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MEMORANDUM

1 June 1949  
M-1230

TO: F. E. Colibehm  
FROM: M. M. Flood  
SUBJECT: PLANS FOR LOGISTICAL STUDIES

The general question of RAND logistical studies was discussed at a staff meeting on Friday 22 April 1949. At that time, I outlined a working approach and general principles to serve as guides in my work during the immediate future while I am designing a more detailed research program in logistics to propose to you and the staff for refinement and approval.

The outline from which I read at the staff meeting is enclosed as Appendix A. The main points may be summarized in a single sentence, with key words underlined, as follows:

The purpose of the RAND scientific research program in logistics will be to devise and prove new methods broadly applicable to the solution of a few of the most important problems faced by the USAF, and the working approach will be to select problems that can be related directly to other RAND research activity in order to ensure the effective application of available RAND resources and know-how and the steady production of by-product results.

My immediate efforts have been devoted to a general survey of the field of logistics in order to collect and list a number of well-formulated problems that are of real importance for the future of the USAF. Contributions to this list have been made by yourself and by members of the staff. I am currently collecting further suggestions from various offices of the Air Staff and from others in and out of Washington. The problems already suggested are listed in Appendix B.

This memorandum proposes a pattern for relating the logistical work to the other work of RAND and is submitted (prematurely) in the hope that you and the staff will pick it apart and thus provide guidance for my next steps in tackling the logistics problem.

M. M. F.

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APPENDIX A

A Preliminary Outline  
of Approach and Principles  
for Design of Logistics Research Program

I. Purpose

- A. Develop Methodology for new approaches to solution of varied problems of logistics.
- B. By-Products adequate to justify effort as work goes along.
- C. Eventually to make convincing analytical case for and against such points of view as those supporting national subsidies for a merchant air fleet, or air transportability policy (because of reduced planning time and resulting savings in pipeline and inventory).

II. Scope

- A. Includes types of activities, things, and problems that are of primary concern to the Director of Logistics of the Army General Staff (or corresponding USAF staff agencies) — and also analogous items of concern to similar authorities at either lower or higher administrative levels.

Examples:

- (1) Procurement, including research and development.
- (2) Training of technical and service personnel.
- (3) Operations of ordnance, signal, transportation, engineers, troops in field.
- (4) Stockpiling, warehousing, standardization, maintenance.

- B. Excludes Manpower mobilization.  
Intelligence and information.  
Strategic planning, tactical doctrine, requirements.  
Combat operations and plans.  
General administration, records, finance, legislative.  
Morale, psychological.

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- Examples:
- (1) Plan and conduct of deployment of forces.
  - (2) Espionage and Security.
  - (3) Propaganda, psychological warfare.
  - (4) Personnel policies, promotions, records.
  - (5) Combat doctrine and troop training.

### III. Exchanges

- A. Air Force and as USAF conceives logistic role and mission.
- B. RAND now and continually has special talents and know-how to be applied.

Examples: (From Mathematics Division)

- (1) Theoretical tools of linear programming, decision-making, games.
  - (2) Analytical and computational facilities.
- C. Scientific (hypothesis and experiment) as opposed to industrial engineering or non-experimental.
    - Includes:
      - (1) Jeep problem.
      - (2) Analogue computer for world petroleum supply and storage.
      - (3) Adaptation of Shannon's theory of information to transportation field.
    - Excludes: (except for required quick and dirty, or urgent)
      - (1) Any typical staff study that could be done by good officer without special scientific training.
      - (2) Methods not centered on a model of wider applicability.
      - (3) Details of application, except to provide a model example.
  - D. Development as opposed to research of uncertain or very slow (greater than one year) payoff.
    - Includes:
      - (1) Analogue computer scheme for world petroleum supply for USAF.
      - (2) Linear programming approach to the real diet problem.

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Excludes: (1) Linear programming approach to the Berlin air lift.  
(2) Broad military worth concept considerations.

- E. At outset a very few problems, that appear to be simple but interesting theoretically, and ones expected to yield models of wider applicability.

Example: Possibly the USAF petroleum supply problem.

## IV. Approach

- A. Fragmentary using partial problems that are of sufficient practical and technical interest to be expected to provide by-products and guidance for further work.
- B. Models constructed from more or less realistic experience to channel thinking temporarily along a main rut with branches.
- C. Sandtable (i.e. "war games") both for experimentation and as a major possibility for a new source of techniques using human iteration and survival (free enterprise) instead of decision theory or "planning".

