

APPRAISAL OF LOGISTICS RESEARCH

7 January 1959

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NOTICE

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INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

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COLONEL LACKAS: Admiral Clark, Gentlemen: Last night I was reading Sir John Kennedy's book for a review of military history, "The Business of War," and I was impressed with the basic notion that in this day and age a considerable part of modern warfare is business--not merely the logistics aspects but the relationship of military strategy to political expediency. One of the forenotes to the book points up that this has come about through the tremendous technological development of warfare.

In our study of materiel management we certainly should become impressed with the relationship of the handling and administration of logistics to the technological developments that are taking place. In that process we make a considerable number of studies, and, if you come to my office, I can show you the results of many of these studies.

This morning we are going to have a speaker who is going to discuss with you the nature of these studies and analyze them from the point of view of their value to the military service. For this purpose we have the Staff Director of Logistics Research in the Office of the Assistant Secretary of Defense for Supply and Logistics, a man who is quite familiar with this platform, because he was a student here a few years ago, and, aside from his presence on this platform as a student, he has appeared here as one of our distinguished speakers on three previous occasions.

It gives me a great deal of pleasure to welcome him back to this platform and to welcome him as Doctor Nathan Brodsky.

DR. BRODSKY: Admiral Clark, Members of Faculty, Students, and Guests: First, as to John's introduction by title, it reminds me that it is said that only a fool needs a title. It makes people call him Lord and Knight and makes them forget to call him his true name which is Fool.

Also, during the years that I have heard John make his gracious introductions from this platform, I have always been impressed with them, just as I was this morning. I think that John calls them as he sees them. It reminds me of the big-league umpire, Bill Clem, who was asked, "Bill, is it true that big-league umpires call them as they see them?"

Bill pondered for a moment and said, "Yes, I guess it's true that most of the big-league umpires call them as they see them; but not me. I call them as they are." John introduces them as he sees them.

It's good to come back to the Alma Mater and to partake of the spirit of learning which prevails here at the Industrial College, or the Industrial War College, as I am sure it is frequently called. It certainly is a challenge to return here, particularly after one has sat in the audience and viewed speakers with a critical eye. After you've heard about the first 100 speak about every aspect of peace and war--as you have already done--you wonder what this guy can possibly say that might be new.

I have scanned your collective biographies, incidentally, and have come to two conclusions. In the first place, your biographies are more appealing than were those of my class, because the College has entered photographs of your wives, a privilege which we did not have. Secondly, I note that on the average you are two years older than the members of my class were, so that I feel in a sense that I might be addressing some elder statesmen.

The subject which we will discuss this morning is, I believe, new in your curriculum. I know that few, if any, of you will be moving into research jobs, but most of you will be moving into top management positions in which a familiarity with our subject will be essential. As managers you will be looking to research to help solve your problems. This does not require that you, yourselves, become researchers; just as when you seek legal advice you don't have to become lawyers. In either case you want to understand the tools that are available and how useful those tools may be.

Our mission this morning, therefore, is to assess the current status of logistics research, to discuss its contributions and its limitations, and to focus attention on the future. For purposes of beginning with a common understanding, let me define logistics research. Logistics research is any systematic and intensive study which is directed toward improving logistics management or planning future logistics management. It is a systematic approach which seeks to define the problem, draw possible hypotheses regarding its solution, test these hypotheses, and then evaluate the conclusions.

Let me illustrate with a specific research study underway. The Navy has been faced with the problem of improving its ability to establish allowance lists which will maximize the endurance of ships in terms of

space and budgetary limitations. Exploration of this problem has led to the hypothesis that, if a system of military worth or essentiality of each part could be developed, the Navy would be able to solve its problem. Thus, a system was devised for measuring the relative importance of supplying one item instead of another.

Here, then, we have the problem and the hypothesis. This system is now being tested in a laboratory in the specific case of a submarine. In this test alternative policies are being examined in terms of specific goals, such as endurance loading, increased capability for independent operations, reduced logistics communications, optimum utilization of space, and so on. The final step will be the evaluation of the conclusions and the preparation of recommendations. This in essence is a logistics research study.

I think you will agree that logistics research, while not identified as such, has been going on for some time. The military services have regularly undertaken studies designed to improve their logistics operations. We have conducted studies in the areas of requirements, inventory management, distribution, transportation, and so on. But the last several years have witnessed a significant growth in logistics research. The new ingredients in the recently explosive research are as follows:

a. A greater need has been felt for systematic and comprehensive analysis to deal with broader and longer-range problems.

b. Increasing emphasis has been placed on the application of scientifically designed tools to the solution of logistics problems.

Let's discuss these two points. The modern logistician finds that he lives in a searching and inquiring environment, constantly seeking better, faster, and less costly ways to utilize and to allocate our defense resources. New developments in weapons, organizations, tactics, and strategy have raised many logistics problems. These problems are too complex for the logistician to solve solely from past experience. He is confronted with too many facts, too many uncertainties, and too many problems with no counterpart in past experience. Realizing the complexities of the problems with which he is faced, and confronted with increasing emphasis on scientific research techniques, the logistician has turned more and more to research in order to provide him with an objective base for decision.

