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**ANNUAL REPORT -
FISCAL YEAR 1980.**



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**U.S. ARMY
INVENTORY
RESEARCH
OFFICE**

December 1980

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report describes work done by the US Army Inventory Research Office during the period October 1979 - September 1980. Reports published during the period are listed, along with papers presented at professional meetings and notes on other professional activities.		

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US ARMY INVENTORY RESEARCH OFFICE

OVERVIEW

This report describes IRO activities in FY 1980. Annual Reports for previous years go back to FY 1966.

Six projects were completed during the year. Two were terminated (one combined with another project) and two suspended owing partially to influx of higher priority work and partially to travel restrictions. Fourteen were carried over into FY 1981.

One major new project which came in unprogrammed during the year and which drew on a significant portion of the IRO resources was Combat Prescribed Load Lists/Authorized Stockage Lists (PLL/ASL). This program was initiated by the Chief of Staff and is being executed under direction of the Army DCSLOG. DARCOM has the responsibility for developing, distributing and maintaining these Combat PLL/ASL, which are tailored to sustain combat operations of field units under specified scenarios. IRO's task is to develop models for wear-out failures and AMSAA for combat damage; MRSA is to take over the models for PLL/ASL production runs once the methodology has been checked out. PLL's were computed for Tank and Mechanized Infantry Companies for a field test held at Fort Carson in September. Additional PLL's and supporting ASL slices were then computed for an expanded test to be run in USAREUR in 1981. IRO, AMSAA and MRSA are now heavily involved in data collection and evaluation of test results to see what methodological or procedural modifications are needed before full scale list production begins.

Other IRO work continued to move forward satisfactorily. Enhancements continued to be added to the SESAME model based on decisions of the DARCOM Provisioning Technical Working Group. Use of the model expanded greatly during the year and IRO spent a good deal of time in helping Project Managers and MRCs use the model and adapt it for application into unusual weapon system and maintenance support configurations. The TWG also took over management of the IRO Bare Bones War Reserves program and an enhanced model is now under development. Another major effort involves redesign of the War Reserves ADP System. At IRO recommendation, AMSAA is performing a preliminary concept study to assure that system design will proceed on a sound policy foundation. Other work in this area included a study on changes needed in the CCSS Supply Management system to enable it to cope with surges due to war emergencies. And, the latest in a series of projects on development and evaluation of forecasting models was brought to a close.

The IRO staff remained unchanged during the year but there were developments affecting future staffing. Commitment was made (through AMSAA) to hire Meyer Kotkin, a PhD candidate at University of Michigan. He had worked at IRO for a summer and has been a part-time OR Analyst at TACOM for the past year while finishing up his course work. He is expected to start at IRO in November. Also, arrangements were made to have Professor Larry LeBlanc, now at Vanderbilt University, assigned to IRO as a Mobilization designee. He spent his summer tour of duty here in July and contributed in development of a linear programming formulation of the Combat PLL model.

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Improvement of Distribution Effectiveness

IDENTIFICATION NUMBER:
IRO Project No. 253

REPORT: "Effects of Backorder Release Policies on Distribution Effectiveness and Customer Wait," Robert L. Deemer, IRO Final Report, October 1978 (AD A060022).

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Supply and Distribution, DRCMM-S

PROJECT OFFICER:
Robert L. Deemer

INITIATION/COMPLETION DATES:
February 1977/December 1979

ABSTRACT: The U. S. Army Development and Readiness Command (DARCOM) depot system went under the Area Oriented Depot (AOD) concept in 1975. With the advent of AOD came the idea of not releasing low priority backorders at out-of-stock depots when stock arrives from an outside source at one of the depots on the premise that an additional shipment might already be underway to the other depot(s).

A model was developed to determine when it is advantageous to hold backorders and for how long. Model was applied at one MRC in FY 79 but after results were reviewed, sponsor requested that model be applied at all MRCs and that additional measures be tested. The additional work was completed and reported to sponsor in Dec 79.

MAJOR CONCLUSIONS/RECOMMENDATIONS:

Distribution Effectiveness (DE) cannot be improved sufficiently by holding stock against low priority backorders to reach the DARCOM goal of 90%. Although holding stock in anticipation of receipt of additional stock is beneficial to DE, it results in longer customer wait times. For batch delivery contracts, it was found that an 8 day backorder hold time gave minimum customer wait with only small increase in DE. However, it was found that backorders should not be held at all on phased delivery contracts because of MRC procurement practices that result in each month's delivery increment being delivered to a single depot. Recommendation was made that each month's delivery increment be distributed among the AODs.

IMPLEMENTATION STATUS:

Recommendations are still being considered by the sponsor. (Delay due to almost complete turnover of personnel in sponsor's office)

RELATED STUDIES:

"Performance Standards for Depot Initial Fill Rates," Alan J. Kaplan, IRO Final Report, May 1972 (AD 744786).

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Implementation of Quantity Discount Procedures at DARCOM Materiel Readiness Commands

IDENTIFICATION NUMBER:
IRO Project No. 254

- REPORTS: 1. "The Application of Quantity Discounts in Army Procurements," W. V. Zabel and S. Gajdalo, Interim Report, March 1979 (AD A066583).
2. "The Application of Quantity Discounts in Army Procurements (Field Test)," S. Gajdalo, IRO, and W. Zabel, PRO, Final Report, April 1980 (AD A084216).

