



AN APPRAISAL OF LOGISTICS RESEARCH

Dr. Nathan Brodsky

NOTICE

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Reviewed by: Colonel Thomas C. Keach, USAF

Date: 25 January 1960

INDUSTRIAL COLLEGE OF THE ARMED FORCES
WASHINGTON, D. C.

1959-1960

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Reporter: Grace R. O'Toole

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Publications No. L60-100

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MR. HENKEL: General Houseman, Members of the Faculty, Students, and Distinguished Guests: On October 4, 1957, the Soviets placed Sputnik I into orbit. This startling accomplishment not only opened a new chapter in man's long struggle to complete his physical environment but also inaugurated a critical phase in the conflict between opposing governments and political systems.

As a result of this new technology, modern warfare is becoming a big business, and our logistic programs are zooming to tremendous importance.

In our study of materiel management, we should have an understanding of this relationship of logistics administration and technological developments. As you know, many research studies are being made.

To discuss with you the nature of these studies and to analyze them from the point of value to the military services, we have the Staff Director of Logistics Research, Office of Secretary of Defense, Supply and Logistics.

Not only has he been one of our fine students but he has lectured to us on four previous occasions. It gives me a great deal of pleasure to welcome him back to this platform and to present him to this year's class.

Dr. Nathan Brodsky.

DR. BRODSKY: General Houseman, Members of the Faculty, Students, and Guests: I was on active duty at the Industrial College about a month ago and had the opportunity to hear an oral presentation on irradiated chicken blood. The next day I ran into your illustrious OPer and mentioned the fact that I, too, had attended the University of Pennsylvania. With suave tact, which would well qualify him to a diplomatic assignment to Viet Nam, he said, "Well, you must be older than I, because you attended much earlier than I did."

I just felt that I ought to take this opportunity to report to the class that I have since checked his biography and I find that he is in fact my senior. I therefore just want to leave this word for him. I would suggest that he not take his theory of the efficacy of chicken blood too seriously.

This morning I would like to talk to you about the Logistics Research Program in the Department of Defense. As you know, today's smart executive does not run his business on the basis of hunch. Manufacturers do not set up new plants on a whim. They make plant location studies. Producers don't introduce new products by intuition. They first predict demand through market analysis. Retailers don't stock up on the basis of last year's business. They make sales forecasts.

Now, what has this got to do with the business that we are in? There are more complexities, variables, and unknowns in logistics

than there are in the largest businesses. Just as the business man plans for tomorrow while he continues to make his sales today, so we who are engaged in logistics must be concerned not only with our current mission but also with extending our vision of where we are going.

It is a fact that the same research approach which business has used to optimize its operations has helped to improve the performance of our logistics mission and is a valuable aid in giving us a sighting which we must take of the future. The idea that you cannot make management progress without management research has gained wide recognition not only in industry but also in the military services. New developments in weapons, organizations, tactics, and strategy raise many logistics problems for which our experience is an inadequate tool.

There are too many facts, too many uncertainties, too many interrelationships. Realizing the complexities of these problems, and confronted with the encouraging results from the application of scientific research techniques in the social sciences, the modern logistician has been turning to research to provide him with an objective basis for his decision. This research involves more than the rethinking and improving of our present management techniques and processes. It also seeks to develop new ideas and new methods which will permit us to keep abreast of the changing concepts of national defense.

My purpose this morning is to discuss with you the role of logistics research as a tool for management, its relevance to major logistics

problems, the problem of communications, and, finally, the need for a strategy for research. Now, why should this group be interested in such a lecture? I believe that your interest must stem from the fact that most of you will be moving into top management jobs in which a familiarity with our subject will be essential. You will be seeking better tools for management. You will be searching for keener insights into the interrelated problems which you will face. You will seek a better understanding of your logistics environment.

This will necessitate that you call upon research and analysis. It does not require that you become a researcher but does impose upon you an obligation to familiarize yourself with the tools that may be available and to develop an appreciation of how useful these tools may be.

We said that the logistics manager faces a large number of variables which leave him at a loss regarding the optimum way of accomplishing logistics support. If he is to exercise his professional skills properly, the logistician must interrelate a host of factors before arriving at decisions. He must consider those elements of logistics which relate to national policy and to the national economy. He must consider demands placed upon logistics by strategic plans evolved by the Joint Chiefs of Staff. He must seek efficient and effective operations within the logistics systems which he manages. He has to face problems with tremendous uncertainty in areas such as production, transportation,

materials, distribution. He must be keenly aware of the need for the fullest return from the investment in logistics resources. And he must render decisions on the best allocation of these resources.