In turning to research, we have found not only that the well-known tools of logic and analysis are applicable but that new devices have added

considerable dimensions. Thus, for instance, there is a growing use of gaming techniques in which problem-solving is based on the similarity between various business or logistic situations and ordinary competitive games. Here we deal with the theory of contest under specified sets of rules.

In simulation, another technique, we create a model of a real situation which can be used to test conjecture, and then we perform sampling experiments upon the model. This technique has been used at the Rand Corporation to compare two logistics systems operating under different logistics policies.

Another recently developed device is that of linear programming which is a mathematical method of programming interdependent activities. Input-output analysis is an example of an application of this technique.

Now, these tools are complicated, and few of us can expect to master them. We must, however, understand their uses and their limitations. What contribution do these new tools make to the solution of complex logistics problems? They make possible an inquiring and objective study. They provide a means for discovering new facts and relationships. They permit investigation of interrelationships between many facets of a single problem and between that problem and many related problems. In other words, they give the logistics manager a new dimension to aid him in making decisions.

But let me stress this point: These tools are not a substitute for good management. The tools merely provide logistics managers with a better understanding of the interrelated elements of their problems, an understanding which provides a sounder basis for making decisions. As we face the hundreds of critical decisions which must be made in the area of logistics today, we will find that the new tools add appreciable dimensions and permit us to select the important facts and to integrate them into a framework which helps us arrive at a decision.

I will speak later about research techniques. I would like to point out at this time, however, that not all of the research techniques are new. In the social sciences, for instance, economists have used similar tools to study problems of allocation of resources which are at the heart of economic analysis. Some of the tools have had their initial application in the military. Command post exercises, for instance, were engaged in long before simulation was developed for the analysis of operational problems.

The contributions made in recent years in the area of techniques are not so much the technique per se as the synthesis of already existing analytical devices and the increasing emphasis on their combined uses. Operations research, for instance, is not a self-contained body of analytical tools to be used in the solution of problems. In my judgment operations research is a synthesis of many existing analytical devices which makes possible a more precise analysis of logistics problems and a more accurate prediction of the range of possible results.

I would like now to turn to a review of logistics research in the military departments. Such research is carried on inhouse, in industry and in educational institutions under contract to the Government. This research has been contracted for primarily under research and development and operations and maintenance funds. Until a little over a year ago there was no inventory of the variety of logistics research projects sponsored by the military departments, nor was there any organized attempt to interchange information concerning these studies. This led the Office of the Assistant Secretary of Defense (Supply and Logistics) to the conclusion that better means were required to exploit research results and to promote the application of the research approach to appropriate logistics areas.

A research analysis program was therefore launched in conjunction with the military departments. This program has six interrelated objectives. First, we want to assist in indoctrinating key personnel regarding the benefit which may be derived from the application of research to the solution of logistics problems. As you know, it is frequently difficult to convince a hardheaded operator of the benefit of long-range planning. It is even more difficult at times to demonstrate to him the benefit which may be derived from an objective evaluation of the things which he is doing. We believe that we should be using our resources to show key personnel how many of their complex problems may be better understood and perhaps solved through the application of objective and analytical devices.

A second objective of this program is to aid in formulating and obtaining budget support for future logistics research programs. We are spending billions of dollars on research in the areas of hardware. It seems to me that it would be fruitful to spend a reasonable sum to develop the concepts and the managerial techniques which are necessary to employ the hardware so that we may get the maximum utilization therefrom.

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A third objective of this program is to maintain and to disseminate up-to-date information on completed logistics studies. This information should be useful to all of the military services. We ought to maximize the returns for much of the research that we sponsor. There are too many examples of unilateral studies which are of broad interest from the point of view of both the methods employed and the substantive results achieved. We believe that we should interchange such studies.

A fourth and a corollary objective is to encourage joint sponsorship of logistics research projects of interest to more than one department. There are many areas in which joint undertakings would not only prove economical, in terms of dollars, but would save time in terms of arriving at solutions to problem areas.

A fifth objective is to provide a closer relationship among military, commercial, and educational agencies engaged in logistics research. We have found that institutions working for the military departments were unfamiliar with similar work being conducted for the military departments by other contractors. We found a wide gap between logistics managers and those who were performing research on the problems with which those managers must live. Our objective, therefore, is to provide a closer relationship among those who have a direct interest in logistics research.

Our final, and extremely important, objective is to obtain the maximum benefit from logistics research through its translation into operational use. As in all fields of research, we recognize that there is an area in which a direct casual relationship between research and results is not always possible. We recognize the value of basic research aimed at attaining a fuller knowledge or understanding of a subject rather than the solution of a specific problem. We believe, however, that we must bend our effort toward insuring that logistics research does not merely end in some journal or on some shelf but that, wherever possible, we exploit the opportunity to translate that research into operational use.