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICERS:
Steven Gajdalo, IRO
Wayne Zabel, PRO
(This is a joint project with Procurement Research Office, Fort Lee, VA)

INITIATION/COMPLETION DATES:
July 1977/April 1980

ABSTRACT: A change in the present DARCOM Materiel Readiness Command procurement procedures, whereby bids on quantities larger than the EOQ are solicited, may result in significant savings. This depends on the proportion of cost-effective discounts, on the magnitude of the discounts, and on the size of the award quantity relative to the EOQ. A field test conducted at two DARCOM MRCs revealed that the change does produce significant savings and should be used routinely within an automated framework.

MAJOR CONCLUSIONS/RECOMMENDATIONS:

The proposed QD program is feasible for implementation and it will meet the objectives for which it was designed provided procedures are automated. It is recommended that a short term study be done to develop specifications for automation and to develop the cost to implement.

IMPLEMENTATION STATUS:

DARCOM sent an SCR to ALMSA to develop specifications for automation. QD Program is in the LSRC Master Plan for Implementation but ALMSA suggested a joint effort with PRO/IRO to definitize the specs and develop implementation costs. This is to be done some time in FY 81.

RELATED STUDIES:

"Project EOQ: A Success Story in Implementing Academic Research," L. M. Austin, Interfaces, Vol. 7, No. 4, August 1977.

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Integrated Forecasting Techniques for Secondary Item Classes

IDENTIFICATION NUMBER:

IRO Project No. 263

- REPORTS:
1. "Integrated Forecasting Techniques for Secondary Item Classes, Part I, Active Items," Edwin P. Gotwals, III and Donald A. Orr, IRO Final Report, September 1980.
 2. "Integrated Forecasting Techniques for Secondary Item Classes, Part II, Inactive Items," Edwin P. Gotwals, III, IRO Final Report, September 1980.
 3. "Evaluation of Forecast Methods in an Inventory Management System (An Empirical Study)," Edwin P. Gotwals, III, IRO Technical Report, September 1980.
 4. "A Statistical Approach to Evaluating Results From the ALPHA 4140.39 Simulator," Edwin P. Gotwals, III, IRO Technical Report, to be published.

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:

Edwin P. Gotwals, III

INITIATION/COMPLETION DATES:

December 1977/September 1980

ABSTRACT: This is the last of a series of IRO studies on forecasting methods for Army item demands in the wholesale supply system. This report summarizes results for old and new algorithms on an extended data base of 48 quarters. A more intensive analysis is made than in previous studies.

Forecast algorithms were used with various item activity classes with the intent of detecting patterns which could indicate where certain algorithms work best. It was hoped that ultimately a synthesis of procedures for forecasting by item classes and for interfacing across classes could be developed. However, the evaluation results as described in Part I presented no clear-cut alternatives to the current method for active items. In Part II, a new forecast procedure was developed specifically for inactive items. The method was tested in a surrogate inventory setting and performed better than alternative procedures. Other results of statistical interest are described in the last two reports.

MAJOR CONCLUSIONS/RECOMMENDATIONS:

Do not change the current method of forecasting demand in CCSS for active items.

Project 263 (Cont'd)

Institute a study to develop an improved method for managing low demand items. Incorporate the forecast method developed in this report.

IMPLEMENTATION STATUS:

Further work will be done on inactive items when work program priorities permit.

RELATED STUDIES:

1. "Demand Forecasting with Program Factors," Martin Cohen, IRO Final Report, September 1975 (AD A017858).
2. "Demand Forecasting Using Process Models and Item Class Parameters: Application of Ancillary Variables," D. A. Orr, IRO Final Report, April 1976 (AD A026081).
3. "Kalman and Moving Average Filters for Forecasting: Systematics of Demand Processes and Extensions," D. A. Orr, IRO Technical Report, October 1976 (AD A032476).

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Pilot Test of Driver Concept for Projecting Resource Requirements

IDENTIFICATION NUMBER:
IRO Project No. 271

REPORT: "Driver Concept for Projecting Resource Requirements: Two Pilot Tests," Donald Orr, IRO Final Report, March 1980 (AD A086625).

SPONSOR: DARCOM Plans and Analysis Directorate, DRCPA

PROJECT OFFICER:
Donald A. Orr

INITIATION/PROGRAMMED COMPLETION DATES:
August 1978/March 1980

ABSTRACT: Entities whose values depend on Army policy and which drive the workload and resource requirements of Army organizations are analyzed for the Materiel Management (MM) and Maintenance (MS) Directorates of CERCOM and TACOM. These drivers, which are typically classes of entities such as major items, secondary items, requisitions, product improvement programs, and fielded weapon systems, vary from year to year. Man years and dollars necessary to perform functions related to the management of these drivers, if such resources had been and are rationally allocated, should vary in a similar fashion. Forecasting changes in driver values over future years should allow corresponding forecasts in resource requirements to be made.

The results of testing these driver concepts on the historical data bases of the four above mentioned directorates produced mixed results. The CERCOM MS analysis produced good statistical results in the area investigated (pre-issue development). The TACOM MS results were poor in a historical statistical sense. In the two MM directorates, the analysis indicated some functional areas where the historical trends fulfilled the postulated relations and other areas where the historical resources expended did not track the related driver values very well. Data availability was generally easier in the MM area.

MAJOR CONCLUSIONS/RECOMMENDATIONS:

Based on the two pilot tests at CERCOM and TACOM of the driver concept and availability of data, the following recommendations were made.

a. Develop guidance package for remaining MRCs MM directorates and conduct seminars. Use driver values and their trends to study MM requirements.

b. Suspend driver analysis of maintenance until the CERCOM experience with an adequate, automated data base is monitored.

Project 271 - Continued

c. Pursue limited analysis of other functional organizations of Commands if:

(1) Other studies (at higher level aggregation) are not successful.

