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14 November 1947

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Publication Number L48-40
THE INDUSTRIAL COLLEGE OF THE ARMED FORCES
WASHINGTON, D. C.

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LIEUTENANT COLONEL HAAS: The subject of my talk is the "Determination of Requirements for Raw Materials". Unfortunately, it was also the subject of a conference with Subcommittees 5 and 6, at which I stole most of my own thunder. So some of you gentlemen will have to hear repeated a lot of what I said then.

The first question that comes to mind is, "What are raw materials?" Let me disabuse your mind on this point. I am not going to limit my discussion to raw materials alone. So, rather than give you a definition which will have little use at this time, I will define the limits of the field to be covered. Originally, I thought of saying that everything which is not an end-item came under this heading. But when it is recalled that what one user considers an end-item is merely a step in another's manufacturing process, I decided to be more specific in my definition. There can be little question regarding the basic raw materials such as coal, oil, and steel. By any definition, they would fall into the category under discussion.

The next type of item which we have chosen to include in this field is the semi-processed material, such as castings and forgings. There should be no quarrel with the inclusion of this class of material in this discussion. We have also included in this category materials such as sheet steel, rolled brass strip, copper tubing, and iron pipe. These are the materials which find their way into many different manufacturing processes and are even occasionally used as end-items. Beyond this point--to coin a phrase--I am going to tread on moot ground.

For the purposes of this discussion, and for that alone, we have also included the broad category of materials commonly called components and assemblages. Many of these in the late war were the so-called "off-the-shelf" items of the "B" list. However, we cannot include the list as a whole because many of the items on the list are quite definitely end-items.

Incidentally, to answer the question asked of Mr. Small yesterday, typewriters were a "B" product. To illustrate the scope of the list, so were the tractors used by the Corps of Engineers. To sum up, we have lumped together for our own purposes all those items variously referred to as basic raw materials, raw materials and contributory materials. By combining all these items under one heading doesn't mean that we consider them all to be raw materials. Certainly no definition of the term would cover such a broad field. It doesn't even mean that we consider the problems inherent in determining requirements for the various

members of this group to be the same. It does mean that we consider all elements of this class far too important to be overlooked and too often that is exactly what happens unless they are specifically mentioned.

The importance of this type of material is perhaps best illustrated by the fact that during the late war many of the threatened production breakdowns and most of the slowdowns or decreased schedules were traceable to shortages of items that fall into this field. It was not lack of heavy truck assembly capacity that caused the shortage mentioned by General Lutes in his talk. It was a lack of forge capacity and gear-cutting capacity to make the gears for transmissions and axles that was one of the principal bottlenecks. This is only one of many similar cases that could be cited.

These shortages came about mainly because in planning the expansions to produce the necessary munitions--the end-items--there was little cognizance taken of the needs for the intermediate products. Requirements for end-items and major components were generally estimated with some degree of accuracy. Even the needs for basic raw materials were usually stated in the correct magnitude. But high-level production planning for the steps between these two extremes was either never done or was completely out of line. Within the military services during peacetime there had been little or no experience with these problems. Because of the complexities and lack of experience with them, there was a great tendency for military personnel to oversimplify in order to solve the problems by use of methods with which they were familiar. As for those who had come from industry, they had never before concerned themselves about the capacity of their suppliers. It was something that was taken for granted: If one source proved inadequate, another was always available. There was apparently no one who knew enough about the parts and pieces, the shapes and sizes that made up the overall production picture.

This lecture has been scheduled to insure that you will include all of these elements in your study of requirements determination. We feel there is a great need for acquiring and disseminating information pertinent to the problems inherent in the determination of requirements for raw materials. You can see the importance we attach to this subject since we are directing the efforts of two subcommittees to a study of it.