Now, what are these logistics research programs of the military departments? I know that within the last day or two in each of your rooms we have made available a recent inventory of logistic research studies in the military departments. I suggest that you can get some of the detail from that booklet. In general, these research programs center around finding new means for controlling inventories, for establishing inventory decision rules, for forecasting requirements for materiel and services,

for allocating resources, for decision making on optimal transportation systems, for measuring supply effectiveness, for implementing automatic data systems in logistics management, and for improving industrial management within the Department of Defense.

Several of these projects look toward the establishment of an adequate defense posture at some future period, and attempt to project logistic systems which will be required perhaps 5 or 10 years from now. Each of the departments places special emphasis on its areas of research, and I would like to discuss with you briefly the programs of each of the departments.

In the Army the Deputy Chief of Staff for Logistics monitors the Army-wide logistics research. He gives guidance to the Chief of Research and Development, who serves as a focal point on research activities. The Army has recently organized a logistics research and development division at the Army Logistics Management Center at Fort Lee. This division will develop logistics studies and will maintain a central file on logistics research projects.

The Army's research program centers around inventory management, forecasting, control systems, and gaming. A substantial amount of Army research is concentrated in the Operations Research Office at Johns Hopkins University--and I am glad that we have some visitors from the Operations Research Office here today.

Additionally, the Army has used a large number of outside contractors, including educational institutions, to perform its research. Harbridge House, George Washington University, Stanford University, and MIT are among the prominent contractors of the Army. Incidentally, one of the graduates of the Industrial College last year, Colonel Rice, who is in the audience today, is one of the prominent men in the Army logistics research program today.

In the Navy, central guidance for its logistics research is provided by the Chief of Naval Research. The Navy uses two agencies for contracting for its logistics research--the Office of Naval Research and the Bureau of Supplies and Accounts. The Navy has what might be described as a two-pronged effort, one dealing with basic scientific theory and the other with management practices. The Navy, perhaps more than any of the other services, places emphasis on basic research in logistics. In the development of basic theory, the Navy is exploring radical approaches to broad procurement and supply problems. This program includes a

substantial amount of research on mathematical theories and the use of probability theory in economic or logistic situations. The Navy's management practices studies include problems of inventory management, the use of premium transportation, etc.

A large portion of the Navy's research is accomplished by the logistics research project at the George Washington University. The Navy has also contracted for research with organizations such as Stanford University, Stanford Research Institute, the Planning Research Corporation, Columbia University, and Princeton University.

In the Air Force, the Director of Logistics Plans, the Deputy Chief of Staff for Materiel, is the focal point for participation in the logistics research program. He works in coordination with the Logistics Research Division of the Air Materiel Command and with the Rand Corporation. The Director of Development Planning administers the Rand contract but technical guidance in logistics is provided by the Director of Logistics Plans.

The Air Force logistics research emphasizes supply management, missile logistics, transportation, requirements, maintenance, logistic simulation, and electronic data processing. Its largest single effort is concentrated in the logistics department of the Rand Corporation. Additionally, there is a substantial amount of inhouse research in the Air Force. A valuable contribution comes from the logistics education and research project at the Air Force Institute of Technology.

You can see, then, that there is a substantial research activity underway in the military departments. The military departments are seeking the best talents to help solve their problems. Research is conducted inhouse, but a substantial amount is contracted for with outside organizations. This is because of the specialized skills required, the greater objectivity which is possible--although I know that this is not universally true--and the fact that an outside organization can give undivided attention to the problem under study.

I think that it should be obvious that the problems attacked by the several departments are of such a nature that undoubtedly much could be gained if there were an interchange of results achieved. This interchange could apply not only to the substantive material but also to the research methods employed. While it may be true that the details differ, it would be useful, for instance, for one contractor to know that another has already tried a specific method to solve a problem and has found that method lacking in certain respects.

I would like to illustrate an area in which the interchange of research would prove fruitful. The Army today is sponsoring a research study at Harbridge House on economic inventory policy. The Navy is sponsoring a study at Stanford Research Institute on stock and safety levels, which is concerned with reorder levels, economic order quantities, and relative military essentiality. The Navy is also sponsoring a study at George Washington University on relative military essentiality. For the Air Force, Rand has been developing policies for base and depot inventory stockage. All of these studies are in the area of economic inventory policy.

Having familiarized myself with these studies, having talked with the contractors, I am convinced that there are significant areas of transferability of findings among these studies which could serve to accelerate all of them. This is related to the objective which I described earlier of maintaining closer relationships among the contractors and of interchanging logistics research information. I am hopeful that, as this program proceeds, we will devote more effort toward attaining these objectives. Wherever duplication exists, I believe that we should have an awareness of such duplication and should be convinced that it is in fact necessary. On the other hand, if we find that we can reduce unnecessary duplication, we should then divert our resources into more fruitful channels.

Having discussed the importance of logistics research, our objectives in the program, and having described how logistics research is carried on in the military departments, I would now like to turn to a discussion of the limitations on the research as I see them to date. I believe we should understand limitations as well as successes. I am particularly glad that we have some researchers in our audience, for they can help eliminate the limitations.