(2) These organizations can list and project drivers for their areas with reasonable time and effort.

IMPLEMENTATION STATUS:

No plans at present to formally institute this approach across MRC functional organizations.

RELATED STUDIES:

"Methodology for Projection of Resource Requirements," A. Kaplan, D. Orr, IRO Final Report, November 1973 (AD 771049).

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Maximum Release Quantity (MRQ) Edits under Mobilization

IDENTIFICATION NUMBER:
IRO Project No. 272

REPORT: "Maximum Release Quantity Edits under Mobilization," Arthur
Hutchison, IRO Final Report, January 1980 (AD A087263, LD
42858AX).

SPONSOR: DARCOM Directorate for Materiel Management
Programs and Projects Office, DRCMM-L

PROJECT OFFICER:
Arthur Hutchison

INITIATION/COMPLETION DATES:
July 1978/January 1980

ABSTRACT: During the mini-MOBEX exercise at Fort Bragg, NC, an evaluation of wholesale edit procedures to detect suspiciously large quantities was made. About 2% of the requisitions were rejected. Two questions were formulated based on the results. Under a mobilization build-up, would MRQ rejects adversely affect requisition processing time? Would the proposed MRC model (see Related Studies) based on the average requisition size of the item result in an unacceptable number of rejects?

The 55000 MOBEX-78 requisitions were processed against the current and proposed MRQ's. For the current MRQ, 4.3% of the requisitions were rejected. An abnormally high reject rate was observed at TSARCOM because they use a MRQ 1/3 lower than the other MRC's. A high percentage of these rejects occurred on non-stocked items.

The IRO-recommended AIQ model resulted in a reject rate of 4.9%. MRQ rejection rates during normal operations range between 2 and 5 percent.

MAJOR CONCLUSIONS/RECOMMENDATIONS:

a. Based on the MOBEX data, no serious impact on readiness would result from use of either MRQ model during mobilization.

b. The Army Logistics Center should investigate implementing a MRQ check based on the average requisition size at Division and Corp levels.

IMPLEMENTATION STATUS:

This study recommended no changes to MRQ edits at the wholesale level during mobilization. Recommendation has been accepted. DARCOM requested DCSLOG to initiate action to evaluate the use of retail MRQ edits as recommended in this and the referenced IRO study.

RELATED STUDIES:

"Analysis of Large Requisitions," Arthur Hutchison, IRO Final Report, February 1977 (AD A036003).

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: OSD Stockage Policy Analysis Working Group

IDENTIFICATION NUMBER:

IRO Project No. 282

- REPORTS: 1. "Stockage Policy Analysis: Final Report," OASD (MRA&L),
31 August 1980.
2. "IRO Work on OSD Stockage Policy Analysis Work Group," W. Karl
Kruse (to be published).

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRC:M-RS

PROJECT OFFICER:

W. Karl Kruse

INITIATION/COMPLETION DATES:

January 1980/September 1980

ABSTRACT: This study consisted of IRO participation on the OSD Stockage Policy Analysis Working Group which was formed by OSD (MRA&L) to answer questions raised by OMB during the FY 80 budget hearings. OMB was primarily concerned with the amount of safety level, the amount of numeric stockage investment, and the latitude given to item managers to arbitrarily adjust stockage levels.

The purpose of the work group was to analyze these areas to determine if problems and abuses exist, and to recommend solutions where appropriate.

MAJOR CONCLUSIONS/RECOMMENDATIONS:

Specific conclusions and recommendations are too numerous to list here. They are given in detail in the DOD report. Basically, the work group recommended more standardization among the services, provided a policy framework for determining stockage, verified that item manager abuses are infrequent, and called for more use of program data in the forecasting of demand.

IMPLEMENTATION STATUS:

Recommendations have been accepted by the Steering Group. OSD (MRA&L) is expected to assign implementation tasks to the Military Service and DLA during FY 81.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Design of a Prioritized Depot Scheduling System for Secondary Item Repair

IDENTIFICATION NUMBER:
IRO Project No. 255

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:
Arthur Hutchison

INITIATION/PROGRAMMED COMPLETION DATES:
July 1977/November 1980

PROBLEM: There are problems in the secondary item repair system in maintaining readiness and emphasizing reduction in Repair Cycle Time inventory investment costs. Defense of the PAA budget requests is impaired since the elements of RCT are not clearly defined or measured.

OBJECTIVES: Develop a requirements-driven depot operation where MRCs identify quantity and urgency of repair programs. Develop system for short-term depot induction schedules based on prioritized MRC requirements.

CURRENT STATUS:

A Selective Management program to reduce repair cycle times has been developed and approved for implementation by DARCOM. Implementation is scheduled for January 1981.

The design of the first phase of a requirements-driven repair process was completed and presented to DARCOM for an implementation decision. A CCSS application would be run at each MRC to identify reparable in a back-order status and with unserviceables on-hand. This information is next passed via AMDEX to the repair facility. The depots induct the quantity necessary to alleviate the B/O status as a high priority program.

A final report has been written describing all work completed in this project and longer term recommendations remaining to be implemented. It will be published in December 1980.

RELATED STUDIES:

"Requirements-Driven Repair Scheduling System for Secondary Items," Arthur Hutchison, IRO Final Report, September 1977 (AD A046579).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: War Reserve Requirements for New Weapon Systems

IDENTIFICATION NUMBER:
IRO Project No. 258

SPONSOR: DARCOM Directorate for Plans, Doctrine and Systems, DRCPS-P

PROJECT OFFICER:
Donald A. Orr/Bernard B. Rosenman

INITIATION/PROGRAMMED COMPLETION DATES:
September 1977/December 1980

PROBLEM: Heretofore War Reserve requirements have not been developed for new weapon systems until they have actually been deployed. It is desired, however, to estimate what these requirements will be for budgetary purposes far in advance of that time.

