient to know the identity and quantity of volatile compounds in a food to provide a basis for an objective procurement procedure. It is also necessary to know which compound or compounds are most important to the flavor of the food; that is, what is the threshold level of perception for these compounds and how this relates to the food acceptability. In coffee, for example, our laboratories and others, have identified over 300 separate compounds. Obviously, all of these cannot contribute equally to the agreeable aroma and flavor of freshly ground and brewed coffee. To better understand this part of the problem, sensory physiologists and psychologists in the Pioneering Research Laboratory, using both human and animal subjects, are attempting to correlate sensory sensations with chemical composition. Part of the problem is to know the mechanism of taste and odor perception, and current work using the berries and leaves of certain tropical plants have given us some interesting results along these lines.

Time does not permit a detailed report on this work, but I would like to mention briefly some of the findings to the present time. For example, when the leaves of the plant Gymnemia sylvestia are brewed in water the extract when taken in the mouth blocks the sweet tasting buds on the tongue so that when sugar or saccharine is then placed in the mouth it is no longer sweet, but tastes like sand. Similarly, if one chews the berries from the miracle fruit, Synsepalum dulciticum, another tropical plant, sour or acid fruits no longer taste sour, but sweet. The concept of conditioning the taste buds in the mouth in advance of the ingestion of the food offers some rather exciting possibilities for increasing the palatability of food in our ration system. We also need to have a better understanding of the sensory organs controlling the sensation of aroma. Currently, little research has been performed in this area, but we might expect that chemoreceptors are also functioning here and these may be capable of control through chemical action.

In closing, I would like to be able to report that specifications have been written which would make it possible to employ objective methods, such as electronic instrumental measurements, to quickly and decisively decide on the quality and acceptability of a food before it is procured in large quantities for military use. Unfortunately, we have not yet reached this goal. To bring these concepts which I have described into wide usage will require a much greater effort than funds and personnel are available within the Natick Laboratories.

Fortunately, science is an open book - a book that all can read whether they do research in this country or elsewhere. Hopefully, others will pick up these concepts and help to bring them to a point where useful, practical methods for the improvement of the procurement of foods for our military feeding system can be realized.

EARTH SCIENCES RESEARCH IN MILITARY APPLICATIONS

Dr. William C. Robison
Geography Division
U. S. Army Natick Laboratories

In contrast to some of the other laboratories from which you have just heard, Earth Sciences Laboratory does not produce any type of end product except information. It is our mission to study the environment of the earth and to provide technical data which has been analyzed, evaluated, and put into understandable form about any part where our military forces may be stationed or may be required to operate. This information is intended to provide the designer, the tester, and the user of military equipment with knowledge of the environmental stresses to which it might be subjected in the field and the limits of such stresses which should be anticipated. In the past a majority of our research has been concerned with climatic aspects of the environment, but our mission is not limited to the study of climate. It must be concerned with all aspects of the natural environment including climate, terrain, and living things, and their interactions with men and materiel.

The information that we provide may be given on any one of three distinct levels. First, is the level of the scientific community in general. Our research results may be reported either in the NLABS series of technical reports or in the open literature, and they may consist of many different types of material ranging from quantitative analyses of data to atlases presenting information largely in map form. The second level on which information might be provided is in formal military documents. For example, the basic Army document for specifying design criteria is AR 705-15, "Operation of Materiel Under Extreme Conditions of Environment," which sets forth the climatic limits for which Army materiel must be designed. These limits must be consistent with those specified for DOD use in MIL STD 210A (Climatic Extremes for Military Equipment), and with the limits agreed upon for use by the ABCA countries in various quadripartite agreements. The research on which all of these documents are based was largely performed in the Earth Sciences Laboratory.

The third level on which we present environmental information is in informal responses to inquiries that come both from within NLABS and from users in other parts of the defense establishment and their contractors. We have established a separate task to cover these advisory services and we answer outside inquiries almost daily. These inquiries cover a wide range - from summer temperatures in Ethiopia to the height of the forest canopy in Vietnam. Sometimes the answer can be provided by a telephone call; at other times it is in a letter report, maps, or data tabulations.

Two examples of products of the Earth Sciences Laboratory will suffice to illustrate the foregoing remarks. Climatic criteria for the design of materiel were first published in a Special Regulation in 1950. They were based on inadequate data, because data were not available for many parts of the world, and the form of presentation was relatively unsophisticated. This SR, which was to be used by designers, prescribed extreme maximum and minimum temperatures equipment had to withstand. However, to prescribe that all equipment must meet both the maximum and minimum extremes was inefficient. Furthermore, this initial guidance ignored the factor of length of time that such extremes might be expected, and the combined effect of temperature with other climatic elements such as wind and humidity. Subsequent research has made the design limits more realistic by incorporating into an Army Regulation more comprehensive data. These consider the interactions of different climatic elements, the occurrence of daily cycles in extreme environments, the percentage of time during which the extreme conditions might be expected to occur (or in other words, the degree of acceptable risk), and the delimitation of distinctive kinds of extreme conditions in different parts of the world. Eight climatic conditions have been recognized in the latest revision of Army Regulation 705-15, including two intermediate categories. Each of these categories represents distinctive conditions found in different parts of the world, and it is not necessary for a single item of equipment to meet all of them. The revision of the AR, incorporating these conditions, is now in an advanced state of coordination and is expected to be adopted soon for Army-wide use. A revision of Military Standard 210A for DOD-wide use is currently in progress in cooperation with the Air Force.

To make environmental information more readily available and understandable to design engineers, we have cooperated in several projects which are now either complete or in an advanced state. Several years ago, it was decided by Headquarters, AMC, to produce an environmental handbook for use of all AMC elements concerned with environmental engineering. This is intended to provide detailed information on the measurement, occurrence, duration, simulation, and testing of the effects of the more important factors of the natural environment. The Earth Sciences Laboratory is one of the chief contributors to the handbook, and has completed drafts of chapters about temperature, precipitation, humidity, atmospheric pressure, solar radiation, wind, salt fog, flora, fauna, and biodeterioration of materiel. These have gone to AMC Headquarters for consolidation with the contributions of other laboratories and commands.

The original plan of the Handbook called for a final volume to consist of a Glossary of Environmental Terms, standardized for DOD use. This, too, was assigned to the Earth Sciences Laboratory for implementation, with coordination by the Quality Assurance Office at NLABS. As it turned out, the final portion of the Handbook (i.e. the Glossary) was the first to be completed. It has been compiled, coordinated, and adopted as MIL STD 1165, which has been published and is now available to prospective users. It presents approved definitions of terms that are used in describing and studying both natural and induced factors of the environment. Most of these definitions were derived either from glossaries previously standardized by various DOD agencies, or from glossaries standardized by recognized scientific organizations.

The examples of end products that I have mentioned, namely, Army Regulation 705-15, MIL STD 210A, the Glossary of Environmental Terms, and the Environmental Handbook which is now in preparation, are formal documents presenting the results of earth sciences research. We consider as equally important both our research reports and the informal type of information that we can provide on short notice and which our on-going research program is intended to make us increasingly capable of providing. We invite all elements of NLABS to make use of these services.

