Our problem, then, to put it in another way, is to find some means by which we can grapple with the dynamic changes within our basic equation. How can we equate resources and requirements? How can we limit the right items within our short supply? How can we maintain a balance in the complex flow or factors of production within the industrial system? How can we achieve balance in end-item production?

A suitable methodology to solve these problems and our basic fundamental problems must be directed, it seems to me, to perform a number of different functions. I should like to review just four of those I consider to be of importance.

First, it is essential to keep our requirement aggregates realistic and feasible. What sort of a problem do we face here? I think we can divide the general wartime demands to be made upon the economy into three broad categories: ,one we may call direct military requirements. I am sure you are all very familiar with these, they are, such items as finished tanks, guns, ships, airplanes. Now, having accumulated these needs, we must then add: two, what may be called indirect military requirements. These are the ball bearings, the roller bearings, the taper bearings, which go into the machine tools and which in fact, turn out the tanks, the ships, the airplanes, and the guns; and three, we have what might be called war-supporting requirements. We may assume that we have a factory to produce tanks, the original bearings and replacement bearings for the machinery in the tank arsenal. There is a vast number of other requirements which includes such items as transport of raw materials into the factories, requirements to feed, house, and clothe workers, requirements to maintain morale in the factories--which means requirements for such things as juke boxes, pin-ball machines--and items of that character. These are war-supporting requirements.

Several problems become obvious from a review of these items. We must be able to add up these three requirements, each of which has a vast variety of varying item characteristics. And we must be able to get some sort of an aggregate quantitative figure. When this figure is determined, we must be able to relate it to specific resources. We shall inevitably find that requirements are much beyond resources, particularly the least common denominator of the resources. We shall then be obliged to cut back programs. In doing so, it is essential that some methodology, some administrative technique, be available to insure that program cutbacks still leave a balance in our basic resources-requirements equation.

Second, we must be sure that aggregate requirements, before cutbacks, are in balance and that in the face of cutbacks the program maintains balanced relationships. In the military area you know how many airplanes of a given type can be produced by certain facilities.

You know that certain other pieces of equipment must be acquired in a balanced relationship with airplanes so that a unified and balanced striking force is the result. The same thing must be done throughout the entire economy.

The point, it seems to me, hardly needs to be elaborated that in the absence of methodology for effecting such a balance, before rather than after contracts are let, the result will be unbalanced programs. By independent and unrelated decisions we might decide, for example, that we have enough steel for 10,000 trucks, or rubber tires for 6,000 trucks, ball bearings, or plant capacity to produce 4,000 trucks. If we come to such independent decisions obviously we have waste. Motors must be in balance with truck chassis, bearings with motors, wheels with trucks, etc. From our experience in World War II we have ample evidence of the wastage that can result from such lack of balance in programs.

The important point here is that we know there will have to be some kind of a cutback. Requirements are insatiable. The problem is to insure that when there are cutbacks the cutbacks will still leave balance among all of the programs so that, in the final analysis, our industrial machine will be used at what the economists would call "an optimum point"; that is, that every factor of production will yield at maximum productivity.

Third, the above calculations must be made in the face of very rapid and dynamic shifts. Once requirements are calculated and once resources are calculated, they do not remain static. There are constant daily and hourly shifts that take place among them. You are familiar on the requirements side, I am sure, with the shifts that took place during the last war in the tank program, in the DE program, in the landing craft program, and in other programs. These broad shifts were dictated by military strategy. On the other hand, and down below them there were thousands and thousands of specification changes of one kind or another that also set the "pot boiling" to a very important degree.

On the resources side, there are vast changes that take place in aggregate resources, in steel, copper, aluminum, diamonds, etc., and I think it is also worthy to note that even in these resources themselves there are rapid shifts that take place in shapes and forms which are dependent in some measure upon requirements or needs. Depending upon the requirements for steel there is a necessity for changing steel capacity from sheet to armor plate.