OBJECTIVES:

To develop a procedure for estimating War Reserve budgetary requirements for new weapon systems that are scheduled for deployment in the POM/FYDP period. The procedure must be capable of use during early phases of weapon system development when data on expected failure rates, maintenance support planning, etc., are only partially available.

CURRENT STATUS:

The Bare Bones Standard Initial Provisioning (BBSIP) Model, previously developed by IRO, was adapted for use for War Reserve computations. This new model, the Bare Bones War Reserve Model, was tried out on six new weapon systems by estimating their funding requirements for 1980-84 POM. Briefings on the procedure and results of the computations were given at DARCOM, DA and DoD, resulting in approval of its use as a standard procedure, and it has been used for POM submissions since FY 79.

This project was not closed out because of a desire to supersede BBWARRSV by WAR version of SESAME. (SESAME is the refined all purpose provisioning computational model.) This "SESAME-4-WAR" will run many components and several scenarios at a time and hence alleviate much of the manual workload which is associated with BBWARRSV program runs in completing the required format of the budget tableau.

The design and distribution of SESAME-4-WAR has been put under the aegis of the Provisioning Technical Working Group. IRO will provide the Specs and final program. Distribution of the new program will be made in early January 1981.

RELATED STUDIES:

"Bare Bones: A Method for Estimating Provisioning Budget Requirements in the Out-Years," Donald A. Orr, IRO Final Report, July 1977 (AD A044508).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Operational Readiness Oriented Logistic Support Models

IDENTIFICATION NUMBER:
IRO Project No. 260

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS
Associate Director for Maintenance, DRCMM-M

PROJECT OFFICERS:
Alan J. Kaplan/Martin Cohen

INITIATION/PROGRAMMED COMPLETION DATES:
October 1977/September 1981

PROBLEM: Multi-echelon models offer great potential for achieving needed system operational availability at least cost. While a number of models exist, none was fully satisfactory either conceptually or in terms of ease of use.

OBJECTIVE:
Promote use and evaluation of multi-echelon models.

CURRENT STATUS:

IRO has given technical direction to a DARCOM working group overseeing efforts in the multi-echelon area. Improvements in existing models have been made, and a program oriented to DARCOM needs and current DARCOM computer systems and data bases has been developed. This program is widely used and has been evolving in response to user needs and theoretical advances.

As a corollary to this effort, IRO, in conjunction with researchers at a number of universities, initiated a multi-echelon conference series, attended by research people and model users, at which theoretical developments and implementation considerations are discussed. Conferences in previous years were held at Cornell, George Washington and Purdue Universities. Meetings this FY were held at the IRO in November 1979 and at University of North Carolina in May 1980.

RELATED STUDIES:

1. SESAME Computer Program, distributed to Materiel Readiness Commands in February 1979, Alan Kaplan and Martin Cohen.
2. "A Heuristic for Multi-Echelon, Multi-Indentured Inventory Problem," Meyer Kotkin, IRO Technical Report, December 1978 (AD A066590).
3. "An Exact N Echelon Inventory Model: The Simple-Simon Method," W. Karl Kruse, IRO Technical Report, March 1979 (AD A067762).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: RIMSTOP Implementation

IDENTIFICATION NUMBER:
IRO Project No. 261

SPONSOR: Deputy Chief of Staff for Logistics, Army
Assistant Director for Supply Management, DALO-SMS

PROJECT OFFICERS:
Arthur Hutchison/Bernard B. Rosenman

INITIATION/PROGRAMMED COMPLETION DATES:
May 1978/September 1983

PROBLEM: As a result of work done by a study group under its auspices, DoD issued DoD Directive 4140.44 and DoD instructions 4140.45 and .46 containing policies for the management of consumable and reparable secondary items at the consumer and intermediate levels of field supply. It is required that all DoD components implement these policies, which include the requirement for use of inventory models that are far more advanced than those now in use. There are a number of technical and human-computer interface problems that must be overcome in order for implementation to be done successfully.

OBJECTIVES: Evaluate implementation alternatives and modify as necessary. Develop computer and procedural guidance necessary to implement. Conduct pre-implementation tests and provide assistance during implementation as required.

First phase of the project will be handled primarily by Army Logistics Center and will involve implementation of basic variable stockage criteria, variable safety level, and variable operating level models for consumable items. A follow-on phase will be handled primarily by IRO and will involve extensions of these models for handling essentiality, mobility, personnel and funding constraints. Investigation will also be done on the feasibility of applying multi-echelon, multi-indenture models to relate supply availability to weapons system readiness.

Project 261 - Continued

CURRENT STATUS:

Methodology for estimating leadtime demand variability was developed for use in the safety level calculation. The estimation procedure calculates percent forecast errors based on retail demand histories.

Various models for forecasting demand rates for PLL activities were evaluated. Six, twelve and eighteen month base periods were used in a moving average model where demand histories were either that of the individual customer or a combination of like units. Statistical measures indicated a 12-month moving average using individual unit histories worked better than the other combinations. Further evaluation will be made using simulations.

An ADP routine was developed to choosing lambda (backorder cost) based on target availabilities by commodity group and essentiality class.

A retail level simulation was written and will be used for evaluation of enhancements to the basic RIMSTOP model.