AIRDROP ENGINEERING IN THE TECHNICAL DATA PACKAGE

COL James G. Bennett
Director, Airdrop Engineering Laboratory
US Army Natick Laboratories

Gentlemen,

Before discussing what our part in defense operations is, - and how our technical operations contribute to the solution and prevention of those problems which arise when fielding and maintaining equipment - let me first, quickly introduce to you, the Airdrop Engineering Laboratory.

Actually, our function is closely akin to logistics.

Our business in Airdrop Engineering is to provide the vehicle or means by which our troops may be supplied and resupplied by airdrop with not only food, clothing, and ammunition, but all classes of supplies.

Presently, we have the means by which we can airdrop to our troops, items ranging from lightweight food packets, to armored vehicles in the weight range of 20 tons.

The items which we develop range from such soft goods, as parachutes and webbing, to hard goods, such as cargo platforms, tiedown devices, to complete sophisticated systems for use with the new C-5A aircraft, - which incidentally, has a requirement capability of delivering on a single pass, fifteen 10,000 pound loads, or four individual 50,000 pound loads.

We feel that the function of our items are quite important to the safety of our troopers, as well as their personal support, and as well as the logistical support which was demonstrated at Khe Sanh. With all of its lines of communication cut off, annihilation was inevitable; however, by airdropping over ten thousand tons of supplies during the 76-day siege allowed this isolated outpost to survive.

Because of the criticality of our items, we depend on an extensive amount of testing to prove out the safety and reliability of these items.

We start off with the bench testing of components. Then, we go on to obtain an air safety write-off, which means we must receive Air Force approval of our item before we are allowed to use it in Air Force aircraft. This is followed by an extensive engineering-design test where we first "fly" the item. After this is accomplished engineering and service tests are conducted by the Test and Evaluation Command.

The testing develops a wealth of data used to verify the design computations. From this information, we finalize our technical data package. Integrated into this package and inherent to the item, is the reliability and maintainability considerations.

No one laboratory is completely self-sufficient, and we are no exception. We rely on the Clothing and Personal Life Support Equipment Laboratory for their expertise in engineering the fabrics of our soft goods items.

We depend on the General Equipment and Pa aging Laboratory to support us in some of the laboratory testing and their expertise in metals selection.

We depend upon the Pioneering Research Laboratory for the human engineering aspect and upon the Earth Sciences Laboratory to help us in establishing the operational criteria by telling us, for example, what ground winds we may expect in Vietnam on certain days in December, and what the weather will be in other places throughout the world, so that we may engineer our items and know that they will function in the environment where they are expected to operate.

The interfacing of the disciplines available here, and the interrelationships between the other laboratories, industry, and ourselves, is the true recipe for success.

We all realize that very few items developed ever pass smoothly from conception to the end of service life without a good number of problems arising - most of which have solutions.

For the next few minutes, I'd like to talk about an item called the "Cargo Parachute Release".

FILM (2 minutes)

A simple mechanical device is used to disconnect the parachutes from the load at ground impact.

Without such a device, the large cargo parachutes would drag the load causing serious damage to the equipment.

The item you have seen, was originally developed by one of our sister services and, offered in its original form, to the Army for evaluation.

From this evaluation, it was determined that the release would not satisfy Army requirements.

It was reworked and retested. However, new deficiencies were reported which withheld approval for issue pending re-engineering and subsequent confirmatory testing to ascertain that the deficiencies were corrected.

While a tremendous amount of testing is conducted to prove out an item, the true test of item suitability is when you buy a sizeable quantity and place it in the hands of troops. Troops will uncover any weakness that may exist, since they are the users.

Our item was re-engineered and a contract awarded to fabricate a small quantity of test prototypes, which after confirmatory testing were approved for field use.

While I have quickly glazed over this item, let me point out what took place from the receipt of the test item for evaluation, until the preparation of the final purchase description, covered a period of 2 ½ years.

We are now at a point in time where the Army is in a position to mass produce the item for issue and reserve stock.

Permit me to digress for a moment, since we are different from the other laboratories. Ninety percent of all the items which we develop have no counterpart in industry, whereas if industry had a similar item, we could probably be able to specify our items by performance.

But because of the criticality of the item, its peculiarity to military application, and because of the marriage of components to a system, we control our item by design, and therefore our specifications are design specifications.

The procurement package which is used in mass purchases contains all information and documentation necessary to obtain a competitive bid.

This package consists of the Technical Data Package which describes the materiel along with the administrative, legal, and fiscal information necessary to obtain the bid. Naturally, our lion's share of interest is in the Technical Data Package.

You recall the Technical Data Package consists of all technical data required to describe the item. This will consist of drawings, purchase descriptions, specifications, performance requirements, quality assurance provision and packaging.

We start our Technical Data Package as soon as possible in the development cycle, usually used for the first time in procurement of the engineering test prototype.

The Technical Data Package is a viable instrument which is continually improved and updated.

If we had the ideal situation after engineering test, when the design becomes firm, the Technical Data Package would be updated to correct all the deficiencies noted, and then used to procure ST models. Concurrent would be the production engineering phase, where the item would be made compatible with production methods, and in a form which would invite maximum procurement competition. The Technical Data Package would be tested by several concurrent small quantity procurements.

The data gathered from the production test, would be fed back into the Technical Data Package, which would be used in forming the final coordinated specification.

As I said, this would be the ideal. However, several external and overriding pressures are brought to bear, and the unusual becomes the usual. There usually is a desperate need by the field for the item, so we take a few short cuts to alleviate this solution. Funds are critical and in short supply, and certain priorities require that we adjust our schedule. Again, we eliminate a few steps.

With the case at hand, there was no production engineering conducted as a direct engineering effort: There was no designed production tests of the specification and drawings. Couple this with poor manufacturing quality control and poor contractor inspection and you have continuous brush fires which are difficult to extinguish.

Whenever deficiencies in an item such as the release is uncovered, our engineers are quickly put to the task of solving the problem, testing the solution, and revising specifications as necessary to prevent recurrence in future contracts.

Let me make something clear. We are not infallible, and deficiencies will crop up occasionally in our Technical Data Package. However, the majority of changes to specifications are made to beef them up to close loop-holes and to preclude the marginal contractor from delivering marginal quality items.

This has also been the case with the Release. Today there are about 30,000 items in the supply system from approximately five contractors. Of the five contracts, we have only three different fabrications. One of the five defaulted because of his inability to produce an acceptable item.

We, as do the other laboratories, continually police our Technical Data Package. We review and try to incorporate the latest production techniques. We review our package to eliminate unnecessary features - eliminate gold plating. We review our design to lower costs - value engineer it. And most important, we review our package for completeness and accuracy.

In closing, let me say that all of us in the Airdrop Engineering Laboratory believe we are doing our thing when we produce a good specification.

THE SPECIFICATIONS FOR CLOTHING AND TEXTILES AS RELATED TO THE REQUIREMENTS OF THE USER

Dr. S. J. Kennedy, Director,
Clothing and Personal Life Support Equipment Laboratory
US Army Natick Laboratories

The primary job for all of us here in the Army's research and development center at Natick, Mass. is to work for the ultimate consumer. The consumer is your brother, or husband, or friend in Vietnam, or the son of some friend who is somewhere in the Armed Forces scattered over the face of the globe wherever our Armed Forces are deployed. It is our job at Natick -- and not ours only, but that of many other people involved in this same overall task, to find out what he wants -- what he needs -- and then to develop it, test it to make sure it will perform its function properly and adequately, write a specification for it, and then ask DSA to buy it for us.