I would like to list these limitations as follows:

First, lack of definition of the problem in conjunction with those who have the managerial responsibility.

Second, the claim of a cure-all through operations research.

Third, inadequate communications with those who have a responsibility for the programs.

Fourth, insufficient translation of findings into operational use.

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Let me discuss these points. First, with respect to defining the problem, I think we will all agree that frequently those of us who have a problem are least able to define it. It is useful to have others examine the problem with objectivity and to attempt to formulate the scope of the problem. I have found too many instances, however, where research has proceeded without reference to those who have managerial responsibilities for the problem under study. In fact, some of the literature of the researchers expresses scorn for those researchers who look to assistance from the man who is faced with the problem in defining that problem. As a consequence, there is extensive research conducted over a relatively long period of time with little, if any, reference to the people who have the responsibility. We find researchers communicating with other researchers and shying away from discussions with those who have managerial responsibilities.

Now, I acknowledge that researchers, with more time and with greater objectivity, may very well be able to define a problem which the operator cannot verbalize, and I think that we should allow sufficient leeway for researchers to work in those areas which are of interest to them. I believe, however, that we must strike a balance. The researcher must be aware of the fact that decisions are ultimately those of management and not of the researcher and that the responsibilities are those of management and not of the researcher.

The second limitation that I'd like to discuss is the claim of a cure-all. I suspect that part of my discussion may sound critical. I would like to reemphasize, however, that I firmly believe that there is a substantial need for increasing emphasis on logistics research in the Department of Defense. I believe that we cannot analyze the problems which we face with conventional intuitive approaches which were characteristic of most of our previous activity. We must seek to employ those tools of research which create the greatest degree of objectivity and which give us a better understanding of the interrelationships of the problems with which we deal.

My criticism is directed toward those who would have us believe that the tools which they present are in themselves a panacea to our problems. I find, unfortunately, that this is too true of many enthusiastic operations researchers. In fact it is difficult to find a definition of operations research. In one recent discussion at which a definition was attempted, one practitioner finally said, in essence, "Let's not seek a definition; let's just practice operations research." For me this involves too much blind faith.

I was amused, incidentally, to learn that one journal recently, in attempting to classify operations research and not being sure where to put it, classified it under "surgeons."

Some define operations research as a combination of effort to arrive at an understanding of optimal solutions to executive-type problems. In so doing, the talents of engineers, physical scientists, mathematicians, and economists are combined to explore the many facets of the problem. This certainly is a valuable approach, emphasizing the complex interrelationships of many of our problems. Insofar as operations research stresses the scientific method and an organized approach to the problem-solving, I cannot find fault. Where I do have misgivings is when some operations research practitioners begin to make exaggerated claims regarding their ability to solve problems in logistics and social sciences through the use of new tools.

In my review of the literature in the field of operations research, I have come to the unhappy conclusion that many operations researchers have developed what might be described as the "Messiah complex." I think that one observer put it well when he said:

"When it announced the creation of nylon, Dupont did not also claim that they had discovered coal, air, and water. The company was satisfied with having produced something new and extremely useful out of old and basic ingredients. Operations research would be in higher repute today if some of its practitioners had exercised the same reasonable restraint."

It is my view that operations research has made a valuable contribution by focusing attention on the wide variety of scientific tools which can be used to solve problems in the field of logistics and the social sciences. As you know, most of these analytical devices arose during World War II, when the physical scientists found it useful to apply their training in the use of scientific tools to the solution of problems in the fields of military strategy. Since that time the use of these tools by physical scientists to solve problems in the area of the social sciences and logistics has grown as wide claims have been made of their utility; but in my judgment it is fallacious to approach the area of social sciences and logistics as if the regularities which we expect to find in the areas of physical sciences apply equally as well. I believe that physical scientists may continue to make a contribution in the analysis of logistics problems, but only insofar as they approach these as problems of logistics and problems of uncertainty, and not as problems which have specificity and accuracy of prediction.

One of the greatest difficulties in today's world is that of semantics. Too many who claim to have the panacea to all of our problems cloak their solutions with an unfamiliar jargon which confounds the listener. Thus, the lawyer speaks in terms which confound his clients. Similarly, a so-called "semantic curtain" has been established as a barrier between operations researchers and managers.

I think that this can be illustrated by quoting in part from an article which appeared recently in Punch and was reproduced in Operations Research. This article is entitled "Written in a Queue." It seems that the London Transport Board announced the employment of an operational researcher to study the causes of queuing at bus stops and "that methods developed in the military were being applied." Punch advised that the operations researcher discovered that the fault lies in "dynamic instability." Now, this certainly sounds like a penetrating analysis. What does it mean? Punch says:

"There is no knowing whether any particular bus is going to arrive early or late or not at all. This is a big advance. And it is not all. Plunging still deeper into the complex problem, operational research concludes that a major cause of dynamic instability is time lost in traffic jams. Spectacular proof of the correctness of this theory has been afforded by the recent acute petrol shortage, when it was shown that with less traffic on the streets buses ran more regularly."