The following reports on work done this FY were published:

1. "Calculation of Percent Error Tables for Use in the RIMSTOP Implementation," Arthur Hutchison, IRO Technical Report, September 1980 (AD A090141).
2. "Evaluation of Several Forecasting Techniques for Retail Level Stockage," Arthur Hutchison, IRO Technical Report, September 1980 (AD A090104).

U'S ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Evaluation of Provisioning Procedures

IDENTIFICATION NUMBER:
IRO Project No. 265

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Maintenance, DRCMM-M

PROJECT OFFICER:
Donald A. Orr

INITIATION/PROGRAMMED COMPLETION DATES:
May 1979/September 1982

PROBLEM: Many Army proponents feel initial support requirements (Spare & Repair Parts), when determined in accordance with DODI 4140.42 policies, are inadequate to support newly fielded systems at their required operational availability. To bolster or belie this intuition, evaluations of provisioned quantities based on field performance are needed. Although Army policy requires such evaluations (Post Provisioning Review) 360 days after initial deployment of the end item, such analyses have been barely extant at best. A main (but not the only) reason for the dearth of reviews has been a lack of a paradigm and consequent systematic procedures for collecting and analyzing data in a reasonable, feasible manner.

With the advent of SIP and the sophisticated SESAME program, it is feasible to compute part quantities in accordance with .42 or with some cost effective optimal technique. These programs, suitably adjusted, can also evaluate the impact of these support quantities and other possibly realized quantities in terms of system availability. Another potentially solvable problem via the program is to assess the impact on quantities and operational readiness when the actual provisioning parameter set (experienced field values of repair times, task distributions, washout and failure rates) differs from the original parameter set used to ascertain initial issue.

OBJECTIVE: Phase 1 - Design an evaluative system for detail comparisons of theoretical, hypothetical, and actual provisioning quantities and subsequent operational readiness values. Consider computed SIP, ERPSL models' quantities and real life adjustment thereof. Use the above evaluator on data obtained from pilot tests on selected end items and identify any shortcomings in DODI 4140.42 procedures.

CURRENT STATUS:
This project has become one phase of an expanded provisioning study chaired by LSO. This expanded project is planning to study the budgeting process, general problems in provisioning and fielded systems that are similar to those currently being provisioned. IRO is working with MRCs and Project Manager Offices on sample data collection plans and evaluative schemes for the XM1 tank, PATRIOT and perhaps one or two other new systems.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Updating Failure Factors

IDENTIFICATION NUMBER:
IRO Project No. 275

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Maintenance, DRCMM-M

PROJECT OFFICER:
Donald A. Orr

INITIATION/PROGRAMMED COMPLETION DATES:
April 1979/June 1981

PROBLEM: Engineering estimates of failure factors (replacement rates of components) often do not reflect actual experience once the end item is fielded. Updating of these estimates is particularly needed for the later provisioning requirements of long-term procurement and deployment programs (including FMS).

OBJECTIVE: Develop an automated method of combining initial failure factors with experienced replacement rates for parts in fielded systems.

CURRENT STATUS:

A strawman package of working papers has been developed to define factors, describe scenarios, code and store scenario information and factors, and to update the various factors using inference techniques on experienced wholesale or retail demand data.

Meetings are being held to uncover implementation problems and make recommendations on redesign of pertinent files. Which items can be candidates and which of a number of alternative updating schemes would be most practicable, for updating automatically in an initial implementation, are questions currently being considered.

RELATED STUDIES:

1. On-going IRO Project 257, Failure Factors for Contingency Planning.
2. "New Concepts for Provisioning Parameter Estimates, Part I," Donald A. Orr, IRO Technical Report, December 1976 (AD A034589).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: ORF/ERPSL Tradeoffs

IDENTIFICATION NUMBER:
IRO Project No. 276

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Maintenance, DRCMM-N

PROJECT OFFICER:
Alan J. Kaplan

INITIATION/PROGRAMMED COMPLETION DATES:
April 1979/February 1981

PROBLEM: Both ERPSL (Essential Repair Parts Stockage List) inventory of secondary items and ORF (Operational Readiness Float) inventory of end items are designed to improve readiness. On any given system it is not clear whether there should be just one or the other or both, and if both, how much should be invested in each.

OBJECTIVE: To develop a methodology to solve problem and demonstrate it on one weapon system.

CURRENT STATUS:
Model was developed and tested on one system. While there was interest and favorable comment, model is not being implemented at this time, as there is not enough confidence it is realistic enough to apply to wartime conditions. Model is being used to determine whether SESAME ERPSL computations should be modified for systems with float. Five such systems will be analyzed before project is ended.

RELATED STUDIES:

1. IRO Project 260, Operational Readiness Oriented Logistics Support Models (IRO study in progress).
2. "Study of Army Maintenance Float Policies and Management Practices," Edwin Gotwals, Larry Smith, W. Karl Kruse, John Fortune, IRO Final Report, September 1977 (AD A048270).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Management of Wholesale Stocks by Weapon System

IDENTIFICATION NUMBER:
IRO Project No. 277

SPONSOR: US Army Communications and Electronics Readiness Command
Directorate of Materiel Management, DRSEL-MMO-S2

PROJECT OFFICER:
W. Karl Kruse

INITIATION/PROGRAMMED COMPLETION DATES
July 1979/March 1981

PROBLEM: The Commodity Command Standard System (CCSS) contains an application called the Supply Performance Analyzer (SPA) which is intended as a budgetary and management tool to enable the MRC to determine the safety level investment needed to achieve supply performance goals. For a variety of reasons, the SPA is difficult to use and its projections of costs and performance are subject to substantial error. As a consequence, it has fallen into disuse despite the fact that it is the only means available to relate supply performance and cost.