In that sense we at NLABS represent the consumer, because we are the ultimate organization that is responsible for translating his needs into three-dimensional items, and then finding a way to describe them in a specification which will set objective standards for you to bid on, and to produce against.

Let us look for a moment at our job here at Natick in terms of what the users want and need. Their needs are expressed ultimately in terms of specifications. Here you should recognize that there are three essential aspects to specification:

First, they are the end product of research and development. All of the research into materials; all of the study of design in relation to other elements of the soldier's clothing-equipment system and all of the consumer testing, whether in this country or in combat areas, is wrapped up into the specification.

Second, specifications represent the expression of the functional requirements of the user, which the research and development was conducted to meet; and third, they have been designed and worded to provide all suppliers with a fair level of competition.

In the area of clothing and textiles, we are concerned with two types of items:

Uniforms
Combat Clothing and Equipment

Requirements for service and dress uniforms are established by the Department of the Army Uniform Board. Ultimately, the Chief of Staff gives the final approval on any uniform changes.

Requirements for combat clothing and equipment are established by the Combat Developments Command, which determines requirements for all Army materiel out of their overall assessment of strategic requirements.

We can sum up the requirements for combat clothing by saying that the function of the combat clothing and equipment system is basically to provide protection against the battlefield environment. Its job is to provide the maximum protection which the state of the art will permit against not just the climatic environment, which you are most likely to think of, and the physical environment, expressed in terms of the terrain, the jungle growth, the mud, and all the rest that nature throws as obstacles in the way of the combat soldier, but also the enemy-imposed environment.

It must serve as multifunctional protection against Chemical Warfare agents, against flame, against the thermal effects of atomic weapons. It must protect against observation by all of the new sophisticated detection systems that have been invented, as well as the human eye and photography. Finally, it must include armor to protect the vital areas of the body to the maximum degree possible without seriously interfering with physiological efficiency.

This task of protection falls upon the soldier's clothing, footwear and equipment system. For only from textiles and textile-like materials can we satisfactorily fashion a protective shield against one of these hazards, which we refer to as the soldier's twelve-dimensional environment. And this shield must be integrated into what he wears or puts on his body.

But we cannot build a Maginot line around him. We are concerned with protecting a living being, whose level of body activity varies widely, and who is provided with a whole complex of body functions whose role is to maintain him in thermal balance, regardless of what his environment may be. Whatever we put on him affects his physiological responses. The more protection or protective devices we place upon him, the more we limit the period in which he can be effective as a combat soldier.

Accordingly, our task is not simply to develop effective means of protection against each of these hazards in a textile-clothing-equipment system but to incorporate all of these forms of protection into a single efficient system created from multifunctional materials. It must be a system that will react positively against several of these combat hazards simultaneously, so that it will provide some degree of protection against all of them.

To accomplish this, we need to have the benefit of all kinds of research, for ours is an inter-disciplinary task. We draw upon the results of research in many fields:

Physiology
Psychology
Human Engineering
Physics
Chemistry

Geography
Climatology
Medicine
Anthropometry
Materials Science
Textile Technology
Clothing Design

Contributions from all these fields find their wa .to our final decisions as to materials and design selection.

In a sense we are primary users -- perhaps, the primary users of the results of research in many of these fields here at Natick.

Our aim is to be alert to what other elements of this Natick research complex can contribute to attainment of our objectives, as well as to what is being done in industry and in the fields of science outside. They need also to be alert to our needs and to adjust their progress so that they will be making positive contributions to our development programs.

I could say a lot about other development problems of working in a field which is dominated by art and craft, but I only mention the question once put to the late Albert Einstein, who was asked why with such great advances in science, it was not possible to distribute the fruits of these achievements more effectively to the peoples of the world. He replied, "Politics is much more difficult than physics."

I think we can say the same of this problem of protection against modern munitions, that it is much more difficult to counter the effects of the rapidly increasing lethality of weapons with a protective system, than it is to develop the weapons and munitions themselves. Just look at the problem of protecting against atomic weapons.

When you look at the broad spectrum that extends from basic research on the one hand, to the art of clothing design on the other, it is apparent that as you progress out of the field of basic research toward engineering and the art and craft of clothing design and construction, the application of science becomes more and more difficult.

And yet in spite of this, our accomplishments in providing protection have been impressive. We have body armor in Vietnam that has saved many lives. Most people, particularly military officers, who are entranced by exotic new weapons take clothing and footwear for granted and do not recognize what a miracle clothing actually is; what great technical achievements, what imagination and art have gone into the creation of mass-produced clothing that will fit figures of all sizes and shapes and provide significant protection against the whole spectrum of the hostile environment. Just because this is so is no reason why we here at Natick should sit by quietly while the so-called "pure scientists", and "basic research" devotees look askance at us.

We are accomplishing something useful -- even though they may be shocked at the idea.

We are working for an objective, to protect our combat troops, and we need the results of their research to help us.

Ultimately, after the item is developed, we shall need a purchase description. The first edition has to be developed during the development process, but it becomes improved and refined progressively as development and testing progress, until the item is finally type-classified.

What we produce, accordingly, in a purchase description or specification is:

(1) An accurate description of materials
designs,
construction details,
major test criteria
for establishing the standards of performance of components and materials.

(2) A standard for fair competititive procurement.

In clothing we have a further task, and a very different one, of developing patterns and grading them.

When you go into a retail store to buy a ready-made suit, you can expect to get fairly well-fitted without major alterations, because the industry produces a very wide range of sizes. A good men's clothing store, for example, at the start of the season would start with the minimum of 100 sizes. Several years ago we checked into this and found that Wannamakers in Philadelphia start the season with 100 sizes; Hart, Schaffner and Marx retail stores at 97; Jacob Reed with 155; and Barney's in New York, who specialize in fitting outsizes; with 168. To do this, the basic pattern must be good and a great deal of skill is required in grading these patterns so they fit properly.

Having prepared the specifications and the patterns, we must then clear the specifications with the other Military Services since we in the Army Natick Laboratories have the responsibility on all common-use items used by all of the Military Services. Also, the specification must be cleared with representative firms in the industry concerned.

Finally, the specification on clothing and equipment items is sent to the DSA Procurement Center at Philadelphia (DPSC) as a specification citation for procurement.

I might add beyond this that we also have a big job to provide DPSC with technical support across the whole spectrum of their procurement actions. This includes such things as providing assistance to contractors who have taken a contract and do not know how to fully make the item; provide technical support in legal cases; assistance to inspection; and many other forms of technical support.

In this area we have many problems, but perhaps the biggest one today which is particularly evident is the maintenance of quality. I am not so much concerned with those aspects of a specification that are subject to objective laboratory testing. While laboratory test methods in the fields of textiles and related products are not perfect, we can generally rely on them to protect the interests of the military consumer.

The area that is most troublesome is the matter of definition of quality in aspects that are not subject to laboratory testing -- overall quality, i.e., freedom from defects, and the standard of quality in respect to defects.

Today this problem is more acute than it has ever been before in my experience. It is true in commercial sales as well as in our procurements.

I am referring to the increasing amount of defective merchandise which is reaching the consumer, merchandise which is competitively priced with good style and appearance, but which is seriously falling short of consumer expectations.