The first step in solving a problem is recognizing that one exists. It seems hardly necessary today, with the example of the late war before us, to prove the importance of knowing in advance what our needs for raw materials will be during an emergency. It is recognized that this is a tough problem, but the very factors which make it difficult are the ones which make this forecasting so necessary. There is no definite way of knowing how far off the emergency might be that

we must plan for; but when it arises, we must be prepared to state our needs quickly. And we must be ready to state them in appropriate terms for use at each of the broad levels--the manufacturers, the military, and the over-all. Unless all concerned have knowledge of these requirements, or can be told what they are quickly and concisely, no careful planning is possible. Without planning, there is inevitable waste.

By now, it is pretty well recognized that our resources must be carefully husbanded if we are to weather the storm. We know now that the barrel has a bottom. This was far from true the last time and was probably due to the fact that in a normal economy our demands in this country seldom exceeded our supply, for when they did, additional supply immediately came forth to effect a balance. This gave rise to a general misconception regarding our self-sufficiency. However, during World War II it was only by a careful system of allocating the available supply of certain items (known as the Controlled Materials Plan) that we were able to meet the demand. Even today, after almost two years of more or less normal operation, there are many items in short supply. And, to anticipate the thoughts of some of you, these shortages are not all the result of labor difficulties. As an example, take the case of good lumber, or good liquor--both need aging; there hasn't been sufficient time to replenish the depleted stocks.

Regarding the subject of timing in these determinations--in other words, the phasing--it is not only important to know the "how much" of any requirement but also the "when". In our system of mass production, most materials that enter into the manufacturing process are not stockpiled to any great extent. Our modern producer does not provide room in his plant for enormous reserves. He relies upon an uninterrupted flow of raw materials, castings, and components from his suppliers. In effect, the production line in any plant extends back to the mine or the cornfield and includes the railroad lines that help feed it. These are the elements which, in general, make up the production lead-time. With this setup it is readily apparent how necessary proper timing becomes from a manufacturing standpoint.

Another aspect of timing is the problem of determining which material requirements are to be filled first. This, of course, is partially dependent upon the relative urgency of the end-item. However, as we must maintain a balanced flow of munitions, the philosophy that "first things come first" cannot be followed too rigidly. It would be entirely ridiculous to supply all the steel for all our battleships before giving any for the production of rifles or refrigerators, merely because battleships are deemed more important than these other objects. Each has its place in a fighting force and the time would come when rifles would be the more urgently needed item.

Another factor that occasionally may overrule relative urgency is the production need. When lack of materials might shut down a plant that is producing munitions of less immediate urgency, diversion of materials may have to be made in order to avert serious labor difficulties. For these various reasons it becomes obvious that material requirements, just as any other needs, must be stated in terms of time as well as quantity. This is true at all of the levels previously mentioned.

One might consider it almost unnecessary to mention that no determination of requirements can be attempted unless a good description of the material involved is included. During the late war, however, we were constantly bumping our heads on this problem. The most common difficulty that arose was in adjusting total steel requirements to total steel production. In order to bring these two figures into balance for any given quarter, cuts in stated requirements were made. No attention was paid to the type of steel that was going to be produced or the specification of the steel that was desired. It was assumed that the demand and supply would be in balance. To a great extent, this was true; but there were many instances of a manufacturer having an allocation for steel but being unable to place an order. This occured because no steel mill was producing the type of steel he needed during the period for which he had an allocation. In such cases, the allocation merely became a hunting license.

Another place where a good description of the item was needed was in looking for manufacturing facilities to produce what appeared to be a commercial item. A good example of this is the case of heavy truck wheels. It was found at one time that an expansion of this industry was necessary. When approval was sought from WPB some official, who had come from the wheel industry, called up a friend and asked if he had any additional capacity. He was assured that such capacity existed. It took six weeks of careful checking of all facilities to prove that this open capacity could not produce the kind of truck wheels that was required. To paraphrase an old saw, there were too many instances of people saying they wanted fruit when they really meant apples.