In brief, the logistician is confronted with the logic of choice and with continual selection among alternative courses of action. And yet he has no precise answers available because he deals with constant uncertainties and constant unpredictability.

It is obvious that previous exposure to a problem does not guarantee the ability to solve a similar problem. It is less obvious, but extremely germane, that the logistician's idea of what the problem is may really be wrong. In desperation he may turn to the use of automatic data processing. But, if he feeds the machine the wrong problem and the same system answers, he has merely expedited his ability to get a wrong answer. ADPS is not a solution to an incorrect diagnosis or to a poorly conceived system. Moreover, even if the problem is similar to one which we faced in World War II or in Korea, we probably need better answers now.

I know that you had a lecture recently on the use of automatic data processing by Mr. Phillips. I saw a little tale recently which reminds me of some of the efficacy of this system at times. It seems that the Book-of-the-Month Clubs now use automatic data processing for determining whether or not the subscriber wants the book, and then the automatic data processing card prepares the shipping ticket. This one man

kept receiving these IBM cards for three successive months and each time he indicated that he did not want a book sent. Nevertheless, for three successive months he received a book. The fourth month, when he got his IBM card, in desperation he bought a punch of his own and just indiscriminately punched two holes on the card and sent it back. Ever since that he has been receiving a refund each month.

Now, what can the logistics manager do to help him seek answers to his problems? The greatest assistance which he currently has is to apply a scientific attitude which encourages an inquiring and objective approach to his problems. This scientific attitude relies on disciplined observation and rigorous proof. It seeks the highest degree of objectivity. It entails systematic and intensive study. Through such study we discover new facts and new relationships which give the managers new dimensions in decision-making.

The scientific method insists on a logical progression and on verification. It begins with a problem, not with a technique. It seeks to define the problem, then develops hypotheses regarding its solution. It tests these hypotheses and then it evaluates the conclusions.

The military departments have been moving steadily toward the use of a research approach in logistics problem solving. A great deal of this work has been accomplished through contract with leading educational and industrial business research institutions. Much of it is being done in-house, that is, by the Department of Defense personnel, either through emphasizing the analytical approach in regular

staff operations or through separately created research and analysis groups. These groups include such groups as the Operations Analysis Office at the Air Materiel Command, and the Signal Evaluation Group of the Army in Philadelphia.

We have said that experience and intuition alone no longer suffice, and that an objective and analytical approach can provide an additional dimension in problem solving in logistics. We have noted that the Department of Defense has been fostering a scientific approach to logistics problems.

Let us, therefore, look at some typical logistics problems which are lending themselves to such an approach, in order that we might get some more tangible evidence of the usefulness of the method which I am describing.

For a long time we have operated as if each item of supply is as important as the next in our supply system. Our traditional approach has brought shortages of essential items and excesses of unessential items, with resultant limitations on overall effectiveness. In the last few years, we have undertaken research to find better ways for determining our stockage policies. There have as a result been several studies designed to establish a measure of essentiality for items in our inventory. The Rand Corporation performed such a study which resulted in the design of a fly-away kit. The Operations Analysis Office of AMC is engaged in a study in this area.

I would like to describe briefly a study which is being conducted by the Navy Logistics Research Project at George Washington University under Dr. Marlowe. George Washington concentrated on a particular class of submarines where space limitations and reduction in the need for resupply are important. The study found an erratic pattern of demand for installed technical items. An analysis of submarine parts revealed that about 75 percent of the items had no demand over a 4-year period. Of the remaining 25 percent which had had some demand, 70 percent were demanded only once during the 4-year period.

How then should we establish an allowance list for the items which showed no demand? How should we determine the really important items, thereby maximizing the submarine's self-reliance and endurance? The George Washington University study sought to measure the relevant military essentiality or worth of repair parts. Now, what do we mean by military worth? It is defined technically as a relevant, ranking system which measures the effects of a parts shortage or a ship's tactical capability. In simpler language, it is a measure of the importance of one item against other items. Importance in what respect? Importance of the components with regard to the mission effect of the submarine and of the parts with respect to the maintenance potential of the components.

