A RESEARCH PROGRAM IN LOGISTICS SYSTEMS

Final Report

R. L. Francis
D. W. Hearn
T. J. Lowe
E. J. Muth
H. D. Ratliff
B. D. Sivazlian
M. E. Thomas

October, 1975

U. S. Army Research Office

Grant Number DA-ARO-D-31-124-72-G123

Industrial and Systems Engineering
University of Florida
Gainesville, Florida 32611

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED
**Title:** A Research Program in Logistics Systems  

**Authors:** T. J. Lowe, M. E. Thomas, R. L. Francis, E. J. Muth, D. W. Hearn, H. D. Ratliff, B. D. Sivazlian, M. E. Thomas

**Performing Organization Name and Address:** Industrial & Systems Engineering, University of Florida, Gainesville, FL 32611

**Contract or Grant Number(s):** DA-ARO-D-31-124-72-G123

**Program Element, Project, Task Area, and Work Unit Numbers:** 20061102Bl4C, Expl. Rsch. in Mathematics

**Report Date:** October, 1975

**Number of Pages:** 18

**Abstract:** This proposal covered a three year research program in logistics systems and complemented research which was already in progress under contract number DAH CO4-68C-0002 and Grant DA-ARO-D-31-124-70-G92. The on-going contract provided supplementary support for graduate research assistants, secretarial support, travel, and publication costs.

The project was performed through the College of Engineering under the general supervision and guidelines of the Engineering and Industrial Experiment station, and administered through the University of Florida's Office of...
STATEMENT OF PROBLEMS STUDIED

The problems studied were a variety of areas affecting logistics management. Examples include special inventory problems, scheduling activities, transportation and distribution problems. Reliability and maintainability models as well as assembly line problems in a stochastic environment were also considered. Finally nonlinear optimization problems were also addressed with application to facility location and design and test range instrumentation location.

All of the above mentioned problems directly affect the operation of a logistics system. For example the location of supply depots is a crucial question and the work in facility design and location provides useful insights. Distribution problems and scheduling resources on scarce transportation is another problem which often faces the logistics manager. A perusal of the reports which are referenced herein indicate the variety of problems studied.
SUMMARY

This proposal covered a three year research program in logistics systems and complemented research which was already in progress under contract number DAH C04-68C-0002 and Grant DA-ARO-D-31-124-70-G92. The on-going contract provided supplementary support for graduate research assistants, secretarial support, travel, and publication costs.

The project was performed through the College of Engineering under the general supervision and guidelines of the Engineering and Industrial Experiment Station, and administered through the University of Florida's Office of Sponsored Research.
1. Journal Papers

A. Manuscripts Submitted


"The Transient and Steady State Distribution of a Continuous Review (s, S) Inventory System with Arbitrary Interarrival Distribution Between Unit Demand," by B. D. Sivazlian, submitted to Operations Research.


1. Journal Papers

B. Manuscripts Published


The following research reports have been supported in part under Army Research Office and/or Office of Naval Research, Department of Industrial and Systems Engineering, University of Florida.


"Analysis for a Naval Air Rework Facility (NARF) One-for-One Exchange Inventory and Repair System", by Christopher Haas and Thom J. Hodson, Research Report No. 73-10, August 1973.


2. SCIENTIFIC PERSONNEL SUPPORTED BY ARO

A. Professors

R. L. Francis  
E. J. Muth  
D. W. Hearn  
T. J. Lowe  
H. D. Ratliff  
B. D. Sivazlian

B. Students

W. D. Randolph, Ph.D. 6/74  
R. C. Dorsey, Ph.D. 3/73  
A. W. Chan, Ph.D. 8/74  
S. Lakshminarayan, M.E. 12/74  
J. J. Bartholdi III, M.S. 6/73  
F. L. Nordai, M.S. 12/74  
K. T. Nguyen  
L. A. Martin-Vega, Ph.D. 3/75  
C. H. Choi, M.S. 6/75
A. Meetings, Papers Presented and Seminars

Name of Meeting: TIMS International Conference
Location: Los Angeles, California
Author: Robert N. Braswell and F. M. Allen
Subject: Non-parametric Sensitivity Analysis in Linear Programming
Date: Fall, 1971

40th National ORSA Meeting
Anaheim, California
E. J. Muth
A General Analysis of Closed-Loop Conveyor Systems
October 27-29, 1971

40th National ORSA Meeting
Anaheim, California
E. J. Muth
On Applications of the Root Locus Method in Operations Research
October 27-29, 1971

40th National ORSA Meeting
Anaheim, California
E. J. Muth
The Production Rate of a Series of Work Stations with Variable Service Times
October 27-29, 1971

41st National ORSA Meeting
New Orleans, La.
R. N. Braswell and J. A. Marban
Necessary and Sufficient Conditions for the Inequality Constrained Optimization Problem Using Directional Derivatives
April 26-28, 1972

41st National ORSA Meeting
New Orleans, La.
R. N. Braswell and T. Clark Pewitt
Generalizations of a Class of Frequency Functions
April 26-28, 1972

41st National ORSA Meeting
New Orleans, La.
B. D. Sivazlian
On Some Discounted Replacement Problems with Arbitrary Repair Time Distribution
April 26-28, 1972
41st National ORSA Meeting
New Orleans, La.
E. J. Muth
Closed Loop Conveyor Systems with Discrete Material Flow
April 26-28, 1972