The next point to be considered is the agency to be charged with determining requirements. Here is where the levels which I mentioned earlier have definite significance. To say at what level any particular requirements should be calculated, one must know for what purpose the results are to be used. In World War II, the WPB was charged with overall supervision of all production. One of its earliest problems was to determine whether or not sufficient capacity existed within any given industry with a view to planning expansions if necessary. Naturally, the first thing the WPB wanted to know was what were the requirements. It was a relatively simple problem to get a statement of end-item requirements. Everyone adopted the attitude of the Pullman porter who

was asked by an inexperienced traveler the average tip was for a cross-country journey. The porter blandly replied "$5.00". The traveler gave him this sum. The negro appeared embarassed and then said, "Boss, ah reckons ah oughtn tell you that, so far, you is de first person whats come up to de average." Like the Pullman porter, everyone asked for plenty.

With regard to civilian-type end-items, WPB kept the responsibility for expanding these industries. Usually there was enough information available to make a reasonably good analysis. The claimant agencies which, in the main, were the military services, were charged with sponsoring all expansions for "A" or military type end-items. Here, too, after consultation with the manufacturers, fairly good decisions could be made. However, when WPB tried to translate end-item requirements into terms of castings, forgings or components, it found it was impossible to compute these needs at that level. The Board even found it impossible to compute requirements for the three controlled materials—steel, copper, and aluminum. So another approach was adopted. The WPB called in the manufacturers on an industry-wide basis. By consultation with these producers and by studying order boards to determine urgency of orders, the Board then determined which industries--generally in the so-called component field--had to be kept operating at 100 percent of capacity. To each producer within these industries there was allocated 100 percent of his stated requirements for the controlled materials. This was all part of the Controlled Materials Plan. As you have adequate information on that subject assigned for reading, I will not go into any further details about it.

At this time I would like to digress a moment to point out that no survey can be considered worthwhile unless it is comprehensive. This statement would be an idle platitude if there had not been some serious errors committed in planning, due to incomplete analysis. The most glaring example I can recall from the late war was in the synthetic rubber program. Here was a critically needed substance that had top priority, even to the extent of being set up under a separate director. Everything necessary to get the program rolling was supposedly done. Just about the time the new plants were due to go into action, a shortage of one of the necessary elements in rubber production, carbon black, was discovered. There was much scurrying and head-knocking in the next few months to overcome the deficiency.

This was cited as an example of what can occur when planning is not thorough and is not intended as a criticism of the over-all job done by the superagencies in World War II.

During peacetime, both the Government and industry are constantly engaged in determining requirements. One might at first wonder why, in our normal, rather "laissez-faire" system of operations, the Government would be interested in this field. It might surprise some to learn that the Department of the Interior is charged by law with estimating requirements for oil. Furthermore, every time that Congress decides to investigate some aspect of an industry on a country-wide basis, another of the Nation's executive departments has a new survey job. During the past few months, for example, the Bureau of Mines has been on the hot-spot over the coal situation. It has had to furnish an endless stream of statistics to everybody. It is not only Congress that calls on these agencies for facts and figures. Our hard-bitten industrialists have grown accustomed to placing reliance upon them for the same type of information. They are the first ones to scream when cuts in government expenditures threaten to dry up these fonts of knowledge.

The government agency most familiar to all of us that is constantly concerned with requirements is the Munitions Board. It is continually assessing the industrial mobilization requirements for materials and manufactured products needed in case of an emergency. The Board, in turn, has charged the Technical Services, the Bureaus, and the Air Force with these computations for military requirements. Although they do not have the responsibility for calculating civilian emergency requirements, they are at present engaged in these computations; no other agency is so doing and without some such estimate, the over-all Mobilization Plan would be worthless. It is expected that the National Security Resources Board will either assume this duty when it begins to function or will assign responsibility for these calculations to some other agency. Inasmuch as you have all been given literature on the operations of the Munitions Board, and I might also add, inasmuch as the Board is at present in a state of reorganization, I will not go any further into the subject.