In measuring the mission effect, George Washington University was determining what impact the failure of a component would have on

the submarine's mission. Would it terminate the mission? Would it involve high risk, low risk, negligible risk? To obtain data on this, questionnaires were submitted to designated submariners in the Bureau of Ships and the Bureau of Ordnance so as to obtain a combination of views from both operators and designers.

In measuring the maintenance potential, George Washington was seeking a measure of the capability of keeping the component operable when a part has failed through means such as on-board manufacture or cannibalization. For this part of the study submariners and civilian technicians in the Submarine Ordnance and Electronics Supply Office were questioned. From the data obtained, each part was placed in a category which expressed the combination of its mission effect and its maintenance potential. Alternative policies were formulated, each tailored to a particular combination of objectives, which included goals such as endurance loading, reduction of paper work afloat, optimum utilization of storage space, minimum maintenance burden aboard ship, and so on.

There is considerable evidence that the policies developed as a result of this study will reduce the range of parts to be carried aboard the submarines without jeopardizing their missions. Three of the developed policies were simulated and reported in a study by Drs. Solomon and Dedicoff, published in May 1959. These simulations, mainly accomplished on machines, were concerned with the effectiveness

of the proposed policies. This was determined by comparing the sample allowance lists which would have been computed on the basis of the study with the actual usage during specified periods.

The study concludes that the use of allowance lists under the policies developed under research would, first, reduce shortages of all high military-worth range items; second, purge items having both low military worth and zero movement; and, third, provide feasible endurance loading of technical spares.

I understand that the Chief of Naval Operations is considering issuing allowance-list policies based on the results of this study. I have described the study somewhat in detail to illustrate the uses to which research is being put in the field of logistics. With better knowledge and understanding of the related factors and appreciation of the alternative risks which you take, we are able to make management decisions with greater confidence that the results desired are within the realm of achievement. We do not get absolute answers but we certainly have a sounder basis for our decisions.

Another study which I should like to describe briefly in order to show the variety of research under way relates to the economics of rebuild of equipment. The Operations Research Office at Johns Hopkins University, under Dr. Johnson, was asked to conduct such research for the Army, and it has made a pilot study on the quarter-ton jeep. This item was selected because the new model was expected to cost

substantially more in procurement. The question to be answered was: Is it more economical in the long run to overhaul the existing inventory or to purchase new equipment? Data were accumulated on the maintenance and performance both in the United States and overseas. All echelons of maintenance were considered. Though this report has not yet been presented in final form, the Army has already taken steps to modify its procedures based on the findings of the study. Many revisions and maintenance policies pertaining to the quarter-ton jeep have been directed. There will be no more rebuild of the jeep. The economic service life of the vehicle is reduced from 8 years to 5 years for replacement planning purposes. Policy concerning research and replacement of major components has been modified so that there will be no national stocking except for the initial stocks required for field maintenance.

This study has not only produced operational results but has also developed a technique of research which may be applied to more complex equipment.

Still another type of research in the area of logistics is being conducted through laboratory-type simulation. I mentioned the simulation of alternative policies developed by George Washington University for the submarine. That simulation depended mainly on the use of machines. Another type of simulation, a laboratory type, is being conducted by the Rand Corporation for the Air Force. It includes both men and

machines. Simulation, in simple terms, involves setting up a model of a real situation and then performing simple experiments upon the model. The objective of simulation is to determine the behavior of real systems under a variety of prescribed conditions.

Rand's first simulation in its logistics laboratory was designed to evaluate the implementation of the three proposed logistics policies in contrast to the actual Air Force policies of 1956. Both sets of policies were applied to identical flight programs, identical numbers of aircraft, and so on. One of the policies tested was that of deferral of quantity procurement of expensive spares until adequate demand data are accumulated. The second tested policy was a stockage policy for medium and low-cost spares, designed to achieve economic procurement, distribution, and repair. The third policy tested was the use of data processing to provide automatic distribution and central record-keeping.

The laboratory simulation is described in abbreviated form by Mr. Murray Geisler, the manager of the laboratory, in the July 1959 issue of Management Science. The simulation of identical problems through the two systems was rigidly controlled to insure that as much realism as possible was maintained. Each simulated day took 30 minutes of man time and 30 minutes of machine time.