A few months ago I went to a store with my wife to buy a new fall coat. It was a top quality women's specialty store, and its goods are not low-priced. When she went to button up the first coat she tried on, a button came off in her hands. Then a second button came off. She turned to me and said,"What do I do with these buttons. Whoever buys this coat is going to want them."

Let me read you an excerpt from a recent newspaper article from the Providence Evening Bulletin of September 30:

> "Los Angeles--Nellie Wong donned her new $50 frock for the first time and headed off for her job as a secretary at Bethlehem Steel Corp. in San Francisco. She sat down to type, glanced down at her side zipper and gasped as she watched it creep open by itself--from the wrong end.
>
> "That's nothing, Nellie. You should see what the store that sold you the dress is contending with these days. And the factory that made it.
>
> "In fact, the entire clothing and textile industry, from raw fabric producer to retail merchant, is facing a titanic new problem with defective goods. A cross-section of leaders in the industry agree that the percentage of materials and finished garments leaving the factory with serious defects may be as much as double what it was just 18 to 24 months ago.
>
> "So bad is the problem at times that one major San Francisco soft goods chain shipped back one-fifth of all the goods it received from the factory during one month this year. The average isn't that bad, of course. But Judy's Merchandising Corp., a 14-store Los Angeles-based chain with nine million dollars annual sales, figures it is sending back "way over 10 percent" of everything from suppliers. That compares with less than five percent in 1966.

"At the manufacturing level, Levi Strauss & Co., San Francisco, one of the biggest pants makers, has shipped back about two million yards of unsatisfactory fabric in the last 12 months.

"A Burlington representative recently said, "People are paying more money for an item; so they're looking more critically at quality."

"Consumer complaints about shoddily put together merchandise, especially durable goods, have been mounting generally in recent years. But the consumer is turning his ire on clothing defects."

First, let us face up to the fact that the clothing and textile markets have undergone a profound change in recent years. There has been an intensification of the sensitivity of the market to pricing, cost control and the demands of the market for style and fashion. As a result, price and style have assumed more complete control of the market situation. Most of today's serviceability problems on consumer's goods have been related to the high rate of introduction of new materials, new processes and new products to meet these demands of style and fashion. There has been a new generation of products; we need mention only permanent press items, stretch materials, bonded fabrics, soil release fabrics, new types of knitted outerwear fabrics, non-woven interlinings, and many others.

The trial and error approach to which our industries are accustomed for establishing an optimum balance between price, consumer appeal and performance in service has lagged behind the accelerated rate of commercial introduction. The feedback of information to the materials' originators has been inadequate; new products have displaced those with which the consumer was dissatisfied, before his complaints got back to the maker. It has seemed that if you can just get the item on the market, regardless of quality, it will sell to consumers who have been so manipulated by the forces of advertising that they will not care whether they get good service out of it or not.

Should we expect that people who have been taught by mass communication that they should buy something only to wear it for a short time because it will be obsolete from a fashion standpoint; that quality is not really important and that outward appearance is all that counts, that things are to be thrown away long before they are worn out? Should we expect that these people will be quality conscious when they go to work in industry to make items for the Military Services?

This problem exists even in the distributing trades.

Jack I. Straus, Chairman of the Executive Committee at Macy's, used the occasion of an annual luncheon of the Broadway Association recently to ask some of the questions that have bothered many of us for a long time.

"Why does a clerk in a store, yes, even in Macy's, seem uninterested in waiting on a customer who's willing and anxious to make a purchase? Why is room service in hotels often so slow? Why is service so notoriously poor, and attitudes so unaccommodating at auto-repair shops?"

Straus was primarily concerned about the phenomenon of indifferent customer service, but the same unwillingness to set high individual standards is true of so many persons in the workaday world. The Macy's executive couldn't quite put his finger on the answer to his own questions. He thought it had something to do with today's more permissive society, perhaps the greater availability of jobs, possibly the workings of a system that bases promotion on seniority rather than merit.

What we have done in this new economy of style obsolescence is to take away pride in workmanship. Years ago Thorstein Veblen spoke of the instinct of workmanship as the means whereby more effective means would progressively be developed for promoting the material welfare of society. When we destroy this kind of workmanship by creating a pyschological climate in which it is looked down upon as unimportant, we undermine one of the foundation stones of our society.

From the consumer's standpoint, and that is how we look at it, we are concerned with how we can maintain necessary and fair levels of quality in a market where the industry itself is moving away from intrinsic quality under the impact of this accelerating control of the competitive system by price and style.

To deal with this problem, we in the Clothing and Personal Life Support Equipment Laboratory, have been at work to try to simplify and improve our statement of quality requirements in our specifications.

(1) We have reviewed and revised our two basic test method specifications:

CCC-T-191
KK-L-311

to adapt them more adequately to mandatory contractor testing.

(2) We have studied the application of reliability concepts and practices to clothing and related items and initiated programs to develop means for quantifying certain aspects of reliability as it can be applied to clothing and textile items.

(3) We have also developed a new system for identifying quality in textiles which we refer to as the "point system". In this system we obtain one numerical value to identify the quality of a lot, e.g., a fabric is identified as a 20 point fabric or a 30 point fabric etc., indicating that its quality level is equivalent to the sum total of the defects identified in its evaluation. Thus, a 20 point fabric is better than a

30 point fabric. Similarly, we are developing a simplified point system for clothing which will utilize a standard listing of defects with point values assigned to each. By using this the contractor can identify the quality level in each of his manufacturing operations or plants or sections and thereby readily control his own quality of product by insuring that his product at each point of manufacture meets his own standards. This new system is about to go into production testing.

Robert Louis Stevenson once said, that whether on the 1st of January or the 31st of December, faith is a good note on which to end.

So I feel that this is the proper word on which to end this statement about specifications and quality on our clothing and textile items.

Despite the technological revolution which is occurring in our industries, and the doubts being created in the minds of the general public as to the importance of serviceability and quality, I still feel confident that the contribution to the American public, and to the whole world which the American clothing, textile and footwear industries have made in the creation of high quality mass-produced items will continue, and that despite these difficulties we in the military services will be able to obtain our specification quality items of protective clothing and equipment for the combat soldier.

TECHNICAL DATA PACKAGES - A VARIETY

Irving M. Weitzler
Associate Director
General Equipment and Packaging Laboratory

The General Equipment and Packaging Laboratory's commodity mission area is basically general supplies which include mechanical equipment, shelters, and packaging and packing materials and machinery. This wide diversity of products, both of military and commercial origin, requires a similarly wide variety of technical data packages for use in procurement of equipment and in control of design to insure compliance with all military user requirements.

GEPL's work includes participation in programs of (1) research and development; (2) production engineering; (3) procurement of equipment and missiles, Army (PEMA); (4) engineering support; and (5) standardization. In the mechanical equipment area, the end product of all these technical activities is a TDP, regardless of the program under which the requirement was initiated and the design established and accepted. Specifications and standards with supporting data such as drawings, associated lists and supplementary quality assurance provisions, make up our technical data package.

For major items of Army equipment, all of the five programs which I have just mentioned may be involved on the same item. If these major items of equipment are of military design, the design is established, evaluated and accepted under the R&D Program. The Production Engineering Program may be involved in refining the producibility and broadening the procurement base for greater competition. The Standardization Program then reflects this approved design in the specifications and standards as a technical data package, and engineering support is furnished during the procurement, inspection, and acceptance phases of supplying these items to the field.