H. D. RAtliff and Jean-Claude Picard
A Graph Theoretic Equivalence for Integer Programs
April 26-28, 1972

R. L. Francis
Properties of a Multifacility Location Problem Involving Euclidean Distances
April 26-28, 1972

T. Goswick and B. D. Sivazlian
The Mixed Ordering Policy in Periodic Review Stochastic Multi-Commodity Inventory Systems
April 26-28, 1972

M. E. Thomas and G. L. Hefley
Decomposition of the Group Problem
April 26-28, 1972

Joint Meeting of AIIE/ORSA/TIMS
Atlantic City, N.J.
Robert N. Braswell and D. G. Linton
Some Advancements in Reliability Theory for Systems with Standbys
November 8-10, 1972

P. M. Dearing and R. L. Francis
A Network Flow Solution to a Multifacility Minimax Location Problem Using Rectilinear Distances
November 8-10, 1972

R. L. Francis
A Minimax Lattice Point Location Problem
November 8-10, 1972
Joint Meeting of AIIE/ORSA/TIMS
Atlantic City, N. J.
B. D. Sivazlian
A Multi-Product Sequencing Problem on a Single Processor Under a Stochastic Environment
November 8-10, 1972

Joint Meeting of AIIE/ORSA/TIMS
Atlantic City, N. J.
R. L. Francis
Chairman of Sessions on Production Planning and Control, and Location Theory
November 8-10, 1972

Joint Meeting of AIIE/ORSA/TIMS
Atlantic City, N. J.
D. W. Hearn, J. Elzinga and Pl Polyzos
An Implicit Enumeration Algorithm for a Class of Multifacility Location Problems
November 8-10, 1972

Joint Meeting of AIIE/ORSA/TIMS
Atlantic City, N. J.
E. J. Muth
Modeling of Serial Production Systems with Random Service Times
November 8-10, 1972

30th Meeting of Military Operations Research Society
Fort Lee, Virginia
H. D. Ratliff
Optimization of Mine Countermeasures
December 12, 13, 14, 1972

Nonlinear Programming Symposium
George Washington University, Washington, D. C.
D. W. Hearn and W. D. Randolph
A Dual Method for Quadratically Constrained Quadratic Programming
March 14-16, 1973

43rd National Operations Research Society of America Meeting
Milwaukee, Wisconsin
R. L. Francis
A Selective Review of the Location Problem Literature
May 9-11, 1973

31st Meeting of Military Operations Research Society
Annapolis, Maryland
H. D. Ratliff
Chairman of Session on Operations Research in Mine Warfare
June 19-21, 1973
Name of Meeting: ORSA/TIMS Joint National Meeting
Location: Boston, Massachusetts
Author: P. M. Dearing and R. L. Francis
Subject: "A Minimax Location Problem on a Network"
Date: April 23, 1974

Logistics Research Conference
The George Washington University
R. L. Francis
"Recent Analytical Advances in Facility Layout and Location: A Survey"
May 10, 1974

ORSA/TIMS Joint National Meeting
Boston, Massachusetts
D. W. Hearn and Albert Chan
"A Weighted Round Table Trip Location Problem"
April 23, 1974

ORSA/TIMS Joint National Meeting
Boston, Massachusetts
E. J. Muth and P. D. Mehta
"On the Reversibility of Production Lines"
April 23, 1974

Conference on Reliability and Fault Tree Analysis
University of California, Berkeley
E. J. Muth
(no paper given)
September 3-7, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
Donald W. Hearn and W. D. Randolph
Properties of a Generalized Inverse Dual
October 16 - 18, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
Donald W. Hearn
Chairman of Session on Management Information Systems
October 16 - 18, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
H. Donald Ratliff
Chairman of Session on Network Applications
October 16 - 18, 1974
Name of Meeting: Joint ORSA/TIMS Meeting
Location: San Juan, Puerto Rico
Author: L. A. Martin-Vega and H. Donald Ratliff
Subject: Scheduling Vehicles Loads Under Certain Fixed Routing Assumptions
Date: October 16 - 18, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
Michael E. Thomas
Chairman of Session on Panel Discussion: Should OR/MS Programs be Updated
October 16 - 18, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
Robert L. Papineau and Richard L. Francis
A Minimax Facility Layout Problem
October 16 - 18, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
Richard L. Francis
Program Chairman
October 16 - 18, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
Albert W. Chan and Richard L. Francis
A Round-Trip Location Problem on a Tree Graph
October 16 - 18, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
B. D. Sivazlian
A Sequential Replenishment Policy in the Inventory Control of a Perishable Commodity
October 16 - 18, 1974

Joint ORSA/TIMS Meeting
San Juan, Puerto Rico
B. D. Sivazlian
Replacement Theory - Current and Future Direction
October 16 - 18, 1974
Name of Meeting: Joint ORSA/TIMS Meeting
Location: San Juan, Puerto Rico
Author: Thom J. Hodgson, Kerry E. Kilpatrick, and Ira Longini
Subject: An Integer Quadratic Programming Approach for the Scheduling of an Outpatient Clinic System
Date: October 16 - 18, 1974