Fourth, and finally, methodology must be closely related to administration feasibility. The requirement here again is simple in its concept but very difficult to solve. It is to insure that the methodology fits into the administrative organization so that policy can be established easily and effectively, and efficiently administered. Procedures can be used, as we know, both to acquire the necessary data and to place firmly quantitative responsibility on administrators and check compliance with that responsibility. Facts must exist upon which competing claims at all levels of production can be adjudicated promptly and in conformance with basic policy decision.

I shall not bother trying to explore the implications of all these statements. Let me give you one or two illustrations and then pass on.

Inability to administer programs in World War II could and did create substantial imbalance in industrial production. We learned that methodology, to be of greatest use, had to tie closely into administrative machinery and provide the framework for its operation.

Basically, what I am trying to say is that the methodology that we try to develop here should not only give us the facts, upon which basis we can make basic policy decisions, it also should give us the facts upon which we can make thousands of minor policy decisions. At the same time it should provide the framework within which all policy decision can be carried out and administered. In a very real sense the accomplishment of maximum production in World War II rested not alone on over-all policy decisions of how many tanks, planes, or guns we could have in relationship to one another and in relationship to limited resources, it rested also on thousands and thousands of decisions of a much more minor character, such as, shall we ship this steel plate to Oak Ridge, to a landing craft in Hawaii, or should we send it to a small town in Kansas for the repair of one of its boilers?

Let us summarize. It seems we have a series of insoluble problems. How is it possible for one to develop an effective and efficient procedure for doing these jobs which does not embody dangers of catastrophic breakdown? How is it possible to develop methodology to do this job in time? The problems really are extraordinarily complex and difficult. Let us try to piece together a methodology.

Experience in dealing with a problem of such magnitude as this reveals the kind of information which is required. The underlying problem is to translate available men, materials, and machines into the greatest possible quantity of goods required for military and other war-supporting activities in suitable end-product relationships and in necessary time periods.

We know what the factual requirements are. On the resources side, information must provide in integrated detail the actual and potential production of mines, forests, farms, etc. The entire fabric of industrial resources and end use must be revealed clearly in totality and in detail. Details must tie together in a factual picture, expressed in common units of measure and in definite time periods.

On the requirements side, we must have a statement of the demands for these resources in such terms that the two can be compared. The demand for resources must be built upon a detailed and realistic statement of direct and indirect military requirements. The statements must be in terms of specific items needed directly by the Armed Forces and civilians--the materials, the components, the facilities, etc. In short, total requirements must be known, classified into procurement programs and production details. This factual statement must be realistic, accurate, and in the same common units of measure used in measuring resources.

The two statements must be brought together in what truly will become a national resources-requirements balance sheet. With such an array of data, it is possible to adjust programs among themselves and in relation to the most restricting resources limitations to achieve reasonable balance in the entire industrial machine.

Actually balancing these balance sheets is a very enticing story. I will have to leave the story to someone else.

How can all this be done? I should like to develop a statement of the methodology by centering attention upon raw materials, particularly metals. This is a reasonable method of departure because we know beyond a question of doubt that in another war metals will be one of the limiting resources. We will find among them one of our least common denominators. Metals are used universally and they can be used to develop a resources-requirements balance sheet upon which other shortages and other balance sheets can be focused.

One of the first and obvious tasks is to ask ourselves whether here are any accepted common denominators which uniformly apply to the esources and requirements which we are trying to get together. Obviously, ou cannot thread the eyes of all these needles unless you have some ind of binder. The binder is some kind of common denominator.

What kind of common denominator do we have in thousands and housands of procurement items and in different types of resources? One hread obviously is price, the dollar tag. Another possibility is unit f labor; another possibility is unit of transportation; another, and a ost usable one, is unit of basic material or raw material ingredient.

For products incorporating steel, the common denominator would e tons or pounds of steel. For jewel bearings, it would be carats; for thyl alcohol it might be gallons of 190 proof; for penicillin, it might e billions of Oxford units; for leather, it might be in terms of equiva- ent hides and skins.