Commercial items are adapted to military requirements generally through our overall production engineering program of which PEMA is a part. Many commercial items are included in the GEPL, PEMA Program.

Throughout the development and refinement of technical data necessary for procurement, there is a continuing working relationship between the design and development personnel responsible for acceptability of the item and the standardization personnel who will eventually formalize these data into standardization documents. The design people must insure at all stages of development of the technical data that the integrity of their research and development is maintained and also insure that expansion of requirements in the interest of securing competition does not disturb the acceptability of the item to its user. By the same token, the specification writer under the Standardization Program must reflect these requirements in a document which will provide the best possible procurement situation and still maintain the performance requirements of the item.

To be responsive to development and type classification forecasts, we try to have the technical data package available on the date of type classification of the item so that procurement can proceed immediately. To insure availability of the document it must be started during the development cycle generally at the test and evaluation stage of the prototype. Our technical data package keeps pace with the progress of the design even though changes are still being made.

When the technical data package is later used in procurement, engineering support is furnished by both design engineers and specifications writers in the form of clarifications, interpretations, and processing of recommended deviations and waivers to specification requirements.

The preparation of a technical data package for some mechanical equipment also requires coordination with and participation of other engineering elements within the Army and Department of Defense responsible for components utilized in our equipment systems. For example, the mobile field laundry is, in effect, a laundry equipment system which incorporates such major subsystems as an engine-generator and a trailer. The engine-generator incorporates a military gas engine as a component. The technical data package in this case must reflect adequate systems engineering to insure compatibility of components and subassemblies in an end item system performing to the basic military characteristics for the laundry system. Many times these major components are purchased by the Government and furnished to systems contractors as Government Furnished Material (GFM). The Government, therefore, maintains the responsibility for the satisfactory operation of these GFM components as issued to the contractor. The systems specification and the total technical data package must be written to provide satisfactory overall performance of the system regardless of the lack of responsibility of development for certain GFM components. What I mean here is that, for example, if an engine developed by another Army agency is to be used as GFM in one of our systems, we must bear the responsibility for that engine to work properly within our system. Even though the engine may have been type classified as a military standard, we must still assure that it will work properly in our system and if it does not, we are responsible and not the original developer of the engine.

As would be expected, the preparation of the Technical Data Package brings into play many diverse technical disciplines and programs. It, therefore, calls for very close coordination of the input of these various technologies. When the coordination is good, you usually wind up with an excellent Technical Data Package. When it is not good, you usually wind up with a can of worms.

To outline or illustrate some of this interplay among technical programs in preparing, maintaining and supporting technical data packages, you may be interested in some of the events connected with the development and purchase of the single-trailer mobile laundry which is now being used in Vietnam.

The origin of the development goes back some years, but nevertheless there is an unbroken chronology delineating major milestones which had an effect on the Technical Data Package.

The Army established a requirement for a single-trailer laundry to replace the previous two-trailer laundry.

An R&D contract was awarded for development and delivery of test prototypes and engineering drawings.

The trailer and engine-generator were being developed and procured under two separate contracts and were being furnished as GFM by us to the contractor for use in the prototypes.

It was necessary for us to coordinate closely with Ordnance Corps to insure maximum use of standard parts in the development of the trailer; likewise with the Corps of Engineers for the engine-generator.

During the R&D contract, reviews were made to insure ease of maintenance and use of standard parts to be reflected in drawings being made by the development contractor.

The preparation of drawings was monitored by us for control of format, size and identification. These drawings were purchased to be used as part of the specification for the laundry. No documentation other than these drawings was purchased as part of the development contract.

A combined engineering test and user test was conducted by the test agency.

A standardization project was initiated to prepare a specification for the laundry unit in anticipation of type classification.

A request was received from the PEMA Supply Manager for a TDP in anticipation of first procurement for programming purposes prior to type classification.

Our draft specification was converted to purchase descriptions for use as a TDP for PEMA procurement. Separate purchase descriptions were prepared for the laundry equipment, trailer and generator. These were written by us.

The preliminary report of test and coordination with maintenance people required certain changes necessary and the purchase descriptions were revised accordingly.

The item then was type classified; however, the procurement which had been planned right after type classification was cancelled and this allowed us the time to complete the specification project and publish the formal military specification.

Subsequently, the responsibility for the specifications for the trailer and for the engine-generator were turned over to TACOM and MECOM, respectively, as a result of the Army's reorganization and realignment of responsibilities. The specifications they have produced for both of these items are now a part of our overall Technical Data Package for the laundry by reference.

A procurement was subsequently scheduled for the laundry. During plant surveillance by DCAS inspectors, difficulty was being experienced (by untrained inspectors) in establishing workmanship standards and criteria for acceptance. As a result, supplementary QA information was furnished DCAS on workmanship defects to be checked and close coordination was maintained between the manufacturing operation and NLABS.

After completion of the first procurement, extensive coordination was conducted with all interested activities prior to drafting of formal revisions to the military specification and updating of the entire Technical Data Package. From this, a limited coordination revision to the specification was issued to incorporate all of the changes brought to light.

Another procurement was made and input from this procurement was coordinated into an additional revision of the Technical Data Package.

As to today, NLABS is watching closely the development of a new tandem axle trailer by TACOM for possible use in the future since TACOM is attempting to standardize this tandem axle trailer for optimum application. Also, NLABS has designed and has under test a modified washer extractor drive using a fluid coupling to reduce generator peak load, with a view toward extending the service life of the generator. This work is being done under a product improvement program. If we are successful, then the Technical Data Package will once more be updated.

Obviously, during the course of the above events, we ran into technical problems that needed resolution. For example, the trailer needed modification for an overloaded condition. Stiffer springs were used to correct it. As a result, greater shock was imparted to the laundry equipment. This necessitated additional bracing of the laundry equipment. There were still other problems that required similar additional technical changes and decisions.

Generally speaking, if we have responsibility for the development or adaptation of an item, then control and quality of the evolving Technical Data Package is no great problem if we use the resources available to us wisely. The problems arise with the procurement phase when changes and waivers begin. Also, another problem is the limited availability of feedback information both in ongoing productions and from field usage of the items. In other words, a Technical Data Package is a dynamic not a static document. Its currency is only as good as the feedback information by which it is continually updated. If this information is valid and flows freely, the Technical Data Package will continue to be good. If not, then the Technical Data Package becomes obsolete.

The importance of the Technical Data Package is now further emphasized in the current staffing of a Technical Data Package AMCR at AMC Headquarters. This will be the first AMCR specifically addressing itself to the whole TDP.

EVOLUTION OF THE FOOD PACKET, LONG RANGE PATROL

F. P. Mehrlich
Director, Food Laboratory

The story of the development of the Food Packet, Long Range Patrol is a success story. It can be used to illustrate the interplay of research and development: It grew from a gleam in the eyes to a full-blown subsistence achievement because of the breadth of supporting information available to the developers owing to long continued studies by a score of individuals in our Laboratory. When the requirement was placed upon us to produce a startingly new type of food packet for use in Vietnam, we were able to respond quickly and adequately.