On the next level below the Government during peacetime, where requirements computation is a constant activity, stand the various trade organizations. These are important sources of information for their various members as they present an industry-wide picture. The importance of getting this broad picture was clearly recognized in the late war. The best method of obtaining it was found to be the Industry Advisory Committees. They proved to be invaluable aids both to WPB and to the Armed Forces. One of the faults that developed, however. was that in some cases they assumed too much power--WPB often allowed them to dictate policy. An example of this, with which I am most familiar, occurred in the tire-chain industry. The Army was persistently unable to meet its requirements for this item and continually tried to expand the industry. WPB, acting under the guidance of the Industry Advisory Committee and being under the supervision of a man from the industry, insisted that

capacity existed. It was not until the Army made a thorough 90-day survey of the industry that it was able to prove that there was not sufficient capacity to meet both military and civilian needs. Remember, this was a "B" item, so the survey was unofficial and the industry not too cooperative. The problem was solved, incidentally, by a voluntary moratorium on civilian orders declared by the industry--after the facts had been well-publicized!

The next level below the trade association is made up of the mass of individual manufacturers. In the normal peacetime operations of our large and small industrial concerns, requirements determination is an everyday occurence, just as it was during wartime. They have two different kinds of requirements to determine, front-door and back-door. Expressed in other terms, they must estimate their customers' demands on them and their demands on their suppliers. Each of these demands in turn must be estimated on a short-term and a long-term basis. Though in many industries today, potential sales are greatly restricted by production limitations, either within their own or in their suppliers plants, under normal conditions back-door requirements are dependent upon the front-door estimates. This short-term front-door estimate or sales forecast, as it is commonly known, is one of the most valuable tools in the hands of industrial management. Executives use these forecasts to regulate every aspect of their business. Production departments use this short-term figure to set their goal and to calculate their material requirements. Purchasing departments must know quantities in order to establish sources of supply and to get better prices.

Undoubtedly some of the most important decisions that management is called upon to make are based upon the long-term sales forecast. This is particularly true with the basic raw materials. When it is realized that plans for the development of mines and the erection of refineries must be based upon estimates of the probable consumption of a product ten years in the future, the crystal-ball gazing has to be good. Sometimes, though, the crystal ball tells a different story to different people. Witness the recent controversy between the Government and the steel companies over the expansion of that industry.

As you can see from what I have said so far, the determination of requirements is certainly one of the vital forces guiding industry during peacetime just as it was the alpha for our great wartime logistic effort. Certainly a problem as important as this warrants some careful consideration in the selection of methods of solution. There are almost as many methods as there are people estimating. Colonel Mickelsen has told you previously that for each purpose--at each level for each item--a different method may be necessary. This statement is certainly as true of this class of materials as of any other.

The method most familiar to all of us in the military services is the summation method, based on bills of material. This is the method generally used by purchasing agents to do their actual buying. The starting point for these calculations is an estimate of the end-item requirements. Each end-item, in turn, is broken down, in so far as possible, into its many constituent parts. Like pieces are then grouped together wherever feasible and then, by a series of multiplications and additions, the final, precise figure is obtained. Without a doubt this is the most exact--and exacting--of all methods, providing an answer that is mechanically perfect.

What is generally overlooked, however, is that no solution is any more accurate than the least accurate factor which has been used in the determination. Quite often, some empirical figure is used in the estimation of end-item needs and then the balance of the operation proceeds with pin-point accuracy. The fallacy of this is rather obvious. It is perhaps necessary for a purchasing agent in some company, that can be supplied with a precise bill of material for some one product of which the final design is frozen to use this type of operation. But, to use it when one is estimating over-all material requirements for economic mobilization, seems a bit far-fetched. In the first place, designs are never static, certainly not until production starts and often not even then. In the second place, it is impossible to get a national bill of material or even a military bill of material in the detailed form that would be necessary to make this a workable operation. You might try to get bearings, sufficiently well delineated, as a starter. In the third place, even if there was a sufficient quantity of lightning mechanical computers available, it would still take too long and use too many people to correlate the myriad elements of the total picture. And, in the fourth place, as I have previously indicated, the methods used to estimate end-item requirements are not sufficiently accurate to warrant such attempted precision. Certainly the summation method has its uses, mainly for procurement purposes on a short-term basis when relatively few items are involved. Its use should be restricted to this or similar operations.