Merrill M. Flood  
The RAND Corporation

1 June 1949

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APPENDIX B

USAF Logistical Problems

A. Airbase planning

A number of problems posed are a part of the general problem of attaining effective location and design for airbases for use in air operations. Bases may be intended for use in defense of the continental United States, for long-range strategic bombing operations, or for tactical support of ground operations - or for a combination of such purposes. The central need seems to be for planning factors, better grounded on science and experience, that can be applied in designing or locating bases for each type of combat purpose. Colonel Callahan (DCS/M-LPG), and others, support the view that this general area of research is worth serious attention by RAND.

Lt. Colonel Roper (Directorate of Installations) has proposed two base problems in some detail, as follows:

1. Optimum base locations for strategic air effort.

a. A strategic air effort directed against an industrial target system located at a distance of 5000 nautical miles from base areas in the U. S. may be conducted in two principal ways:

(1) Using aircraft having a 5000 mile radius of action based in the U. S.

(2) Using aircraft having shorter radii of action based outside the U. S. at distances of 3000, 2000, or 1000 nautical miles from the target system.

b. Considering the over-all effect on the national economy resulting from relative cost of aircraft, attrition and sortie rates, base development requirements, petroleum requirements, shipping and supply line requirements, base defense requirements, etc., and the effects of refueling techniques, the problem is to determine the relative cost in natural resources of destroying the target system using each aircraft type selected for consideration in meeting the foregoing alternate conditions.

2. Optimum location of new bases as land offensive advances.

a. Having established bases for the conduct of air operations, a land offensive may result in the seizure of additional base areas nearer the target area.

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- b. For any given aircraft type (i.e., heavy bombardment, medium bombardment, light bombardment, fighter, fighter-bomber, etc.) the problem is to determine what proximity to the target system must be gained to warrant the abandonment of an established base and the establishment of a new base, considering the cost of construction, the effectiveness of the air effort, attrition and sortie rates, logistical effort involved in the lengthened supply line, etc.

Captain Dupret (USN), Lt. Colonel Hall (Joint Staff), Colonel Nyquist (and others of the Logistics Plans Group - DCS/M), Colonel Baker (and others of JIPG), and others agree that base design and location is a vital matter - and they second Colonel Roper's proposals.

3. Optimum design of a complex of airbases serving a particular operation

Once the general area has been settled upon for a particular air operation the logistician must decide how many separate bases to establish in order to provide the best platform for the project air operation, taking account of vulnerabilities to probable enemy action and requirements for contingent operations anticipated under the strategic concept. Colonel Howe (DCS/M-LPG) and Colonel Ruestow (formerly DCS/M-LPG) stressed the great importance of rapid or advance construction of airbases if full advantage is to be gained from speed of action early in the war - and both of these men believe that improvements in base design would be very important. Ellis Johnson (ORO) notes the competition between services for naval shipping and proposed that RAND collaborate with ORO and OEG in its study of sea lane shipping losses as affected by such major supply requirements as those for strategic airbase construction and operation.

4. Optimum design of a single airbase.

There seem to be a number of important problems to be solved in connection with the more detailed design of a single airbase. Colonel Roper would like some results concerning the size force that can best operate from a single airstrip, and the supporting elements it should have. Colonel Hall would like to have a scientifically prepared table showing optimum runway lengths for each airplane, presented as a function of total weight of fuel and bomb load, taking account of pertinent tactical parameters such as crew experience, etc. Colonel Nyquist stressed the importance of decisions concerning the planned permanence of bases, and the same point has been made directly or indirectly by various others, including:

Lloyd Young, with regard to outpost defense bases and such considerations as length of tour of duty, morale, etc.

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Colonel Zeller and Colonel Curtiss (GSUSA-Log D), with general reference to designing capital facilities to fit probable duration of need.

Lee R. Reynolds (DCS/M-D/MSS), who would like RAND to make an evaluation of the effect on individual morale if the USAF were to adopt the policy of providing fully furnished quarters, world-wide, at every Air Force installation for all married officers and first three grade airmen.

5. Optimum base locations for continental defense.

RAND has done a good deal of work on the general problem of airbase location as a part of its Air Defense Study. I have noted a problem concerning the choice between a forward northern fixed defense by Army troops and that possible by rapid air transport of troops to defense locations when the place of immediate need is more apparent. These problems are closely interrelated since the Army will need both to provide ground protection for forward bases and to operate anti-aircraft artillery and other fixed defenses at and near the bases.