The ground was prepared for such a genesis years before the Southeast Asian conflict broke into full fury. Planners in the Department of Defense and in the Army conceived of the battle grounds of the future as those in which a high degree of mobility would be required. Quick assembly and quick dispersal of fighting units was conceived. Free-fall air drop was considered to be a preferred supply technique under conditions of strong enemy challenge to small or larger forces. Military characteristics for foods under development to subsist in these theatres had to emphasize what in modern terms we are wont to call "convenience": ease of preparation, or no preparation at all prior to eating; compact format, minimal weight, nutritional and microbiological stability.

During the mid-1950s the concept of preservation of foods by freeze drying had yet to be proved. This technique, however, was chosen, because of the demonstrated capabilities of freeze drying to conserve the primary quality attributes of food for long periods without refrigeration. Through freeze drying, a process comprised of the steps of quick freezing at low temperatures (of the magnitude of -40°C.) and sublimation of the water at high vacua (a few millimeters to a few microns of mercury) reduction in weight amounting to as much as 70%-90% of fresh weight could be achieved. Thus, in transport and storage, weight could be reduced to 20% or 25% of initial weight. Shelf-life of the products conserved in this manner would exceed in many instances that of foods preserved by more conventional means.

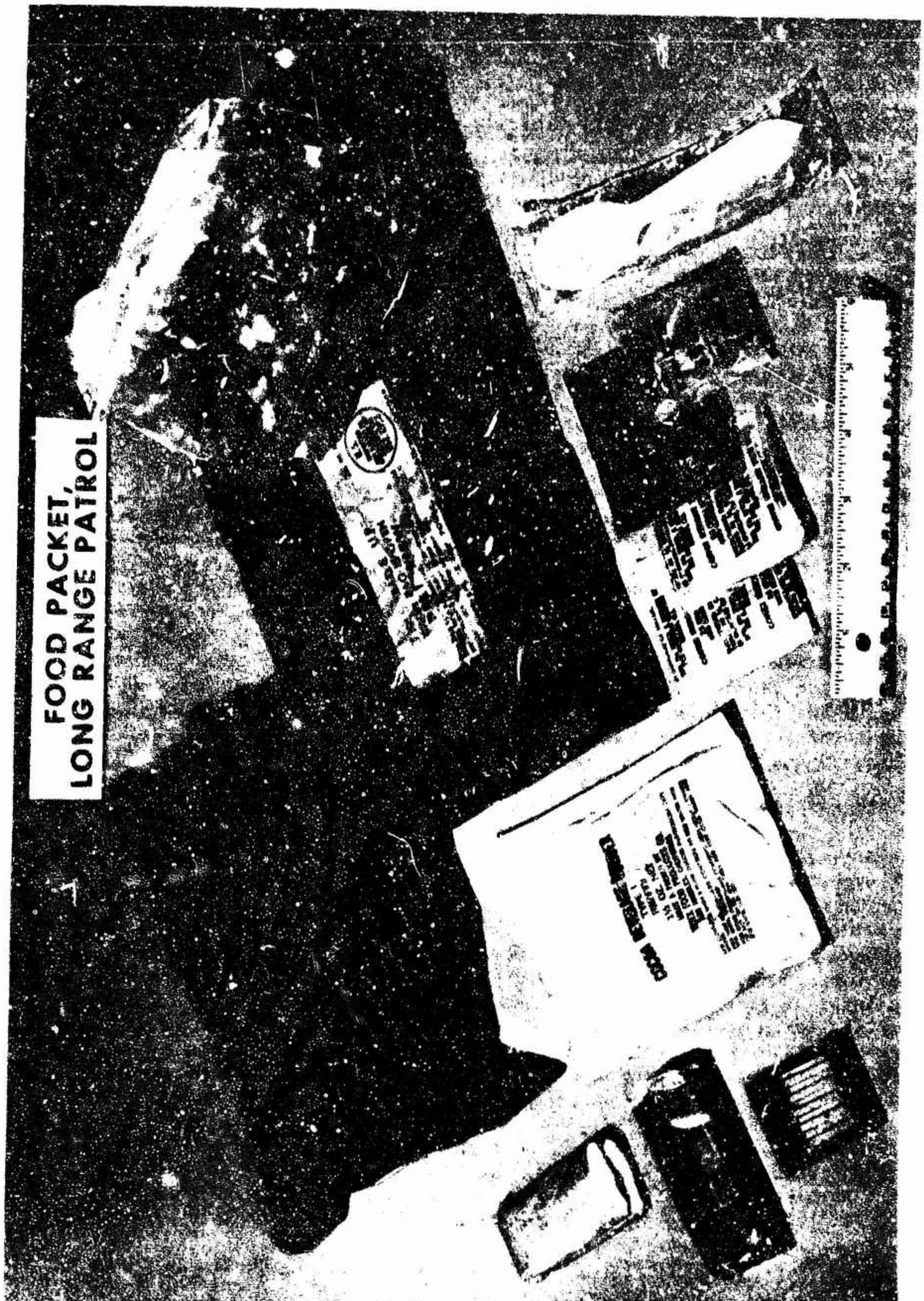
Freeze drying was proved to be an elegant process for stabilizing quality at a high level: It was the only method used during WWII for the preservation of the life-giving biologicals, blood plasma and antibiotics. But owing to the relatively small tonnage of such products required, efficiency of the process, from an engineering standpoint, had not been achieved. It was costly, therefore, and wasteful in the use of labor.

It was necessary to start almost at scratch in designing laboratory and pilot plant equipment and procedures. Pioneering in this field has characterized our efforts during the past 10 years. Through our persistence and successes, industry was impelled to take a second look at the potentials of freeze drying. Combined efforts have brought this process to a position of dignity in virtually every food processing company world wide. Drying times were reduced from 24-30 hours to time frames of 4½ to 6 hours, and in special cases in the drying of emulsions or of finely comminuted slurries drying times of 1 to 1½ hours have been achieved in continuous flow, virtually automatic equipment.

Costs of freeze drying have been reduced continuously, from initial levels of as much as $0.30 per pound of water removed to as little as 1 cent to 1½ cents per pound on the same basis. Many operators experience costs in the area of 5 cents to 6 cents per pound.

Teams of experts in our laboratories have become world famous for their studies on textural problems, as these are related initially to improvement in or preservation of the original texture of a wide array of plant and animal foods. Completely new concepts in modes of measurement and definition of the several important parameters of texture have established themselves as keystones in the structuring of food science and technology. Elite, pioneering efforts in the measurement of lipid-protein and lipid-polypeptide systems have derived sensitive new methods, an understanding of underlying degradative phenomena in areas heretofore relatively unexplored, and more importantly from a practical standpoint, the establishment of new methods for stabilizing such food systems.

New, masterful studies of oxidative changes in dried biologicals and foods have lead to the development of mathematical models and clear insights into means for blocking such unwanted changes. Such efforts in their totality,


FOOD PACKET,
LONG RANGE PATROL

even though far from completion, have afforded erudite guidance in the formulation of products and processes used in the beloved LURP of the GI in Vietnam...the name accorded to the Packet, Long Range Patrol, by our customers in Southeast Asia.

Proceeding apace in the development area were the formulation of scores of new kinds of foods to be used in the "convenience" type meals under study: These were the Quick-Serve and the Meal, Uncooked, 25-Man.