If we accept a unit of raw material as a basic common denominator, t is obvious we need yet another standard or common denominator. This is standard classification of shapes and forms of raw materials. Steel, or example, doesn't mean much if you just say steel. If you say steel heet, or steel bars, or steel plate, it means a lot more. It still doesn't ean enough. You have to specify the particular shape, specify the imension of a sheet versus a plate, a bar versus a rod, etc.

A third common denominator, and of great importance, is a classi- cation system for both products and programs. Such a classification ystem obviously provides common units by means of which calculations can e made in homogeneous terms.

One final common unit of measurement is the period of time.

So we have four common denominators--units of raw materials, menclature and classification of basic raw materials, nomenclature and assification of products and programs, and time. There are others but ese are absolutely essential in the development of our methodology.

All of this raises a number of provocative questions. So we have common denominator. Now what? Suppose a B-29 and a field radio can said to have a common denominator in terms of a few raw materials. How can e relate them to other end-items, to raw materials resources, to other sources, such as labor or transportation? What methods can be used to parate supplies and materials which are common to both military and vilian use, such as tractors and hospital beds?

It is one thing to say that various end-items have a common characteristic in that they both use carbon steel, but one item may use carbon steel rod and another carbon steel sheet. What does one do then? What sense is there in finding out the steel content of a small ball bearing in an important computer when the dollar cost of the entire computer is tremendously beyond the cost of the steel ingredient? How do you relate a material common denominator to labor shortages, shortages in transportation, or other factors of production and materials? (If any of you find the answer to that one, I would like to have it. I will try to give you a partial answer.)

These are a few of the more or less technical points, together with broader problems we have noted, which can be resolved in the initial stage of analysis by the use of a bill of materials approach.

Now what is this bill of materials that we are attributing such powers to? A bill of materials describes for a given procurement item the basic material requirements necessary to produce the item. The bill of materials for a ship, for example, would show (1) the quantities of steel in mill shapes and forms--note I said "mill" shapes and forms--needed to produce each major integral part going into the finished product; and (2) other quantities of steel in mill shapes and forms incorporated in and necessary to produce the finished product. These are the component elements, such as fractional horsepower motors, electric switches, bearing and items of that character.

My concept of this approach is that component bills of material should not be calculated by each procurement agency or subassembler. The procurement agencies for tanks, guns, or ships should calculate only basic shape and form requirements for a tank or ship and not the steel ingredients involved in the components. The procurement agency for tanks, or guns, or ships would, however, calculate the number of units or components that would be required in the finished product. Some kind of central organization, such as the War Production Board perhaps should obtain a bill of materials for each of the components and multiply the material quantities in the bill of materials by the units calculated by the procurement agencies.

Obviously, this methodology is a concession to administration. Without it you would have every agency calculating a bill of materials for the same component. There would be differences.

The time element, as yet unmentioned except in terms of the common denominator, is quite important. Requirements in mill shapes and forms should be determined in given time periods. It is essential, for example, to calculate for each given time period the flow of the material

shapes and forms through the industrial system from the metal mill through the fabricating and subassembly stages to the final end product. Thus a structural beam or keel of a ship would be needed at the keel-laying date, which might be six months before the launching date. Steel plates for the hull would be needed over a period of time. The deck housing steel would be needed close to the launching date, and maybe hatch covers, in the absence of prefabrication, might also be needed at just about the launching date.

What this means is that all calculations in the bill of materials should be made in terms of lead times or flow times between the required production of materials by the supplier of a material to the final delivery of the procurement item.

All this may sound interesting and reasonable enough, you might say, but does not a bill of material calculation for a bomber, with its thousands of items, differ from that of a canteen tin cup? The answer is no. The problem of calculation is infinitely more complex for a bomber, but the methodology is the same, and the results can be shown on the same piece of paper. It is the essence of this approach that this be so; otherwise, it would be impossible to add oranges and apples, or to use my first analogy, peaches and bananas and get pianos.

Granting this, what sense, you might say, is there in trying to calculate a separate bill of materials for various types of screw machine products, electric switches and connectors, or nuts, bolts, and washers? The answer is it doesn't make much sense.