OBJECTIVE: To provide CERCOM with the tools necessary to budget for and to control Safety Level investment by various weapon system groupings. The long term goal is to implement these concepts in CCSS and the budget process.

CURRENT STATUS:
During the course of this project, the Weapon System SPA, as it is now called, has evolved from an off-line imitation of the CCSS SPA to a set of programs which provide the user with the ability to manipulate and view weapon system related data in real time. MICOM and TACOM are now using these programs on a pilot basis to determine what enhancements should be added before it is put into use in the budgeting process.

RELATED STUDIES:
"Supply Performance Analyzer," W. Karl Kruse, IRO Final Report, June 1976 (AD A029711).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Financial Management of the Army Industrial Fund

IDENTIFICATION NUMBER:

IRO Project No. 279

SPONSOR:

DARCOM Office of the Comptroller
Finance and Accounting Division
Property and Cost Policy Branch, DRCCP-FW

PROJECT OFFICER:

Alan J. Kaplan

INITIATION/PROGRAMMED COMPLETION DATES:

October 1979/March 1981

PROBLEM:

DARCOM finds it difficult to justify requests for additional cash from higher headquarters, or to determine whether returns of cash from revolving funds may be made.

OBJECTIVE:

Develop a cash flow model which will objectively project future cash requirements in a timely manner.

CURRENT STATUS:

Project was initially undertaken for the Army Stock Fund. It was shortly decided by the sponsor, however, that work on the problem within the AIF was more urgent.

A cash flow model was developed and tested first for DARCOM Depot activities and DESCOM. As a final test, it is now being used by DESCOM personnel on a pilot basis as if it were already implemented. Work is underway to modify model, as needed, for use by the other kinds of DARCOM AIF activities.

RELATED REPORTS:

None.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: CCSS Go-To-War (Supply Management)

IDENTIFICATION NUMBER:
IRO Project No. 280

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:
Bernard B. Rosenman

INITIATION/PROGRAMMED COMPLETION DATES:
October 1979/November 1980

PROBLEM: Concern exists about the ability of CCSS to respond to a surge in activity and sustain operations at a satisfactory level when a war emergency occurs. In the Supply Management area, it is recognized that certain applications must immediately switch over to a wartime mode of operation and others must be scaled down, deferred or eliminated entirely in order to allow both the ADP equipment and personnel to cope with wartime conditions. This study was undertaken to develop a set of recommendations for such a situation.

OBJECTIVE: Determine what changes should be made to CCSS Supply Management applications to respond to sudden increase in activity due to a wartime emergency and to sustain operations and at a satisfactory level under wartime conditions.

CURRENT STATUS:
A work group comprising people from the Requirements Distribution and Execution (RDES) Re-Design project developed a set of recommendations including parameter switch-over procedures (to estimate wartime demand rates, for example), identification of a set of mandatory applications that must be run to preserve minimal integrity of the supply management function and a reduced set that must eventually be run during wartime but which can be deferred for some period of time during the initial surge of activity. These recommendations are undergoing final review before submission to DARCOM.

RELATED STUDIES:
DARCOM Mobilization Automation Work Group

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: War Reserve ADP System Project

IDENTIFICATION NUMBER:
IRO Project No. 281

SPONSOR: DARCOM Directorate for Plans, Doctrine and Systems
Associate Director for Systems, DRCPS-S

PROJECT OFFICERS:
Bernard B. Rosenman/Steven Gajdalo

INITIATION/PROGRAMMED COMPLETION DATES:
April 1980/December 1982

PROBLEM: Computations of war reserves, TLR/S, and LOGPLANS at the Materiel Readiness Commands are only partially automated and are not standardized. Under this arrangement it is difficult to justify/audit computed requirements and to respond to "what if" questions from DA and DOD. A new regulation (DODI 4140.47) has directed that all sources have a common baseline for war reserve computations, necessitating major changes in current DARCOM approaches to computations.

OBJECTIVE: Develop a standard automated capability to compute requirements and produce output products for the full range of war reserve and mobilization planning actions (i.e., General Mob/AR 11-11, TLR/S, LOGPLANS). These applications are to be in consonance with the DODI 4140.47 and with other DOD and DA guidance.

CURRENT STATUS:
A concept study has been completed by AMSAA on approaches to be followed. Concept has been approved by DARCOM Hqtrs. Formation of a work group to be headed by IRO is in process. This work group will develop the Functional Description for ADP implementation of the AMSAA concept.

RELATED STUDIES:

1. "Updating Failure Factors," IRO Project No. 275 (On-going).
2. "Provisioning Master Record Redesign," current effort of the PMR Work Group.
3. "War Reserve Requirements for New Weapon Systems," IRO Project 258 (current effort).
4. "Operational Readiness Oriented Logistic Support Models," IRO Project 260 (on-going).
5. "RIMSTOP Implementation," IRO Project 261 (on-going).
6. "Combat PLL/ASL Methodology," IRO Project 283 (on-going).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Combat PLL/ASL Methodology

IDENTIFICATION NUMBER:
IRO Project No. 283

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Maintenance, DRCMM-MS

PROJECT OFFICERS:
Martin Cohen/Alan Kaplan

INITIATION/PROGRAMMED COMPLETION DATES:
March 1980/September 1981

PROBLEM: This is the IRO portion of DA-sponsored work to develop stockage lists for Organizational and Direct Support Units. The lists are to contain the parts needed for combat operations.