B. Air transportability.

Several problems posed might be solved by increased use of air transport for personnel and materiel. F. R. Collbohm has stressed the importance of this with particular emphasis on situations where a reduction in forward planning time would make planning more certain, reduce need for contingent operations, and thus accelerate and ease supply. Brad Young's work, and that of others, has shown many instances where operating costs may be reduced by wider use of air transport due to the reduction in supply pipelines, etc. The possible uses of air transported field troops, and completely airborne operations, have been discussed widely and raise many questions worth serious study. Colonel Callahan supports the demand for scientific air transportability studies in all important areas of USAF interest.

1. Air evacuation of general hospital patients.

Lt. Colonel Hickey (DCS/M-D/MSS) has proposed that a study be made by RAND "to determine whether or not it would be economically and tactically feasible to institute a program for the National Military Establishment of the evacuation of all general hospital patients from overseas theaters." He notes that such a change in present practices would have far-reaching effects within the NME.

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2. Air lift of spares.

Colonel Hickey has stated the belief that more widespread air lift of selected aircraft spares would produce real economies due to reduction in work of filling pipelines. Mr. Collbohm, and others, have remarked on the economies effected under the Berlin air lift by air shipment of spare engines from the U. S. Many officers interviewed have stressed the importance of the spare parts supply system and remarked on the heavy pipeline and storage requirements as the problem has been handled in the past.

3. Airborne operations.

Colonel Kengla (DCS/M-LPG) and many others have stressed the importance of research on the general problem of air transportability of combat forces, particularly for Army operations, but also for the Air Force. J. Lipp reports that General Kenny is interested in the possibilities for self-sufficient air task forces. Mr. Haddad (MB) believes the airhead problem to be greatly in need of study and he feels that useful data for such research is available from Vittles, Haylift, and the Alaskan tests. Colonel Hickey also believes that many such useful lessons could be learned by study of Vittles.

4. Air lift planning factors.

Major Dewey (DCS/M-D/MSS) has proposed that RAND consider developing more realistic airlift tonnage factors than, for example, the ten pounds per month per man deployed in the field as used in current general mobilization planning.

5. Air lift criteria.

Colonel Williams (DCS/M-Directorate of Armament) notes that air lift of certain munitions may be economically and tactically desirable. Incendiary bomb cluster components and proximity fuzes are very costly to stock, pipeline, inspect, and maintain and might well be air lifted in proper cases. Crude estimates indicate that the procurement cost of the planned war reserve of incendiary bomb cluster components will be some 500 million dollars, and that storage and other annual upkeep costs for this reserve item will be some 75 million dollars annually. These requirements for the reserve are based on supply procedures like those of World War II and a change to air lift procedures would modify

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these vary appreciably. Harold Welkind (DCS/M-LPG) notes that supply requirements for certain jet engines of quite short life are very great if slow transportation is used and refers to recent official memoranda proposing that serious consideration be given to more frequent air lift of such engines. He also notes the critical importance of precise actuarial estimates of service life and replacement curves for such engines as part of the basic data needed for study and decision concerning the supply details for jets. Major Hefferen (DCS/M) notes the critical connection between jet engine life, supply requirements, and feasibility of proposed mobilization plans. There is general agreement that what is most needed is a usefully reliable set of criteria applicable to materiel, personnel, or forces that would serve to indicate whether air lift, or another form of transportation should be used in each case. These criteria would, of course, have to reflect accurately the effects of all those dominant tactical and economic factors that determine the best decision.

### C. Supply management

More problems have been proposed to me in the general field of supply management than in any other. There appears to be a ceaseless set of such problems, ranging from superficially minor matters relating to forms and record-keeping to apparently major questions affecting the whole military supply system. There is a rather general feeling that supply problems are awfully numerous and important but very unglamorous and dull. As one officer put it, if the supply officer cannot find a way to support the operating plan, then the commander gets a new supply officer. Careful culling should point up some problems in this general area that are well worth some attention by RAND.