First, various combinations of productive facilities from a common inventory would make calculations exceedingly complicated and would virtually prevent precision. Even though it was possible to get precision, it would hardly make much sense to devote so much energy to doing the job. To minimize these difficulties, the methodology provides for what may be called a "prototype" bill of materials.

A prototype bill of materials makes essentially the same calculations as the bill of materials, but instead of covering one single item, it covers a group of roughly homogeneous items which differ only in details. These details have comparatively little effect upon aggregate material content calculations.

Modification of the procedure to eliminate unnecessary calculations for models incorporating the same parts is inherent in the bill of materials concept and approach to our basic resources-requirements coordination problems.

There are a great many other modifications that should and ought to be made in this approach. For example, some items contain negligible quantities of basic materials. Particularly, where such calculations cannot be made with too much precision or where such calculations are very difficult, there should be some modification.

I remember vividly when I was with the War Production Board going to a plant in Brooklyn that was making precision instruments for aircraft, and the engineers of the plant were busily engaged in calculating bills of materials for these instruments. The quantities of alloy steel were negligible. They spent many man-hours and went to considerable expense in making these calculations. The quantities of materials were negligible. The answer to their problem was simple. The answer was: "Don't try to make the detailed calculation. Get out your crystal ball, because, for purposes of the basic problem, you probably can get just as good an answer."

This leads me to my second point. During World War II we discovered or rediscovered an amazing concentration of material consumption in comparatively few plants and products. Such knowledge in the next war, should it ever arise, ought to be used to modify this approach wherever possible.

The necessity for making detailed calculations when reasonable estimates would serve just as well should be considered very carefully, and energy should be concentrated on the larger items. During the last war we often concentrated as much energy on bobby pins as we did upon tanks and airplanes. The point is a very simple one. A 100 percent mistake or even a 1,000 percent mistake in calculating a bill of materials for resisters, filters, or condensers for radio and radar would hardly offset a 5 percent error in calculating requirements of steel for valves, for welding electrodes, or metal barrels, drums and kegs, not to mention ships and tanks.

What are the results? The bill of materials provides us with a statement of all material requirements in common terms of basic shapes and forms for given time periods. We need something more before we finally get our balance sheets. There is the question of calculations for (1) which shape and form? (2) for which programs or products? and (3) for which time periods?

These are other tools of analysis. I should like to go through them very quickly. It is obvious, first of all, that data accumulated by the bill of material are useless unless there is a satisfactory classification of basic material shapes and forms. A very large part of the fumbling, improvisation, and trial-by-error in the War Production Board in 1941 sprang from the absence of such a classification. We did not have standard nomenclature and classification of basic raw materials; neither didwe have standard nomenclature and classification of programs and products. It was not until the official Red Book, or "Official

Classification List of Raw and Basic Materials" was issued jointly in 1942 by the Army and Navy Munitions Board, by the WPB, and the Maritime Commission, in conjunction with the Bureau of the Budget and the Bureau of the Census, that this problem was well along the road to solution. We are very fortunate in having that background work behind us because the problems of nomenclature in this field from that time have been problems of minor adjustment and modification.

A second tool, and one closely associated with raw material nomenclature and classification, is product and program classification for both end products and for programs, such as export programs. A product classification system permits categorizing hundreds of thousands of products into homogeneous classifications or boxes. It separates them for purposes of analysis. Without such a classification, rational analysis of data for purposes of creating program balance is impossible. If a rational policy decision is made to curtail a tank program, the figures in the tank program cannot contain data for battleships, or for guns, radio, radar, or for valves or faucets.

Such classification makes obvious the answer to the question, "How can the military segregate its calculations from those of the war-supporting economy for a comparable procurement item?" Disentangling calculations for tractors, bulldozers, hospital beds, valves, electric motors, etc., used by military procurement agencies and the civilian economy are then very simple. The military has an organization for calculating requirements for tractors and hospital beds. So do war-supporting agencies.

Third, is the time factor. It need give us no concern here. It can be monthly, quarterly, or semiannually, as circumstances dictate. Experience taught us that the quarterly time period was generally most useful. A monthly period is too short and a semiannual period is too long. It is true for some items the War Production Board used daily time periods. For many products, a monthly time period was used. When the WPB attempted to aggregate the resources and requirements on an overall basis it used a quarterly time period.