There are several detailed papers on various aspects of this study. You would be interested to know that the systems which were tested under simulated peacetime and wartime conditions demonstrated that

the proposed policies did better than the 1956 policies in both effectiveness and costs. These results, coupled with substantial in-house research in the Air Force, have been extremely useful in implementing policies concerning high-value and low-value items.

The laboratory at Rand is currently engaged in designing a logistics system for missiles in the period 1963 to 1965. It is hoped that this research will permit the Air Force to anticipate and solve potential logistics problems.

Time does not permit elaboration of other problem areas which lend themselves to research, but, in order that you might have as complete a picture as possible, let me quickly mention a few additional areas.

To develop logistics concepts for operations under conditions of limited war, the Army has initiated a study in the Operations Research Office at Johns Hopkins University. ORO is also conducting a study designed to determine the optimum method for providing strategic lift for future Army units. Another ORO study is concerned with the optimum use of air transport in the operational support of the mobile field army. Another major logistics problem which lends itself to research pertains to the impact of financial controls on logistics operations. In this area there has been much heat and very little light. Proponents of financial controls contend that properly applied controls are essential not only for fiscal reasons but also to improve logistics support.

Dissenters claim that such controls are burdensome, unnecessary, and impeding.

In order to introduce some objectivity into this area, George Washington University is conducting a study for the Army, and the Air Force is sponsoring a similar study at Rand.

Research is under way to improve the efficiency of modern industrial operations. This includes considerations such as the scheduling of job-type production as distinct from production-line flow, the establishment of labor-force requirements for industrial plants, cost-control procedures, production planning, and so on. Studies in this area for the Navy are being conducted at the Carnegie Institute of Technology and at the University of California at Los Angeles.

We spoke earlier of the work being done at Rand to design a logistics system for missiles. It is essential that the logistics implications of new weapons be correlated with their development. In keeping with this need, the Navy has sponsored research with the Planning Research Corporation on the Polaris Missile. The research is directed toward establishing provisioning methods for Polaris Missile submarine components and spare parts. This study is profiting considerably from previous work by the Rand Corporation and the Technical Military Planning Operations Office of the General Electric Company.

A problem closely allied to that of logistics implications of new weapons is the question of how to best manage the new weapons once

they enter our system. Do we group all the support around the weapons or do we assign commodity groups responsibility for providing their respective commodities to all systems? This is a crucial problem for logistics managers, and several studies, both in-house and under contract, are being conducted on this problem.

Another study area which is under investigation is that of measuring supply effectiveness. In this area the Operations Analysis Office of the Air Force is investigating the problem, and the Case Institute of Technology also is conducting a study in the area.

Efficient management of inventories has been a subject under study for several years. In this area institutions such as Harbridge House, Massachusetts Institute of Technology, Stanford Research Institute, Rand, and George Washington University are making studies.

I have illustrated the types of logistics problems which lend themselves to research in order that you, as logistics managers, may better comprehend the kind of assistance which will be available to you. The list could be increased many fold to include problems such as those in the areas of procurement, maintenance, transportation, and so on. I hope that the illustrations which we have just considered have conveyed to you the fact that there are major logistics problems in which the research approach is not only applicable but also necessary.

Thus far we have discussed the role of logistics as a tool for management and have tried to demonstrate its relevance to major

logistics problems. Having stressed the successes, I feel that I should also apprise you of the shortcomings/^{on} which we are working to overcome. I discussed several limitations last year and won't repeat them. I would like to reemphasize, however, the problem of adequate communications and to introduce an additional consideration, namely, the need for a strategy of research which requires knowledgeable participation by logistics managers.

Communications between those who are doing the research and those who are responsible for management is essential if research in logistics is to be properly applied. Such communications are required not only because the manager must understand the problem and the end product of research but also to orient the researcher as well. Too many researchers are inclined to pursue a problem as they see it rather than to determine the problem which actually exists. Without adequate communications between researcher and manager, the researcher often changes the basic problem to fit the pattern of his experience. It is under conditions of this sort that we frequently wind up with the right answer to the wrong problem.