OBJECTIVE: Develop an automated method of producing least cost stockage lists that will meet operational availability targets for essential end items without hampering mobility. IRO's responsibility is the development and test of appropriate models and computational procedures and preparation and evaluation of initial lists. It is expected that MRSA will take over production of Combat PLLs/ASLs once the models and procedures are deemed to be operating satisfactorily.

CURRENT STATUS:

Several models were developed for PLLs. Initial PLLs were produced for test units (a Mech Infantry and a Tank Company) at Fort Carson. Models, data gathering and PLL distribution procedures are undergoing evaluation. Future work will involve development of models for computation of the supporting ASLs, development of models for combining wearout and combat damage failures, computation of initial PLLs/ASLs for USAREUR and participation in USAREUR program for evaluation of list effectiveness. This work is being carried on in conjunction with AMSAA, MRSA, MRC, Army Log Center and TRADOC activities.

RELATED STUDIES:
None.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Treatment of Serviceable Returns in Supply Control Studies

IDENTIFICATION NUMBER:
IRO Project No. 284

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:
Sally Frazza

INITIATION/PROGRAMMED COMPLETION DATES:
August 1980/March 1981

PROBLEM: Serviceable returns should be accounted for when determining future requirements. Currently, because the forecast of these returns is not trusted, the Commodity Commands set a limit (not standard) on the percentage of demand forecast which may be offset by returns. This can result in overstatement of future requirements.

OBJECTIVE: Recommend improved method for treatment of serviceable returns in computing stock requirements.

CURRENT STATUS:
Data from TACOM show an overwhelming percentage of items with a high ratio of return to demand. Of items with returns, 13% have more returns than demands. Data have been requested from MICOM and TSARCOM.

The 13 year IRO demand history file of AVSCOM items was expanded to include returns and is being used in IRO's new forecast evaluator (IRO Project 263) which has been modified to evaluate various forecasts using returns. Initial progress indicates that subtracting returns from the AMD does not significantly improve the demand forecast. Work is in process to find causes of extraordinarily large single return transactions which occur seemingly at random in the demand/returns time series of most items.

RELATED STUDIES:

1. "Estimation of Demand Variability Parameters," Alan J. Kaplan, IRO Final Report, May 1974 (AD 781942).
2. "Comparison of Asset Return Forecasting Techniques," W. Karl Kruse, IRO Final Report, December 1974 (AD A003997).
3. "Forecasting of Secondary Item Returns," Richard M. A. Urbach, IRO Final Report, August 1976 (AD A030343).
4. IRO Project 263, Integrated Forecasting Techniques for Secondary Item Classes.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Supply Control Study Instability

IDENTIFICATION NUMBER:
IRO Project No. 285

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:
Bernard B. Rosenman

INITIATION/PROGRAMMED COMPLETION DATES:
August 1980/June 1981

PROBLEM: Many items experience changes in recommended action from one supply control study to the next--Buy to Cutback, Cutback to Buy, Buy to Excess, etc. These "flip-flops" cause turbulence in supply management and supporting activities such as procurement and depot rebuild. Little is known about what causes these conditions and how to correct them.

OBJECTIVE: To determine if there is a pattern of causes for these instabilities and to recommend corrective actions.

CURRENT STATUS:

Data analysis by means of a special program written at ALMSA and run at the MRCs showed that the problem is significant at all MRCs but worse at some than at others. Preliminary review of a sample of supply control study folders at TSARCOM revealed no strong pattern of causes. Further analysis had to be postponed because of TDY restrictions. Project is expected to be resumed early in FY 81.

RELATED STUDIES:
None.

US ARMY INVENTORY RESEARCH OFFICE
SUSPENDED/TERMINATED PROJECTS

<u>PROJECT NO.</u>		<u>SPONSOR</u>
257	Failure Factors for Contingency Planning	DRCMM-M
	Objective of this project is to develop methodology for translating peacetime Failure Factors into wartime Factors where failure modes indicate that this is possible, and to keep these Factors updated as data from field exercises become available. Because of similarities in methodological approaches, sponsor requested that this project be combined with Project 275, Updating Failure Factors.	
259	Forecasting Methods for Parts Support of Overhaul	DRCMM-RS
	This project is concerned with improvement of data communications between Depots and MRCs so that overhaul parts forecasts may be improved. Project was not worked on in FY 80 because of priorities of other projects. It is expected to resume in FY 81.	
268	Supply Management Mini-Computer Applications	DRCMM-RS
	This project entails assisting DARCOM in determining, from a functional point of view, how the capabilities of mini-computers might best be exploited in a distributed processing mode. Work in FY 80 was limited to participation in ALMSA's RDES Redesign effort. Further work along these lines will be deferred until the new RDES is implemented. Project is therefore terminated.	
278	Supply Performance Indicators	DRCMM-RS
	Project was initiated to develop methods for tracking and analyzing statistics on conditions that might degrade stock availability at some future date. Work was done with TACOM to define conceptual approaches. TDY fund shortages caused project to be suspended, and it is in that state now. Efforts will be made to resume work in FY 81.	

US ARMY INVENTORY RESEARCH OFFICE

LOGISTICS MANAGEMENT ASSISTANCE

In addition to its formal work program, the IRO provides assistance upon request to DARCOM Headquarters and its Commands, and to other DA and DoD activities. This assistance involves work of a short term nature, generally requiring no more than a few man-months of effort. Some of the tasks worked on in FY 1980 are described below.