#### 1. Requirements determination.

Dr. Kusner (MB) stressed the need for usable criteria of military worth for application in analyses of requirements such as those being made under the SCOPF project. Mr. Haddad argues that perhaps the most common error made in supply work is to provide inadequately for maintenance, or in mobilization planning to estimate too inaccurately for maintenance capabilities. Colonel Keating (DCS/M-LPG) is interested in exchange relationships between tactical performance and maintainability. Colonel Zeller and Colonel Curtiss (GSUSA-Log D) cite instances of serious errors in providing handling equipment, and similar accessories, for use at ports. Mr. Lipp notes the critical dependence on predictions, as to time and place of use, of requirements for full storage and supply.

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## 2. Systems costing.

Many decisions as to types and quantities of items that will best implement a strategic or tactical plan depend for their validity on costing studies of alternate systems potentially available for the tasks. L. E. Root has noted that the work of RAND on the symmetric air war leads naturally to important costing problems for possible alternative systems. Mr. Lipp has proposed three important areas for evaluation of comparative system costs:

- a. Strategic bombardment by a 10,000 mile carrier-missile defended by ground anti-aircraft weapons in comparison with known alternatives.
- b. Guided missiles for anti-aircraft in comparison with guns.
- c. Missile launching station, with accompanying radar control system, for each of several traffic capacities.

These are only a few of the many problems that might properly be posed for system costing analysis. Since the majority of logistical problems might be approached from this viewpoint it is more helpful to list them in other ways under the classifications of this memorandum.

## 3. Control procedures.

J. S. Imiris (OSAF) stresses need for improved inventory control, with dollar control of stocks tied carefully into budgeting. Colonel L. E. Johnson (DCS/N-D/MSS) and his associates indicate that new standardized USAF stock control procedures, and plans for improved inventory and budgeting methods, represent a long step toward the goal. He emphasized the value of projected indexes of performance and efficiency to be available routinely to permit depot and inventory control. Colonel Tischbein (MB) also stressed the need for improved and more uniform control procedures, and expressed approval of the concept of performance indexes as a guide and stimulus for better work. Lt. Colonel Dyer (ME) and Mr. Imiris criticized the current practice of accounting and controlling in similar detail for minor and major supply items. Mr. Imiris notes that requirements established in routine manner for such non-routine items as wings or control pedestals are almost sure to be excessive, and that some mechanization is needed that will in effect "think" through and correct for such special situations. Many problems have been posed pertaining to the establishment of proper levels of supply, or of good stock levels, and success in solving these will usually depend on having improved control procedures - as Lt. Colonel Dyer (ME) has pointed out.

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4. Quantity determinations.

Colonel Baker (JLPG) emphasizes the importance of procuring spare parts for aircraft routinely as a part of the same orders as those for the aircraft. He stresses the difference between needs for operations in the ZI and in overseas theaters, and suggests that RAND might develop guiding principles for this type of procurement task. Colonel Zeller offers several problems as samples of those met in quantity determination:

- a. What "luxury" items can properly be included in the TO&E, particularly those for personal use such as varied food, clothing, etc?
- b. Supply levels for food, vehicles, etc. have often been too high in the past with consequent waste.
- c. Oversupply of items of short life, or with component parts of relatively short life, is particularly wasteful - for example, drum seals for aviation gasoline sometimes failed before the gasoline did.
- d. Capital facilities, and equipment with long life, should be designed and supplied in harmony with the expected period of use.
- e. Quantities required are often substantially affected by contingent requirements - for example, the decision not to construct a proposed contingent field depot represents a calculated risk.

Mr. Lipp has also stressed the contingent item problem, with special reference to fuel stock levels abroad.

5. Operating procedures.

I proposed the problem of distributing fuel efficiently for USAF use throughout the world as one of importance, and one which can be analyzed theoretically and perhaps be solved in practice by suitable electronic computing equipment. Captain Jones (DCS/M-D/MSS) proposes that RAND might well investigate this general problem as it relates to overseas land transportation of aviation fuel. E. W. Paxson and Mr. Young have proposed several problems related to division of responsibilities for repair and maintenance as between the several echelons, and propose that RAND might develop principles for making these allocations more efficiently. Several relatively minor operating problems have been proposed, including:

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- a. Colonel Haywood (DCS/O-D/PO) suggests that "packages" of men and materiel shipped overseas should be better balanced to fit the needs of the various users who may receive them.
  - b. Captain Dupret (USN) stressed need for rapid methods of calculating and revising requirements, perhaps with the aid of modern high-speed electronic calculators.
  - c. Captain Dupret believes that naval supply of overseas units should be improved - for example, he notes that ships were often used in crowded ports in the Pacific for storage, and he questions the desirability of the practice.
  - d. Captain Dupret notes the wide use of "expeditors" and believes that a better mechanism should be provided for ensuring efficient movement to central assembly establishments.
  - e. Captain Dupret feels that a much better job could be done in supplying items for personal use (food, clothing, etc.), and proposes that RAND might develop principles for optimum depot location as a function of pertinent tactical and operating factors.
  - f. Colonel Hickey notes that ship-mounted aircraft repair facilities may sometimes be desirable within theaters of operation, and proposes that RAND might analyze these possibilities.
6. Disposal of property.