I spoke earlier about the scientific technique which begins with a problem, not with a technique. I am concerned about the tendency at times for methodological convenience to become paramount. This is particularly true of those with mathematical inclinations. I have the deepest respect and admiration for those who are mathematically

oriented and who seek to solve problems in the behavioral and social sciences through mathematical processes. But, to summarize a point which I made last year, we must be careful not to pretend to solve a logistics problem as if we are dealing with absolutes and certainties. Mathematics is a valuable language of logic. It is a method of drawing exact deductions from given premises and of verifying the logical consistency and adequacy of premises. But, before mathematics is applied, we must be certain that we have defined the problem and that the tool is in fact suitable for the solution. We must not pretend that learned qualification is synonymous with objective scientific research. It may be only one aspect of such research and, if improperly applied, an undesirable one.

If we use mathematics in solving our problems, we must make clear what the problem is that we are trying to solve, what the significance of the approach used is, and what the significance of the proposed solution is. Professor Merrill Flood of the University of Michigan has pointed to some of the limitations of the mathematical approach in his article, "Operations Research in Logistics" in the December 1956 Navy Research Logistics Quarterly. Dr. Flood warns that mathematical models may become extremely complicated as the number of variables increase beyond manageability from a computational standpoint. Even if we have a faithful model, he says, the difficulties of wringing useful information from it may be very great.

My argument with some of the purely mathematical solutions is that they tend to overlook important variables which cannot be quantified. They frequently try to give absolute answers in areas where we deal with uncertainties. They fail to communicate adequately with those who must use the results, and they overlook the problem of establishing criteria for the evaluation of alternate choices, which is generally basic to all of our problems.

I saw recently a chart which was used by a lecturer here at the College which vividly portrays the fallacy of not establishing suitable criteria. In discussing national strength, a chart on per capita income was presented. By this criterion the United States would rate first, but Iceland is third. Do we conclude, then, that Iceland's appropriate position of national strength is third throughout the world? You see, unless we really establish meaningful criteria before we succumb to methodological convenience, we may come up with erudite statements but with poor solutions. Must we not first, in this case, examine criteria which will be useful as a measure of national strength? Must we not first determine whether there is a correlation between national power and total economic output?

This concept, which Professor Galbraith labels the illusion of national security, is accepted on its face value by those who measure military strength in terms of gross output. Yet I suspect a more accurate criterion is the usable military output rather than the gross

figure.

This matter of establishing criteria and of knowing what you are looking for brings to mind a tale which I heard recently of the two boys, age 5 and 6, who were walking down the street. They passed a nudist colony. The 5-year-old boy saw a hole and peeked in, and said, "Wow! There are naked people in there." The second boy asked, "Are them men or are they women?" The first boy looked again and turned and said, "I don't know. They are not wearing any clothes."

This is a matter of knowing what your criteria are.

My points with respect to the adequate communication are that we must establish our criteria before we exercise the logic of choice. We must avoid the inference that we are dealing in absolutes. We must be sure that the mathematics is relevant to the problem at hand. And we must be keenly aware of the need for communication between the researchers and those responsible for management decisions.

Now I turn to my last point. That is the need for a strategy for logistics research. In order to carry out an effective logistics research program, our resources must be allocated in such a manner that they will do the most good. This allocation must include funds for basic research as well as applied research. Basic research is an important element in the management sciences as well as the physical sciences. We must constantly replenish the well of basic knowledge from which eventually we may draw upon for the solution to our problems.

Because of the urgency of our mission and the need for the proper utilization of our resources, we must develop an overall strategy of research which deploys these resources wisely. The development of such a strategy is important because the individual tugs and pulls of researchers do not produce the most desirable results either in basic or in applied research.

Dr. Robert Cautkin, President of Brookings Institution, discussed this problem with reference to economic research at a recent meeting of the American Economic Association. What he had to say is particularly appropriate for us, too. I should like to quote it in toto. Dr. Cautkin said:

"Scholars generally believe that they are the best judges of what research should be undertaken and how that research should proceed. Many feel that, if only society would give them ample resources, they would advance knowledge in the best or indeed the only possible way, by pursuing their own interests in research. Given unlimited talent, time, and funds, this is a congenial and a proven approach. But we have, in fact, limited talent, limited funds, and urgencies for which there is limited time. We have, in brief, an economic problem of allocating limited resources, and hence a strategy is needed for the deployment of those resources to achieve the maximum results. This problem is faced by every thoughtful agency with funds to allocate, and it is a problem for all of those who wish to see economic research

advance.