CCSS Functional Coordinating Groups - IRO continues to provide representation on the FCG's for Supply Management, Maintenance Management, Provisioning, War Reserves and Major Items. This involves attendance at meetings where System Change Requests are evaluated and doing short term studies on problems of immediate interest to the Groups. Attendance at the DARCOM Logistics Systems Review Committee meetings is also involved, where review of IRO projects is sometimes on the agenda.

Other CCSS Assistance - Work was done in conjunction with ALMSA and TACOM in evaluating result of prototype runs of the IRO Inter-Depot Transfer model. Assistance was also provided on implementation actions of several additional portions of the Over-Ocean Cargo Forecasting System.

Shortage Cost Parameter (λ) Analysis - Runs were made for the MRCs to determine what λ values to use in estimating effects on stock availability and requirements levels that would result from incorporating Procurement Lead Time variance in the CCSS Variable Safety Level/Economic Order Quantity module. IRO also assisted DARCOM Hqtrs in putting together recommendation to DA/DoD on this subject.

RIMSTOP - Assistance and advice were given to Logistics Evaluation Agency, which has been given a study by DCSLOG to develop cost estimates for various parameters used in the RIMSTOP model. Data from previous IRO cost studies were made available to them.

Also, IRO reviewed at DCSLOG's request, the SCR prepared by the Army Logistics Center for programming the Phase I RIMSTOP model.

Transfer of Consumable Item Management to Defense Logistics Agency - IRO provided assistance to a DARCOM task group in analyses of the DOD proposal to transfer consumable items to DLA. Analyses concentrated on statistical projections made of costs and personnel requirements made by the Defense Logistics Analysis Agency and the Defense Audit Service.

Meetings - IRO hosted the following meetings that were held in the Custom House, Philadelphia, PA.

War Reserves Functional Coordinating Group, 13-16 November 1979

Multi-Echelon Models Conference, 8-9 November 1979

US ARMY INVENTORY RESEARCH OFFICE

PROFESSIONAL ACTIVITIES

Papers published in technical journals, participation in meetings of professional societies and other professional activities are reported here:

Technical Papers

"Waiting Time in an s-1,S Inventory System with Arbitrarily Distributed Lead Times," W. Karl Kruse, Journal of the Operations Research Society of America, Volume 28, No. 22, March/April 1980.

"A Note on Initial Fill Rate," Alan J. Kaplan, Canadian Journal of Operations Research and Information Processing (to be published).

"Problems of Quantitative Models in Large Management Information Systems," Bernard B. Rosenman, INTERFACES, Volume 10, No. 2, April 1980.

Papers Presented at Professional Meetings

Robert Deemer, "Improved Stock Availability for EW/SIGINT Materiel" presented at 44th Military Operations Research Symposium, Vandenberg Air Force Base, CA, 4-6 Dec 79.

Alan J. Kaplan, "System Availability with Redundancy and Spares," presented at Joint TIMS/ORSA National Meeting, on 4-7 May 80, Washington, DC.

Alan J. Kaplan, "SESAME Model and Applications," presented at Society of Logistics Engineers meeting at Ft. Monmouth, NJ, on 14 May 80.

W. Karl Kruse, "Customer Waiting Time Distribution in Two Common Inventory Systems," presented at Conference on Multit-Echelon Inventory Systems, 19-20 Jun 80, University of North Carolina.

Donald A. Orr, "The Driver Concept in Forecasting Manpower Needs," presented at Joint TIMS/ORSA National Meeting, on 4-7 May 80, Washington, DC.

Bernard B. Rosenman, chaired two sessions at The Joint National TIMS/ORSA meeting held in Washington, DC on 4-7 May 80, one entitled "Performance of Inventory Models in Real Systems," the other "Applied Inventory Models."

Other Professional Activities

Prof. Henri Muller and W. Bruggeman of the University of Ghent, Belgium, visited the IRO on 8 May to discuss topics and research results in forecasting. Exchange of information on on-going research is expected to continue.

Alan Kaplan continued as referee for MANAGEMENT SCIENCE, refereeing two articles during the year.

Mr. Rosenman lectured in a graduate inventory theory class and spoke at an Industrial Engineering seminar at Cornell University on 1 Nov 79.

US ARMY INVENTORY RESEARCH OFFICE

REPORTS

The following reports were published in the period October 1979 - September 1980:

"Annual Report - Fiscal Year 1979," Nov 79, AD A079409, LD 43662B.

"Maximum Release Quantity Edits Under Mobilization," Arthur Hutchison, Final Report, Jan 80, AD A087263, LD 42858AX.

"A Note on Initial Fill Rate," Alan J. Kaplan, Technical Report, Feb 80, AD A080952.

"Mathematics for SESAME Model," Alan J. Kaplan, Technical Report, Feb 80, AD A081931.

"Data Base for NICP Oriented Problems," Sally Frazza, Technical Report, Feb 80, AD A082171, LD 40815A.

"User's Guide for the Selected Essential-Item Stockage for Availability Method (SESAME) Program," Martin Cohen, DARCOM Pamphlet No. 700-18, Mar 80.

"The Driver Concept for Projecting Resource Requirements: Two Pilot Tests," Donald A. Orr, Final Report, Mar 80, AD A086625.

"The Application of Quantity Discounts in Army Procurements (Field Test)," Steven Gajdalo, and Wayne Zabel, Procurement Research Office, Final Report, Apr 80, AD A084216.

"Evaluation of Several Forecasting Techniques for Retail Level Stockage," Arthur Hutchison, Technical Report, Sep 80, AD A090104.

"Calculation of Percent Error Tables for Use in the RIMSTOP Implementation," Arthur Hutchison, Technical Report, Sep 80, AD A090141.

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