Colonel Campbell (DCS/M-D/MSS) notes several problems faced by the USAF in disposal of property, and with particular reference to relationships between the foreign aid and the disposal problem.

#### D. Organization

The general field of research on organization would be a broad one. The problems reported here refer almost entirely to the logistical functions of the National Military Establishment.

##### 1. Combat-technical personnel ratios.

Colonel E. L. Jones (DCS/M-LPG) emphasizes the importance of making adequate provision for service troops, and for technical officers

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on staffs. He suggests that RAND might develop principles for determining optimum ratios of service to technical personnel in terms of pertinent factors. Colonel Kengla, Colonel Langmead (MB), and others also stress the importance of this type of study.

2. USAF Technical Services.

Colonel Kengla notes that the USAF faces the problem of how far to go in organizing independent technical services. Mr. Imirie stresses the urgency of this problem, particularly with respect to items of common supply. Colonel Roper raises similar questions with respect to Air Engineers. There is general agreement that RAND would do a real service if it could provide dependable principles to guide the USAF in reorganization matters of this kind.

3. Decentralization of authority.

Mr. Young, Colonel Langmead, and others propose that RAND attempt to develop principles for the effective decentralization of organizational authority and responsibility. Mr. Young would like to know the effect on communication costs of any degree of centralization in decision-making. Colonel Langmead asks whether supply operations for the services should be centralized in the face of ingrained differences in service viewpoints - for example, as regards speed of operations on land as compared with in the air. Colonel Baker asks whether we can afford highly centralized organizations and facilities that may be vulnerable to disruption through attack or subversion.

4. Standardization.

Colonel Jones proposes that RAND consider doing research directed toward principles for standardizing organizations of major commands. Colonel Dyer (MB) has made an analysis of possibilities for general types of standardization of logistical organizations and feels that further research along these lines should be profitable.

E. Personnel

Wise selection, training, and managing of personnel involved is generally felt to be of first importance for the success of any military activity. The problems reported here relate primarily to logistical personnel.

1. Training.

Colonel Jones feels that the development of improved curricula

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for schools training logistical staff officers is an important matter. Colonel Haywood has observed that supply officers often become so conservative in their estimates of capabilities that they tend to be ignored. Colonel Zeller feels that top staff thinking must be geared toward austerity and economy because the war will be fought in relatively short supply as compared with past wars. Colonel Kengla and Colonel Haywood stress the need for sounder precepts for proper professionalization, specialization, and career planning for technical personnel of all grades. Mr. Lipp notes the importance of research to provide personnel less liable to make gross errors, and he opens this question with particular reference to personnel handling fuels.

## 2. Selection.

Colonel Langmead thinks picking the right man for the job is the heart of the logistical problem, and would like to see surer methods developed for ensuring better selections. Colonel Ocomb (MB) points out the need for firm principles to guide the USAF in its program for recruiting and holding high caliber technical personnel, and proposes that RAND consider research on ways and means for accomplishing this end.

## 3. Morale.

Lt. Colonel McCormick (DCS/M-D/MSS) proposed that RAND determine optimum ways and means to provide food for crews during combat flights. Mr. Young proposes a study of the relationships between rank, and other incentives for high quality performance, and the actual degree of accomplishment in functions such as repair and maintenance. I note that morale considerations enter into very many of the logistical problems discussed elsewhere in this memorandum - for example, those relating to fully furnished quarters or air evacuation of all general hospital cases.

## F. Mobilization Planning

There are very many staff agencies now concerned with mobilization planning. There are also several research efforts, such as the work under SCOOP, that are leading to improvements in mobilization planning techniques. There seems to be a positive demand for still further work on various research aspects of the general mobilization planning problem along the lines of RAND competence. The following few problems may illustrate the character of this need.

### 1. Feasibility tests.

The Munitions Board, and other planning agencies, make feasibility tests of various war plans to determine whether or not they

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