This problem is a very important problem for us in the Department of Defense as well. Dr. Caulkin in his talk used an analogy which likewise applies to our area of interest. The researcher is a tactician who employs the resources at his disposal. He may be the best expert in this area, but tacticians in given sectors do not design a broad strategy of war. This is done by those with an overall view of the resources available and the alternative opportunities for success and failure.

In the Department of Defense we need tacticians and we need strategists. The tactician is the individual researcher who concentrates on those problems on which he is an expert. The strategist in logistics research, however, must be concerned with priorities of research and with obtaining the best use of our research resources. Such resources must be used for basic as well as applied research, but the strategic employment of these research resources must be in the hands of those who have a sense of urgency about relevant priorities and not in the hands of researchers who may be exposed to limited sectors.

What I am saying is that you, as managers, will have an important role to play in designing the strategy of research. You must work with the researchers in isolating the problem areas and you must seek the best use of the research resources available to you. You must nurture the researcher, giving him the opportunity to use and extend his talent,

but you cannot be guided solely by the individual interests of the researcher in placing the limited resources for research.

I hope that our excursion through research as applied to logistics will stimulate your interest. Those of you who will move into positions of high management responsibility will require an understanding of the research resources available and the ability to communicate with researchers. As you seek solutions to the problems of logistics support in a nuclear age, you will find the research approach an indispensable tool.

Thank you.

CAPTAIN SMITH: Gentlemen, Dr. Brodsky is ready for your questions.

QUESTION: Sir, I have seen a lot of these studies in the past. They generally come out and end up in a great big volume, and they have some very interesting conclusions. But the people who really have to make the decisions are too busy and hence they never read them anyway, and it takes an awful lot of effort to push a project through. My question is: In Defense do they have any studies on the total amount of money spent on these studies, and so forth, and on how many dollars we have actually saved? Our management effectiveness generally boils down to how much money we really save in the end.

DR. BRODSKY: I appreciate your concern for the budget. I, too, am concerned about it. I assume your question is directed to the area

of logistics research. In the area of logistics research, for instance, this year we know that we will be spending about \$6 million for contract research only. We put in your class yesterday copies of this booklet which just came out the other day, which lists research projects. I can almost open it and turn to any one page or any one project which has more than paid for this \$6 million many times over.

STUDENT: I mean all these projects, organizationally and all.

DR. BRODSKY: I am here to talk about logistics research only.

STUDENT: I just wonder if the Department of Defense does keep track of how much is being spent on one side and how much we are gaining on the other.

of Defense

DR. BRODSKY: I am sure that the Director/for Research and Engineering could answer that.

QUESTION: I am interested in this project you have to determine which particular spares are necessary from an operational standpoint. I can only say that it is a long time coming. We have needed something like that. My question really is: What is being done about keeping some of these non-essential items off the equipment in the first place? We end up with a lot of that stuff on there that's just eye wash. That's all it is.

DR. BRODSKY: This is an important problem in design. We are going beyond the area of research here, but I might say that efforts are constantly being made to get the logistician and the research and

development people as closely together in the early stage of development so as to minimize the logistic impact of some of these new weapons. Through the Standardization Program, for instance, requirements are being established so that the designer is required to use a standard part except where he can indicate that the standard part won't comply with the requirement of the weapon or the system that he is developing.

The problem you raised is not an easy one to solve. The people in research--and I am talking now about hardware, which is basically the area that you talked about--contend that, in this era, when we have time at a premium and so on, people shouldn't be looking over their shoulders and be submitting them to red tape and so on. They say they've got to get the best weapons and they've got to move ahead. On the other hand, those of us who are responsible for logistics know that, if you don't enter your logistics implications early enough in the scheme, you wind up with something which perhaps you can't support.

Where the balance is on that, I don't know. I don't know that anybody has struck it. But I do know that the problem is one that is being worked on on the highest levels.

QUESTION: Have you made any studies on packaging the items? Lots of times you get lots of items in and the percentage of useful ones is not very high. Is there a study showing the percentage, and how far you can go in packaging the items before they are shipped?

DR. BRODSKY: Yes, there are studies in this area. Let me make one thing clear, that these studies which are presented are not studies which we in OSD have made. They are studies that are being made by the military departments. OSD is concerned merely with the coordination of this overall program. These are military departmental studies.