The use of these tools permit us to calculate a national balance sheet. With material requirements in basic shapes and forms for each broad procurement item, with calculations made in common units of measure for materials and time, and in homogeneous classes of products, it is possible (1) to add up all material requirements by clean-cut classes, (2) to match them against the limited resources which are calculated in comparable terms, and (3) to evolve a national resources-requirements balance sheet.

We have, up to this point, been talking about basic raw materials, such as steel, copper, aluminum. Beginning with a materials resources-requirements balance sheet, it is possible to do these things: analyze the totality of requirements against resources; analyze the quantities of delivered steel to make a specific number of end-items. It is then possible to go to the steel industry itself and analyze how much steel is needed for construction, for MRO, and other purposes. Then it is possible to analyze how much labor the steel industry will require, what facilities it may need, and so on.

The same sort of analysis is possible with other factors of production, such as transportation, electric energy, and so on. This approach, in other words, permits an equating of aggregate demand-supply totals and the balancing of productive facilities within those totals. It focuses attention on data by which over-all balance can be achieved, and by which program balance within the totals can be achieved. It will then, depending upon wider problems of administration, fit into a scheme whereby the flow of data may be reversed to carry out the administration of policy decisions once they are made.

A natural question arises at this point: "Where are you going to get all these data?" Well, during a period of what one military friend of mine called "inactive hostilities," there is only one place, agencies of the Government. The current program of the National Security Resources recognizing that fact, is asking agencies of the Government to make such calculations so that it can prepare resources-requirements balance sheets. In wartime, however, the bulk of the information will flow directly from industry.

In closing, let me say one or two words about the value of this approach in mobilization planning. This methodology can serve as a basis of long-range industrial mobilization planning. It is one of the purposes of the National Security Resources Board to so use it. It will do this in (1) providing a check on over-all feasibility of current mobilization plans (I am speaking, of course, about the demands upon the industrial machine), and (2) provide a framework upon which basis plans and programs of a procedural character, such as allocations and priority plans, may be developed and related. In essence it provides an anchor for realism in projected procurement plans and the strategy upon which they are based, and serves as a basis for determining wartime administrative methods. It will provide a sound basis for immediate operations in the event of an emergency. I cannot emphasize the point too much that the establishment of a methodology such as this in war cannot be accomplished overnight. It must be in operation in peacetime.

In the absence of peacetime training in connection with these calculations we will not be able to establish the methodology to do the job in a reasonable period of time. One of the outstanding lessons of the War Production Board, even with minor questionnaires, was that from the beginning, or from the issuance of a questionnaire to industry until the data from it became realistic, accurate, and useful for analysis, sometimes took a period of six months. For the larger programs it would take a much longer period of time. The lesson is obvious. We cannot build up this kind of methodology in a short period of time. It must be available and it must be in actual operation if it is to be used quickly in the event of an emergency.

The whetsone grinding of five long active war years in World War II sharpened many of the tools of analysis presented here today. I think we are quite fortunate in having these tools and the prospect of even better methods which are promised by electronic calculators and other methods in process of analysis. I refer to the tools of product nomenclature, raw material nomenclature, and the entire methodology that we are talking about here. We must keep all these tools sharp and resharpen them when they are dull.

We cannot fail again in fulfilling one of the basic principles of industrial planning. We must have realism in the conception of what we want to do and we must know how to do it. The resources-requirements balance sheet approach puts the realism into what we want and can do. It provides one strategic methodology in the "how to do it" of preparation for and active engagement in modern war.

Thank you very much.

COLONEL WEAVER: Dr. Steiner is open for questions.

QUESTION: Dr. Steiner, you mentioned a few methods here, one of them, of course, the crystal ball and the other the electronic calculator. I wonder if you could enumerate all of the methods the War Production Board used to analyze the problem of requirements in wartime?