This attempt to cloak solution of a relatively understandable problem with a semantic curtain is certainly an exaggerated illustration of the point which I am trying to make, namely that, while there is a role for operations research, the pretense that through it we may be able to solve all of our problems by inventing new words for them is misleading. I stress this point because I believe that we must arrive at a better understanding between the researchers and the people who have the management responsibilities. I fear that, if a better understanding does not take place, worthy attempts to apply logic and analysis to the solution of our complex problems may be thwarted by administrators who will become impatient with the exaggerated claims of many researchers.

Now, I have discussed two limitations of research--the claim of a panacea and the failure to define the problem with the man who has the management responsibility. I'd like to turn to a third limitation, inadequate communications. Here I will probably be treading on the toes of some of my mathematical friends such as Rosie Junghans, but, nevertheless, I will go on.

This failure to communicate pertains to the tools of research which are employed. In most instances the application of logic to our problem is the basic analytical tool required. This necessitates the establishment of a conceptual approach in which the essential attributes of a problem are formulated and the relationships within that problem analyzed. This is the kind of approach that the social scientist has learned to take in studying problems. He normally strives to formulate and to understand the basic features of the problem, and then he exercises the logic of choice in arriving at a decision. But in recent years there has been an increasing use of the mathematical approach to the solution of military problems.

The August 1958 issue of the Review of Economics and Statistics has several articles on the subject, and I particularly direct your attention to one by Charles Hitch, Chief of the Economics Division at Rand, called, "Economics and Military Operations Research." As Hitch notes, there is no such thing as absolute defense, and, in arriving at decisions on defense, we must cost alternate choices. To do this we must establish criteria against which we may evaluate alternate choices. Since we strive to maximize our national security posture within a given area of resources, the establishment of criteria is basic. We have to determine, for instance, whether our criterion is adequate airlift to support two or more limited wars simultaneously. Is our criterion maximum civil defense or is it maximum strategic air strike? Is our criterion preparedness for small wars only? Or is it any combination of these?

Obviously, where we do not deal in absolutes, we must establish criteria if we are to exercise the logic of choice. Yet this cannot be done by intricate mathematical formulations. We cannot attempt to solve problems of defense as if we are dealing with absolutes. Yet it has become fashionable today in many circles to seek solutions to our logistics problems exclusively through the use of mathematics. But it should be understood that mathematics is but a language of logic; mathematics is a method, a method of drawing exact deductions from given premises and of verifying the logistical consistency and adequacy of the premises.

Properly applied, mathematics has value in deduction and verification, but mathematics is not an end in itself. A knowledge of mathematics by itself does not permit one to formulate and to understand the basic features of a problem. This requires an analyst with skills in the use of logic and in the formulation of problems with which he has some feeling of familiarity.

Once a problem is defined, mathematics may prove valuable in contriving models of the empirical world and testing the criteria which have been established. But the generalizations which would have us believe that through mathematics we may arrive at specific and accurate predictions in the fields of logistics and social sciences which will be true at all times is misleading. For, in the field of logistics, as in the field of economics, we deal with a lack of specificity and of accuracy of predictions. All we can do is strive to attain knowledge of routines and of uniformities in logistics phenomena; but logistics is far from the point where we may uncover immutable laws as may be true in the physical sciences.

I think that Martin Shubik summarized the role of the mathematician in the area of economics, and consequently in logistics, well when he said:

"A mathematician may be far more adept at solving an inventory equation than an economist, once it has been formalized. However, the economist may have a greater ability for recognizing that the equation at hand is relevant to the problem."

Mind you, I am not quarreling with the mathematicians or with the operations researchers or with the physical scientists who seek to attack logistics problems with the skills which they have acquired. What I am asking for is proper recognition of the role that these skills play in the analysis of logistics problems. Furthermore, I believe that development of complex mathematical formulations which may be understood only by other mathematicians does not really contribute to the solution of our problems. If there is lack of communications, the results cannot be useful. Mathematical researchers must learn to communicate not only among themselves but with other researchers who do not have specialized skills in the field of mathematics, and particularly with managers who must apply the solutions to the problems that they face.

In summary, I believe that the use of mathematical techniques does not necessarily increase the validity of the analysis. Moreover, I believe that it is legitimate for mathematicians to write for each other, but they must bridge the gap by communicating with the nonmathematicians. I am not asking for complicated translations of mathematical findings, but the nonmathematicians must be able to understand what the mathematical investigator is trying to do, what he is assuming, and what methods he is employing, and must understand the results which have been attained through the analysis.

Now, let's turn to the fourth and final limitation: insufficient translation of logistics research into operational use. Obviously, one of the limitations which contributes to this is the failure to communicate research findings. There are examples where logistics research undertaken to date has been translated into operational use and where substantially outstanding results have been achieved. These situations must be extended. Our survey of research indicates that much of it is published in some journal or placed in some file and that there is insufficient pressure to determine the practical application of such research. This, to my mind, is one of the prominent areas on which we should focus our attention. There is nothing which will kill a research program as quickly as the lack of sufficient payoff.