While the answer to this question is yes, I'd like to emphasize the fact that the kind of research that I have been stressing this morning is not research in hardware; it is research in management, research at the highest level of management in logistics. How do you determine your inventories? How do you best run your production systems? How do you best run your weapon systems? There is constantly under way research in the area of hardware. This is something which is not the responsibility for which our office is concerned.

QUESTION: With relation to the submarine study, I am interested to know about the spare parts that you put on the allowance list, or that they come up with on the allowance list. First is essentiality and usage. Some parts we know are very critical, and, even though there is no usage factor, we have to have them on board as an insurance factor. Was this ground in? Just how did they do it?

DR. BRODSKY: Yes; there are two effects--the mission effect and the maintenance potential--which were ground into this study. And certainly the essentiality of it is the very basis of the study. So that,

if the item were determined to be essential by the designer or by the people responsible for supply, it received a high rating in terms of going onto the allowance list.

QUESTION: If I were to be critical of some of these studies, I would say that the data on which they have predicated their results could be questioned. Also, when the results of the studies are forthcoming, it is 2 or 3 years later, and we have substantially modified the parts being used and the aircraft being flown, and so on.

My question is: Certainly computers have done at least two things: They have purified some of our basic data and also they have made it available on a somewhat more current basis. Are you aware of any studies that use this sort of data collection and manipulation of results directly in the research, therefore bringing in some more timely and more accurate observations?

DR. BRODSKY: Yes, many of these studies tie in with the use of automatic data processing. For instance, the simulation which I described briefly at Rand is both a machine and a man simulation. There is a whole laboratory set up of machines that are used for it. The Air Force has at Oklahoma City and at another depot that I can't recall offhand established systems of separate control, based on research which was tied in with the use of automatic data processing. The George Washington University study which I described depended mainly on machines, rather than on men. So that I think this is typical of a

good number of these studies.

STUDENT: I didn't make the point clear. I know they are an inseparable part of research. My question is on the point of departure, ^{is} namely, /the information that they are using to get the results predicated on what they are doing on the machines? That's a little more specific than using the machines to get the results as they did at Rand, with which I am familiar.

DR. BRODSKY: You mean: Do they use some of the results which have already been accumulated through the machines?

STUDENT: Yes, the data.

DR. BRODSKY: Yes. This George Washington University study, again, was based on data accumulated over, I think, a four-year period, usage data which had been accumulated on the machines at G. W.

QUESTION: Is there any mechanism within the Department of Defense which will permit or assist the services once they discover from one of these research projects that there may be a long-range saving but a short-range increase of cost? For example, there is the jeep study, where it takes five times as many dollars to buy jeeps as it does to do the repair work. Can the services get support within the Office of the Secretary of Defense through the Comptroller and the Bureau of the Budget and get additional procurement money in order to make these long-range savings?

DR. BRODSKY: This is a good question and a very important one. I can't give it an absolute answer, but I can say this much: In the past OSD, for instance, was handicapped in supporting military programs presented to the budget people because of lack of information as to the significance of it. But you take this program of the jeeps, for instance, and the Navy has had a similar study on machine tools amortization. This begins to provide information to the logistics people which gives them a real club to use in getting the necessary funds, even though the implications are that in the short range we have a higher expenditure.

In the case of the Army, for instance, there is a study which Harbridge House has made on an economic order quantity, and this is being tested very carefully in the Signal Corps. Actually, the conclusion of that study was to stock more initially than less, which means that the initial expenditure will be greater. And the Army has succeeded in getting the funds required for that study.

So that, as we get greater knowledge of this, and as we get a greater understanding on the part of people like us in management of what the implications are, so that we can speak with greater authority as to what the possible results will be, I think we will be more successful in this venture.

QUESTION: I have observed in the case of contract studies, in Army logistics research studies, that a considerable amount of time

is required to brief the researchers, to really acquaint them with the problem, and to give them a sort of military background. This, of course, is an expensive and a time-taking proposition. What is the Department of Defense viewpoint, or the OSD viewpoint, I guess I should say, on contract versus in-house efforts in this area?