It seems that this is the appropriate point to describe briefly how over-all requirements in the past war for the three controlled materials were adjusted to productive capacity.

The first step was for WPB to obtain from the claimant agencies a statement of requirements, or "guesstimate", of the materials needed in the manufacture of the "A" or military type end-items. Simultaneously, it obtained the same information from the producers of "B" products. Next, after consultation with the industry concerned, it estimated potential output. Whenever requirements exceeded capacity by more than 10 percent,

WPB requested the claimants to review their statement of needs. This usually resulted in some reduction. Then, if capacity was still lacking, an adjustment had to be made.

Usually the claimants involved were the military services. So WPB would get from the Joint Chiefs of Staff a decision as to which of the various major end-item programs were not to be cut. After making allowance for these inviolate programs, the allocation of materials for the other military programs were reduced on a percentage basis. Generally, these cuts were made on a short-term basis, quarter by quarter, and did not affect long-range requirements . When future shortages were foreseen, expansion of facilities was planned to eliminate them.

As I have previously stated, industry has come to place more and more stress upon estimating future demands. I will describe a few of their crystal-ball gazing methods that seem to have some possibility of utilization by the military services.

All of these methods observe certain principles which are equally applicable to military and industrial use. First and foremost of these is to know the purpose for which the forecast is to be used. Second, choose the method best suited to that purpose. Third, collect all pertinent data and present it in a readily understandable form. Fourth, analyze these data and draw conclusions from them. Fifth, check actual results with estimates in order to revise the method of forecasting for future use.

The oldest and simplest of the methods in general use relies upon the estimates of top company executives. These men are supplied with all possible factual data upon which to base their conclusions. Inasmuch as these officials come from different fields of operation--sales, production, finance, etc.--their viewpoints differ. By combining and averaging these views a good result can be expected. Although it can be argued that this method relies to a great extent upon personal opinions, they have the weight of proven good judgment.

Very often, personal judgment is supplemented, in part or whole, by some statistical method. There are many forms that this may take. One of the most popular uses correlation analysis, which is a method of measuring the relation between two or more factors. It is particularly useful in forecasting the probable long-term future trend of requirements for some of our basic raw materials. In this instance, the forecast is usually made on an industry-wide basis. Once the total has been forecast, the individual company estimates its own share. The correlation is made between past requirements for the material under consideration and some other base figure of which the future trend is more easily predicted. One commonly used base figure is known as the Gross National Product.

A rather serious limitation to this method is that it is based upon past trends and fails to take account of technological developments that may alter the trend in either direction. This, however, is a calculated risk that must be taken. It is fairly safe to assume that should something occur that would decrease consumption of one of our basic materials, the industry concerned would probably find additional uses for the material to act as a balancing factor.

Another forecasting technique, particularly adaptable for use in the field of raw materials, depends upon an analysis of the future trends in certain consuming industries. It is based on the fact that the major demands for any raw material, or type of material, are found to come from a relatively small percentage of the many actual consumers. By isolating the 10 or 15 percent of the users who consume 85 to 90 percent of the output, it becomes a much simpler task to predict future demands. An allowance factor can be included to take care of the other users.

Many industrial concerns have found it worth while to use two or more methods of forecasting so that they may act as a check upon each other. If there is a reasonable degree of agreement, everyone has much more confidence in the results.

In summing up, I should like to repeat a few points for emphasis: First, there is no one simple formula that can be applied to all forecasting. The method used must suit the purpose for which it is intended. Second, the better the information on which determinations are based, the better will be the results. There is usually much pertinent datum available that is never used. Third, the method selected must be capable of producing an answer, in time to be of use to those who need that answer to make decisions. And, finally, there is no substitute for good judgment.

Thank you.

Any questions?

MR. MASSELMAN: In connection with your forecasting of the use of raw materials, you suggest you use the method used by industry.