Those of us who are convinced that we must maintain a facility for objectively evaluating our programs and for employing a logical approach to the solution of our problems must insist that research findings be evaluated in terms of their practical application. Our inventory of research shows that we are dealing with practical problems in an area such as inventory management, requirements determination, procurement, and so on. Having lent our resources to those who have the skills and the time for research, we must follow through and profit from their findings.

I have deliberately stressed limitations this morning. We have been discussing a relatively new area of endeavor and I feel very strongly that it is important that we arrive at an understanding not only of our common objectives but also of pitfalls. I am anxious that we overcome the obstacles which frequently plague new programs. The best way to do this is by speaking frankly. I believe that the positive factors in logistics research are substantial. The quality of research done has been uniformly high. Logistics managers and logistics researchers have shown a growing interest in attacking problems the solutions to which will aid in managing our vast logistics systems more effectively. There has been payoff in logistics research in several vital areas, such as in provisioning and in inventory management, and many specific problem areas have been identified.

As we search for solutions to our problems of missile support in a nuclear age, we will look more and more to aid from those with analytical skills in devising systems for management of our resources. Those of you at the College who will be in a position of management responsibility will require an understanding of the research resources available to you and an ability to communicate with the researchers.

I hope that you will familiarize yourselves with the logistics research programs of the military departments, with the research methods employed, and with the literature in the field. The inquiring and objective mind which the College strives to develop is well suited for this task.

My aim this morning has been to impress upon you the importance of research in the solution of our logistics problems and to give you some insight into the logistics research status in the military departments. I think that this is an extremely fruitful area, which merits greater resources than have been made available to it to date. I believe, too, that those researchers who are engaged in studying our problems might well ponder the limitations which I have outlined this morning.

If we are to profit from the application of scientifically devised tools and analytical devices to the solution of our problems, we must be able to convince those in managerial positions that we have a contribution to make. I hope that those of you who will find yourselves in positions of sponsoring logistics research will insist on better communications between the managerial and the logistics research staffs and that you will exploit every opportunity to find better means for the solution of our problems through the application of logic, rather than intuition.

Thank you.

COLONEL LACKAS: Dr. Brodsky is now prepared to answer your questions.

QUESTION: Doctor, I am a little confused about where you are and why. In your definition, it seems to me that there will be duplication between what your office does and what management should be doing in the Comptroller's office. Could you not just as well be in the Comptroller's office?

DR. BRODSKY: No. The Comptroller is responsible for matters of fiscal and financial management. I am talking about research that pertains to materiel systems, materiel management, logistics management. The Comptroller certainly has a lot of research with respect to financial inventory accounting and items of that sort. He is not concerned with research on transportation systems, on logistics support of weapons, on inventory management, on requirements computation, and similar matters. In the Office of the Assistant Secretary for Supply and Logistics we are concerned with such research.

QUESTION: The general tenor of your last two sections leads me to ask this. Whenever I read any of these ORO or Rand reports, I develop a resentment regarding the fact that the military profession is not given the opportunity to better itself through this sort of work, that it is not given the time and the money and the access to historical sources and things of that sort, which would make the individual members of it more capable officers. Can you explain in a little more detail why the analytical ability of the civilian organizations outweighs this other aspect?

DR. BRODSKY: I think that's a good question, having many ramifications. Unfortunately, all of us who have engaged in research will agree that you can't do the job successfully on a part-time basis. If you do it sporadically, it takes you 10 times as long and you make many false starts. You must, therefore, be able to sponsor a going organization over a long period of time, with sustained problems that you can feed to it.

Because of the variety of skills required and the variety of problems which we confront, frequently these skills have been developed outside by people who are concentrating their efforts solely in some area. It is true that we could develop those skills and that here and there within our own organizations they exist, but we just can't afford to have those skills on a standby basis, and generally have to contract for them as there is a specific requirement.

The opposite end of the coin is that we should take every possible step to develop analytical skills as SOP, across the board, as you suggest. I think, for instance, that schools of this sort play a prominent role in doing that. The Air Force Institute of Technology and other schools are doing likewise.

I think that as we get to realize more and more that we can no longer solve our problems by intuition and past experience, but that we need an analytical and objective evaluation of what we do, top management will be willing to pay for more and more inhouse research. But until such time, we have to face the realistic facts that we can't hire inhouse the skills that we need on a standby basis.

STUDENT: Let me ask you one other little thing. Is it really the skills that make the difference, or is it the fact that they are given the time and money to do it? Are the skills really that critical?

DR. BRODSKY: I think it's a combination. I think it's a combination of the criticality of skills and the fact that, unfortunately, our procedures are such that sometimes it is a lot easier to contract for it than to get it done inhouse.