DR. BRODSKY: Well, the problem of in-house versus contract is one which I am afraid will be with us always. It is certainly true, as you say, that, when you hire a contractor, he comes in and tries to pump you dry. Then very frequently all of us have been on the tail end of this. Somebody comes out with a recommendation and you feel that this recommendation is something which really stemmed from your files or something you had done before. But I think this is the kind of thing that we are always going to have to live with. It is a fact that an objective approach is something which gets higher rating if it is done by somebody on the outside than by somebody who

purportedly may have a vested interest. This is the kind of a price we have to pay sometimes for getting people on the outside to reexamine a problem which we have already looked at ourselves.

But, additionally, much of this research requires special skills and one-time requirements. Normally we cannot afford to hire those skills on a standby basis. So that we have no alternative except to hire them as we need them. If we need a transportation specialist in research, we may need him today but we may not need him again for

three years hence. Therefore, we go out and seek out one of these consultants who specializes in transportation logistics. There is no way of overcoming that.

So the only answer I can give to you is that it depends on the situation; to the extent that we build up a greater facility in-house we will have less requirement for contractor research. But I don't think we'll ever reach the point where we can say we can dispense with contract research.

QUESTION: I am aware of the advantage of the objectivity of having parallel research going on. You mentioned the Rand contract for a logistics study on missiles and the George Washington contract on the Polaris for the same purpose. That brought the question to mind of where and when are these things coordinated? At some point in time you have to put the two results together and decide which is the proper one, because they probably won't be the same.

DR. BRODSKY: That, too, is a very basic question and runs into some very strongly held opinions. Historically, the Office of the Secretary of Defense did not become vitally interested in the area of logistics research until a little over two years ago. These programs grew up because operators needed them in the military departments. As a consequence they grew up with different concepts, different points of view, and with a considerable amount of duplication. Immediately you are faced with the question: Is duplication bad? Well, my own

personal view is that unnecessary duplication is bad, but duplication of research sometimes is desirable. So you have to be discreet and to distinguish between unnecessary duplication and just duplication. But the fact remains that there still is, in my judgment--this is not an official position--much more duplication than I feel comfortable about.

This is what I mean when I talk about a strategy for research, that the logistics managers have to participate in allocating our limited resources so that we see to it that the duplication is minimized. In order to accomplish this, the Office of the Secretary of Defense has been working with the military departments, and momentarily there is a directive under consideration by the Secretary of Defense which would establish a mechanism for providing greater coordination in this program than currently exists.

QUESTION: Most of the projects you have mentioned seem to be directed to a rather limited area and end up with more or less doctoring up of a portion of the present system. Is any work being done now on the overall system itself, on making radical changes in our logistics system?

DR. BRODSKY: This I would say is a fond hope that I have, that some day we will be able to sponsor something of that sort. About 18 months ago--longer, now--we prepared a proposed study program which said in essence that the whole concept of logistics has to be

reevaluated from scratch, even though we continue to take care of our current logistics operations; that we can't plan for missile support and what have you in the future as if we are planning for the support of clothing and food and spare parts as we have in the past; and that a complete evaluation is required.

I needn't tell you that this steps on the toes of a lot of, shall we say? vested interests, and so far we have not succeeded in undertaking such a study. I certainly think that a study of that sort eventually is necessary.

COLONEL BUCKNER: What is the latest dope on the single service of supply?

DR. BRODSKY: You see, Jean, I have gotten into research. I don't have to worry about problems of that sort any more. That's a broad question. You get in trouble if you don't answer it right, so I'm going to talk slowly. As far as I know, there is no single service of supply which will come from the Executive Department itself. As you probably know--I think you had a couple of lectures on it in the last few weeks, before your vacation--the single manager plan has been extended, and this has created some substantially new and pretty important single managers. This is not a move toward a single service of supply. The single manager plan was predicated, actually, on utilizing the existing facilities. It does, however, in my mind, raise the question: How far can you go with this? This question I don't believe has been resolved as yet. But I think that, as far as the Executive Branch

is concerned, there is certainly no inclination for a fourth service or for a single service of supply.

As far as the Legislative Branch is concerned, there isn't a Congress, particularly in an election year, that doesn't introduce legislation requiring the establishment of that. I am not one who will predict what might happen in an election year.

CAPTAIN SMITH: I well remember three years ago, when Colonel Buckner and Dr. Brodsky were students here, that a number of people, including Nate, went around in circles on this subject, this single service of supply.

DR. Brodsky, thank you very much for coming down again to the Industrial College and giving us your thoughts on logistics research. This is very much appreciated by all of us. Thank you.