What are you going to do in a case where industry differs widely from what the Government officials suggest should be the future consumption, such as in the present controversy over steel, where the two are so far apart?

LIEUTENANT COLONEL HAAS: Did you say, to start with, I suggested you use the method used by industry? I suggested that you study the method used by industry and study the methods used by other government

departments then decide which is best for use in any one particular field. I am trying to avoid recommending any particular method. That is what the committee is supposed to do.

Mr. MASSELMAN: Yes, but something should fit in between.

LIEUTENANT COLONEL HAAS: Maybe they will have to find a balance between the two methods. I am merely trying to recommend that these methods be studied; not that any one particular method be used. I hope I did not give the impression I was recommending any one particular method.

COMMENT FROM THE FLOOR: I thought they were studied during the late war. It seems to me that the Army and these other plans finally wound up with the Controlled Materials Plan which, as I understand it, is your summation method. It seems to me that that did work out pretty well. I cannot see where you have a good objection to that system.

Although I am not in the Requirements Section, and not perhaps qualified to state, it does seem we had some of the best talent in the country working on the summation system that finally came out in the form of CMP. For the Military's use, that is about the only good practical system that can be used.

LIEUTENANT COLONEL HAAS: Well, I'm afraid you haven't studied the Controlled Materials Plan well enough or you wouldn't have made that statement, because the Controlled Materials Plan is definitely not the summation method.

COMMENT FROM THE FLOOR: I'm a little mixed up on the summation method, perhaps.

LIEUTENANT COLONEL HAAS: The summation method, as I tried to show you, starts out with a bill of materials. You itemize them very carefully all the way down the line. You multiply all these items by the total number of items that you want of this particular thing and you come out with a figure. Then you add up all the figures together and come out with a total at the bottom.

QUESTION: Isn't that what the claimant agencies did in order to submit their requirements? After all, the Navy said, "We're going to build so many destroyers, battleships, or something else." Although they did not go through, perhaps, all of the details, they did bring out the fact that so many pounds of lead were going to be used in the construction of the battleship. They had a pretty good idea. Using that as a basis, they did come out with their requirements. In other words, they used, I think, a modified summation system.

LIEUTENANT COLONEL HAAS: Do you recall what Mr. Small said yesterday when he said we might be able to control something by isolating one thing and analyzing our requirements for that one thing very carefully. That is, in effect, what Controlled Materials did in the case of copper, steel, and aluminum. But you had the whole "B" List on the side. There were thousands of items they didn't do that for; they never started out with a bill of materials for those.

I do not want to go into a whole discussion of CMP. They asked industry to come up with their requirements. Industry came to them.

Certainly you can't start production without a bill of materials. We are talking about an over-all top-side agency which will start out with a bill of materials at the top and figure out its requirements.

COMMENT FROM THE FLOOR: Well, I do think the Controlled Materials Plan was a modified form of the summation system for those three categories of material. I might be wrong. perhaps am.

LIEUTENANT COLONEL HAAS: Do you think WPB sat down and figured out the requirements for all of them?

COMMENT FROM THE FLOOR: I don't think any one person did. I do think, before the claimant agencies could submit their requirements, they had to go through a modified form of summation.

LIEUTENANT COLONEL HAAS: They didn't, notall of them, I can assure you. I mean they very definitely did not sit down and figure out the requirements all up and down the line. They did produce the figure finally, yes; but industry did most of the calculation and gave the figure to the claimant agencies.

COMMENT FROM THE FLOOR: Oh, sure! A naval officer couldn't sit down and say, "I have to have so much steel," and so on.

LIEUTENANT COLONEL HAAS: You cannot start with a bill of materials at the top and try to figure out requirements all the way down the line. I don't say your bill of materials hasn't a use; it has. But you can't start with it at the highest level and figure out all the way down the line with it.

Are there any other questions besides bill of materials? Does anybody think I should have gone further into that? No other questions? (No response).

That's all, gentlemen. Thank you.

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