One other point that I overlooked is the claim of objectivity. If you are Army, and if you are making a study on Army, even if you are objective, you are suspect. So many times we find ourselves in the position where somebody coming in from the outside says the same thing that has been said for years, and it's bought. This is just part of the facts of life. What is it? An expert is a guy with a briefcase from out of town. That applies pretty well here, too, I think.

QUESTION: Dr. Brodsky, what technical skills do you seek out for research application to logistic problems? That is, what scientific disciplines do they come from?

DR. BRODSKY: I think that there are a combination of disciplines which apply here. For one thing, I think training in the social sciences is probably the closest that comes to problems of logistics, because we are dealing with questions of allocations of resources, primarily, in both areas. I think, as I said earlier, that mathematicians have an important role to play, once a problem is formulated and criteria have been established.

I think that the approach of physical scientists in the objectivity and the scientific approach which they bring to any problem makes a contribution. I think, as I said earlier, that operations research has made a valuable contribution by emphasizing that our problems are so complex and interrelated that you must synthesize your approach, that, if you approach the problem of missiles today, you can't just have an economist, and you can't just have a physicist, or a chemist, or a mathematician. There are problems of the allocation of the material resources; there is the problem of the capability of the weapon; there is the problem of the compression of time; and so on.

So I think that you need an interrelationship of skills. To the extent that operations research has stressed that approach, I think it has made a very valuable contribution.

QUESTION: Dr. Brodsky, I have heard from the organization of S&L for Research that your office will function to take a close look at all the departmental logistical research programs, that you will review them.

How does the Assistant Secretary of Defense for R&E enter into this? Or does he?

DR. BRODSKY: The Assistant Secretary of Defense for R&E is concerned with research in the area of hardware. He has a corollary responsibility for insuring that the hardware which he develops does not provide any complex logistic problems. I think his charter says he is responsible "for insuring the simplicity of logistics support and conservation of critical materials." So, he makes his contribution with respect to maintainability.

ASD (S&L) is charged with logistics responsibilities. To carry out his responsibilities, he must maintain an awareness of all research in logistics. He is interested in promoting research in logistics matters, in developing better coordination, and in fostering the interchange of information. ASD (S&L) is representative of the consumer interest. He knows the problems, participates in seeking solutions, and is responsible for policies designed to implement approved recommendations. ASD (R&E), on the other hand, is concerned with not only promoting and coordinating research on weapons and military equipment, but also with the broad financing of research and the fostering of basic research. ASD (S&L) and ASD (R&E), therefore, have collaborative interests.

STUDENT: Just one other thing--will the departments then have to justify their programs to S&L and to R&E?

DR. BRODSKY: No. When the departments justify their research programs in the area of logistics to R&E, R&E looks to us for the technical guidance and advice on those programs, just as the Comptroller looks to us for technical guidance and advice on material programs when they come to him.

I might say parenthetically, too, that, while we are talking about research, please keep in mind that a substantial portion of research, at least as large a portion as is covered by research and development funds, is covered by operations and maintenance funds. This does not even fall into the R&E area. We are concerned with integrating both of these areas.

QUESTION: Doctor, you have disturbed me considerably this morning.

DR. BRODSKY: I'm sorry.

STUDENT: I assume that when you say "operations research" you are talking about the formalized organizations which conduct operational research. If so, I am not quite as disturbed as I might be. I am thinking in particular about the solutions that the operators in the field come up with. Quite often they claim a panacea for their particular system, and there's a very good reason for that. That's to get the thought squared and to get it through to their immediate superiors, where quite often it will stop if it is a radical departure from what has taken place in the past. Isn't there some method by which the operational solution that occurs in the field can get better backing higher up the line? For instance, I have come up with a method of transferring equipment, supplies, and Marines from ships off the beach ashore in about a very small fraction of the time required by using the small boats in the conventional manner. I can do it in a matter of six to eight hours versus five to seven days. I have claimed that that is a panacea to the problems of resupply in an amphibious operation, and I have had to end up by writing an article on it and getting it published in a publication, because I cannot get acceptance of it in the operating fleet.

DR. BRODSKY: Does the school have a suggestion box? Seriously, as I tried to stress, I think that we ought to exploit all of our opportunities inhouse as well as outside. I know that there are avenues for submitting recommendations. I presume from what you say that you have submitted yours, and this is a matter of judgment now. Some think that you are too advanced for the time, presumably.

These are the kinds of things that you can't legislate on, you know. These are judgment matters. I certainly agree with you that we should look to whatever resources we have. The resources inhouse are sometimes more useful than those elsewhere.

When I spoke of operations research I was speaking of the formalized area which identifies it as such, as opposed to operational analysis, which I think is the kind of thing you would be talking about. Here again we are back into the area of a semantic curtain, aren't we?

QUESTION: In your answer to the colonel's question, I presume-- and this is possibly an incorrect assumption--that S&L is primarily interested in effectiveness, shall we say, and that the Comptroller is interested in the economy. I know you are interested in economy as well, but basically from the fiscal point of view.

You also mentioned in your talk the practical aspects and utilization of the results of these research projects. I wonder if you could give us an example. In fiscal year 1959 I think we spent over \$5 million in operations research in logistics. Can you give us a practical example of how this has had any practical use within the services?