The Quick-Serve meal, while setting the stage for the facile emergence of the LURP, has stature in its own right. Without the one, there would not have been the other. The Quick-Serve meal, not yet used, completed its development cycle with flying colors: It comes in 21 menus, seven each of breakfast, dinner and supper. The weight of a meal of this sort for six men, including the weight of the packing, packaging and food service appurtenances is only 9.2 pounds. Each module furnishes 1200 calories of balanced nutrition of excellent quality as a component of an integrated family of meals.

All that is needed to prepare such meals for eating is a quantity of hot water. For the Mark I model, the forerunner of the Food Packet, Long Range Patrol, boiling water was needed. As will be seen in the paragraphs that follow, it is now possible to develop Quick-Serve types of meals that can be reconstituted with water of ambient temperatures...the temperature of ground water in Vietnam, for instance. But even in the 1962 assembly, the quality of these meals, tested world-wide was so excellent as to gain plaudits usually reserved for Mother's favorite dishes: Approximately 100,000 meals were tested. A summary of these tests is shown in table 1. There is no question that these meals have met the military requirements (characteristics) laid down for them. But they accomplished a lot more than that: The quality of these and the avid acceptance of them in all theatres where tested gave to industry food for thought.

At the end of World War II, dehydration was a dirty word, and no self-respecting food purveyor would be found with such in his product line. The passage of years, the research referred to above, the careful, methodical development of new processes changed this concept drastically. No little credit for industrial interest and the consequent production-base for the manufacture of the LURP, or of the many dehydrated foods more recently introduced into the A/B rations, served worldwide in mess halls, is owing to the old Food and Container Institute in Chicago and to its successors at Natick. It goes without saying that industry cannot develop production capability for products for which there is no demand. Research and development contracts, test procurements, demonstrations in manufacturers' plants and in the Institute pilot-plants kept this art alive. Its value has only begun to be seen.

Without slight to the equally meaningful developments sparked by work on the 25-Man Uncooked Meal, we can thank the National Space Agency for unusual challenges that lead to the stimulation of new art connected with the preparation of compact, lightweight foods for the astronauts. In the

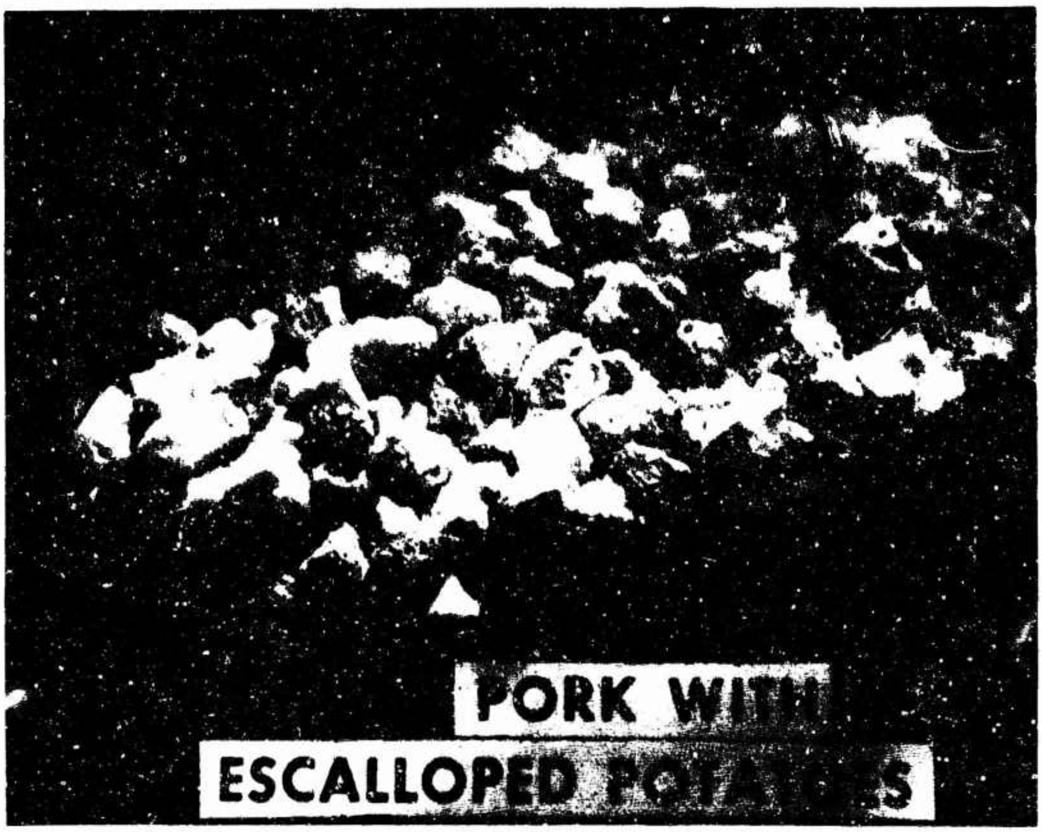
Table 1

Quick-Serve Meal

Acceptability in Field Tests

Date	QSM Test Site	QSM Average	Meal Combat Individual	5 in 1	Number Fed
1959	CDEC, Ft. Ord, ET	6.1			2,509
1961	Ft. Benning, ET/ST	7.8	5.3	6.3	11,500
1961	Yakima, Wash, ET/ST	7.4	4.7		33,000
1962	Mar Corps, Caribbean	7.6			11,000
1962	USAF, S. America	6.7			810
1962	Arctic Test Alaska, ET/ST	7.3		7.1	27,355
1963	2nd Cav, Seventh Army, Europe	7.2			152
	MCI Test Site				
1957	Arctic Test Alaska, ST		6.8		499
1957	Temp/Jungle, ST		6.5		848

CHICKEN STEW



PORK WITH ESCALLOPED POTATOES

Mercury flights, water at a temperature not exceeding 80°C. was available for the reconstitution of foods aloft. Weight savings derivable from the dehydration of the food were most meaningful, for to place a pound of payload into orbit required 1,000 pounds of vehicle and fuel.

To meet the extraordinary needs of the space missions, our technologists found that rapid rehydration could be achieved by cooking all components of mixed dishes together, freezing these and drying them in a vacua. This was in contrast to the separate drying of ingredients in the Mark I model of the Quick-Serve meals...followed by formulation thereof after drying.