DR. BRODSKY: Yes, I think so. Don't take the figures that I give you as accurate, but just to present the concept. Rand Corporation made a study on initial provisioning of aircraft, and the study concluded that, if we deferred procurement of spares until we achieved sufficient consumption data, by the time we came to phasing our planes out of the system we would have less surpluses in the system and that the money saved, if applied to the purchase of additional planes, would give us additional fighting power, with a reduced inventory and a much more useful inventory.

This was the hypothesis with which they started. They costed this hypothesis out, and they have applied it to, I think, the F-106-B. The Air Force had gone ahead on the initial buy, and it bought a number of spares to support the F-106. Then they decided to test out this particular concept of deferring procurement until they got usage data, getting the spares as required from the manufacturer. I can't go into the detail of how it is backed up, but there is a rapid transportation system that is costed into this thing. To make a long story short, as of several months ago--and I haven't been close to it in the last several months--the Air Force has been in its third or fourth buy of that plane, and they found that the spares which they had initially bought before they went into this system are still more than adequate to take care of all the planes they are buying.

This to my mind is a very excellent example of logistics research applied and results being pretty visible.

STUDENT: I was wondering. Would they have more aircraft on the ground?

DR. BRODSKY: I can't answer without going into detail. I recommend this study to you. It is available. The study generally concludes that you have more funds left for buying planes and you have less surpluses left at the end. I recommend this as a good study and a good example of where logistics research can pay off.

QUESTION: Dr. Brodsky, I sometimes find the ideas developed from the platform of value for my own field, which is intelligence. I hope I am not taking you too far afield, Dr. Brodsky, in asking whether in your opinion the techniques you described of simulation and gaming and decision-making would be applicable for, say, economic intelligence. Could we get some insight on probable decisions of the Russians. Are the imponderables so great in your opinion that the techniques are probably not valuable?

DR. BRODSKY: I certainly think that the techniques are extremely useful, if you take them with the caution I described earlier. The techniques have wide application in providing better understanding. They clarify interrelationships. Business has found them useful, too. The American Management Association has recently published a book--I think I referenced it in your readings--on simulation as applied to business. This does not solve business problems, but it gives people in management a feel for the interrelationships of the problem. The man who has the transportation responsibility begins to realize how what he does with transportation ties in with what others do on the production line, in quality control, in sales, and so on.

So I think these techniques have a very useful application in many areas, with the caution, as I said earlier, that they will not solve your problems but that they will give you a better understanding of the complex interrelationships.

STUDENT: I got the impression, sir, that you use these techniques now to decide what your own decision should be regarding the storage of parts, and so on. Have you ever used it to decide what some other person's probable position will be?

DR. BRODSKY: You mean in terms of what the enemy might do? What his capability is?

STUDENT: Yes.

DR. BRODSKY: Oh, yes.

QUESTION: Dr. Brodsky, your example of what has been performed to date and recently in connection with the F-106 I think to some extent points out something which was mentioned previously. Here is a perfect example where many of us who have been associated with the aircraft business know Air Force, in using 30 percent back programs on spares was

probably overprogramming. We didn't have to go to Rand. It has been examined and investigated, and we knew within our own circles. I happen to be with OSD. Air Force managers were also quite suspicious of the fact that we were overprogramming spare parts, overbuying spare parts, and that the procedure could be corrected. We turn around and give Rand the contract and they come up with this brilliant deduction. Why can't we resolve more of these problems internally within the military departments? Why is it that more and more we are turning to educational facilities to come up with things that we should know best? In other words, we have the educators telling the military institutions how to operate, and the military institutions are trying to tell the educators how to educate our students. It's the practice nowadays. Cross-pollination is good, I think. It's healthy and worthwhile.

Your example, to my way of thinking, is one which proves that we could have resolved this without going outside our own area. I might point out that one of the reasons why we are forced to do it is the fact that the military departments take exception to any criticism or any suggestion, and that forces us to choose an unbiased outside agency to do this kind of work.

DR. BRODSKY: I agree with you that intuitively we have known some of the things, which you say. I hope that if you take anything away from the lecture this morning it will be the fact that we have to discard many of our intuitive conclusions and try to justify our conclusions on the basis of logic and consistency. I think that the Rand Corporation has done a wonderful job of providing us with a logical analysis which took the whole interrelationship--and demonstrated in dollars and cents the cost of a system, the pitfalls and the advantages, and the ultimate objective of getting more planes in the air at a reduced cost. To the extent that Rand can do that for what is relatively a pittance in terms of the returns we get, I am happy to see us expend that kind of money.

COLONEL LACKAS: Nate, as you said at the beginning, this is a new area of investigation for the College, and I am certainly glad that we have had you to raise this problem for us, because you have contributed some extraordinarily profound observations, for which, on behalf of the College, I thank you.

DR. BRODSKY: Thank you.

(17 Mar 1959--4, 225) O/mas:epn