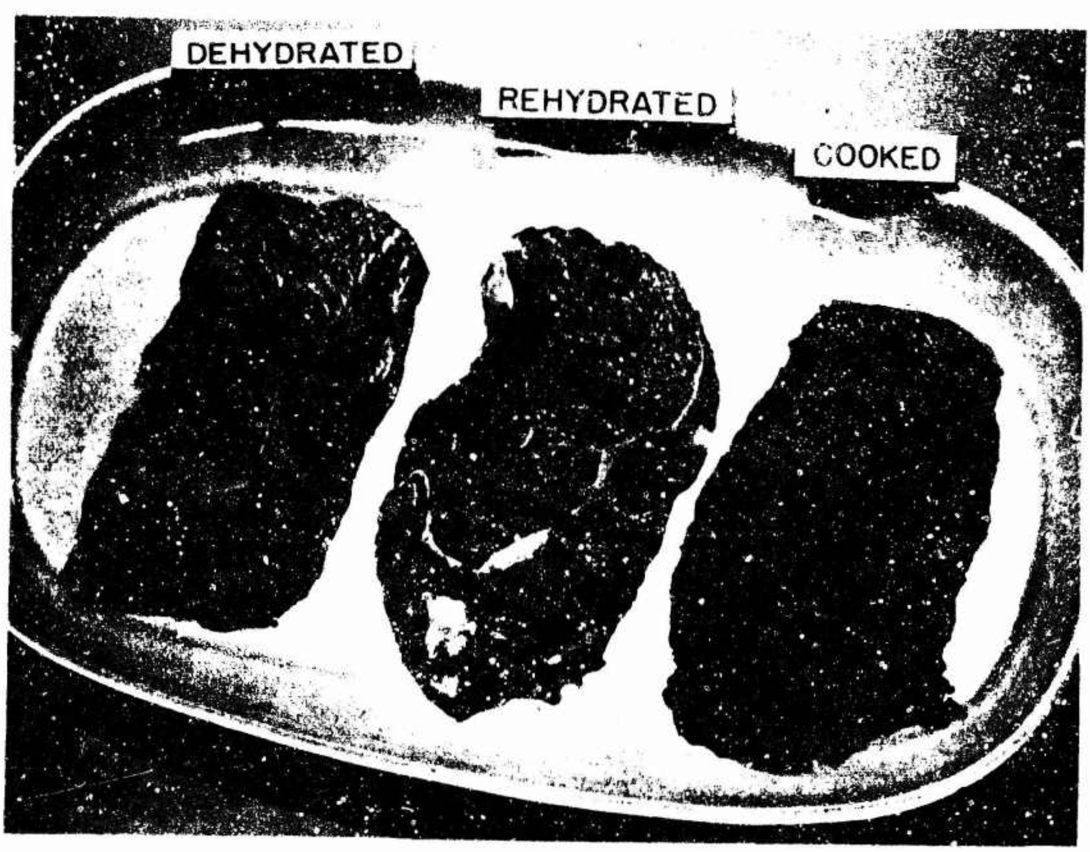
Thus was the scene set for rapid response to a request from General Yarborough, commanding the Special Forces in Vietnam to make available as soon as possible a new kind of food packet: One as light in weight as feasible, of high quality foods, good enough to tempt the appetite of men with "lumps" in their throats and in their bellies. The contours of the packet were to be such as to facilitate the stashing of it in the gear. Free-fall delivery potential was desired. Enough menus to avoid cloying repetition was stipulated. Enough food to keep body and soul together was to be available in each packet. With such there were also to be several non-food items and beverage powders.

Eight menus were developed, depending on experience gained in the production of the Quick-Serve meals. A quantity of 600,000 of these were procured during 1963, for testing in Vietnam. To assure expeditious availability, dependence was put on the tried methods used in the Mark I model of the Quick-Serve meal.

Formal Service Testing of the Packets was accomplished by USATECOM during July and August 1963; they were approved for Limited Production, December 1963. Special Forces in Vietnam requested that additional quantities of these be made available. Comment was directed to hoped for improvement in the rehydration characteristics of the entrees, but with or without the improvement, they were wanted.

Two million packets of a Mark II model were supplied by procurements made in the time frame of 1966-67. The new look incorporated the lessons learned in the design of space foods, as noted. Now it was possible to eat the entrees using cool water to reconstitute them, or in the absence of an immediate supply of water, they could be consumed dry, just as is buttered popcorn. Improvement in packaging was also accomplished to prolong the shelf life of the freeze-dried components.

For the first time in the history of the development of military foods, fan mail began to arrive from Southeast Asia: at the end of this dissertation I shall quote from one of these letters. Suffice it to say at this point, there no longer was any doubt in the mind of the GI as to which side the food technologist was fighting on! Available in Vietnam were 250,000 of each of the following 8 menus: Beef Hash, Chili Con Carne, Spaghetti with Meat Sauce, Beef with Rice, Chicken Stew, Pork with Escalloped Potatoes, Beef Stew and Chicken with Rice. Each supplied approximately 1,000 calories of nourishment.



Freeze drying process. Frozen steaks being placed in vacuum dryer.
Freeze-dried steaks. Ready for eating in three stages.

During the succeeding year, 1967-68, 8 million packets were procured, and some 12 million were bought last year, 1968-69. A very important story is told in the declining prices charged for successive orders: In 1966-67, the average cost of the entrees in the 8 menus was $1.53; the '67-68 price was $0.99 and in the most recent procurement it had declined to $0.75, on a comparable basis. This is not a new story, but it is one that justifies emphasis: Industry will produce for the military what it needs, if the volumes purchased are sufficient to warrant investment in construction, or in modification of necessary production equipment and lines. Recurrent purchases allow a more rational write-off of investment costs, and assures lower prices to the government. Such continuity of purchasing also allows time for the producer to assess the nature of civilian markets that can be developed for the same or like foods. Such stimulation to business makes sense, and again is reflected in economies for the military customer.

Had questionnaires been sent to industry without prior contacts between the technical personnel of the Institute and the potential producers, it is my point of view that the finding might well have been that there existed no capability in the country for supplying the needed commodity. Our approach was to contact people whom we thought had a capacity to produce the Long Range Patrol Packet, explain to them the novel steps, and means for fitting this operation into existing plants. Response to invitations to bid, tendered by DPSC, indicated the validity of this type of approach. Nor did our contact with industry cease at this point: It was necessary to visit the plants of the producers and counsel them, and at sundry times during the development of both the Long Range Patrol Packet and the Quick-Serve Meal, individuals and groups were invited into our pilot plants to discuss the steps essential to assure a smooth transition from experimentation to commercial production.

The many conferences sponsored by ourselves and the R&D Associates also had a bearing on the readiness of industry to meet their part of the challenge.

Type Classification of the Packet as Standard A occurred on 19 October 1967. We have not met a single returnee from Vietnam who has not had a good word to say about these packets. We might also take this opportunity to point out that the same technical background that lead to this outstanding development can be applied, as necessary, to the development of a Mark II model of Quick-Serve Meals.

In closing, I should like to quote from one of the many letters received from Vietnam about the qualities of the LRPP:

".....Gentlemen, if you would be so kind, would you please send me information needed to order more of your incredible and most delicious product? Even a short note to my parents so they could take the steps necessary to send more of your product would be immensely appreciated. Their address is as follows:....

A quick-serve meal.

"Before I close, I'd like to add that several other Marines are also interested in your product and that their appreciation and thanks would likewise be extended in the light of your acknowledgements and the time and effort that it might require. Yours truly,

Pfc. R.C.F.---
2nd Battalion 5th Marines
E Company 2nd Platoon
FPO San Francisco, 96602

P.S. If you have a cute little secretary have her write also!!"

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13. ABSTRACT

The role of the US Army Natick Laboratories in Defense Operations was defined during proceedings of a conference which covered the steps leading From Research to Technical Data Package. The conference was held on 17 April 1969.

The subjects presented included presentations on the Department of Defense Standardization Program Management.

The mission of the Army's Natick (Mass.) Laboratories - from research to technical data package - was described as the end product of science, engineering, technical services - the fusing of all skill levels and interests. Areas covered which contribute to the preparation of the technical data package for which the Natick Laboratories is responsible included specifications for clothing and textiles, earth science research in military applications, airdrop engineering, basic research, general equipment and packaging, and rations research.

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