DR. STEINER: Well, the techniques that were used basically revolved about the so-called Production Requirements Plan approach and the Controlled Materials Plan approach.

The Production Requirements Plan approach was what is called the horizontal approach. Let us put it this way: Suppose each of you represent individual manufacturing plants and I represent the War Production Board. You would send to me, each of you, on a horizontal basis, your requirements for production. Then I would add all your

statements and relate them to resources. The two are in common terms of basic materials. Then I would equate them. I would say that our requirements are twenty million tons of steel and we have a visible production of only fifteen million tons. We will have to reduce requirements by a quarter.

The horizontal approach involved a reduction among all industrial areas submitting data. The reductions were sent back to industry and industry had to cut its procurement of basic materials accordingly. There were many difficulties associated with that approach.

There was also the vertical approach, or the Controlled Materials Plan approach. Actually the Controlled Materials Plan was not so vertica as many assumed. It was both vertical and horizontal.

Let's illustrate the vertical part of CMP. Assume that each of you represent a plant. You would get your material requirements from your suppliers (for class A products) and pass them on up to your procurement agency--the War Department, the Navy Department, the Maritime Commission, BEW, and so forth. There they would be added up and passed over to the War Production Board.

There was a horizontal approach associated with CMP. Instead of sending your material requirements for components (or class B products up through that vertical channel, you would send them directly to me, the War Production Board, on a horizontal basis. I would add them up, add them to other requirements, and get total requirements--I would check them with resources and "cut the pie" accordingly.

I think I am correct in saying that most allocation control systems of the WPB, except CMP, used the Production Requirements Plan approach rather than CMP approach. There were other approaches. For example, the early M-orders constituted a little bit different approach. I have noted the two main approaches.

QUESTION: Would it simplify the problem of the Armed Forces if the requirements and procurement would have a really unified procurement agency in the Armed Forces, in the three Departments--the Army, the Air Force, and the Navy?

DR. STEINER: Well, honestly, sir, I haven't studied that problem. My first guess, if it is of any value to you, would be yes. The methodology that I have been presenting here would be useful in restricting any conflicts that grew out of a lack of coordination of procurement. From a broad point of view, the more coordination is possible and the more unification and standardization is possible in the procurement of the three Services, the more simplified our problem would become. It

would aid in the implementation of our methodology and, I suspect, it would probably permit us to get more production. That is an unqualified answer.

QUESTION: When industry would send in its requirements who would break them down? For example, I can visualize that industrial requirements would be the capacity output of any industry. Is it broken down into essential orders or not? Or is it left up to the manufacturer to put in his requirements on what he can produce?

DR. STEINER: Theoretically, the Controlled Materials Plan--which was the one latest used for the basic controlled materials, showed for each manufacturer the quantities of steel in given shapes and forms to be used in production in accordance with a production schedule that theoretically was given to him by his prime consumer.

Let us put it this way: The Navy might give a manufacturer an order for producing so many ships in a given period of time. The information flowing to the Navy from that producer would show the carbon steel plate, for example, that he needed to produce those ships during that period of time. So your common unit of measure would be ships, time, and steel in mill shapes and forms and in terms of tons.

The Navy theoretically would have the bill of materials to check the quantities of materials that the manufacturer asked for to determine whether or not they were reasonable. Obviously, it would be necessary to take account of inventory, for example. It would also be necessary to do a number of other things, such as calculating the leakage of material allotments as they move from the prime consumer down through to the metal mill. The basic direct answer to your question, as I understand it, however, is simply this, that the manufacturer reports in terms of these common denominators. Does that answer your question?

QUESTION: Yes, I think it does. I was thinking more or less of a plant which makes machine tools, something of that kind, where it will be supplying industry in addition to the Armed Forces. Who breaks down its requirements?

DR. STEINER: In that particular instance, the War Production Board or the Central Control Agency likely would. It did during World War II. In that instance you are correct that such a plant, generally speaking, would base its requirements upon its capacity. Then it would be up to the War Production Board, in cutting back programs, to determine whether or not it should or should not produce at capacity. I think that comes closer to answering your question.

COLONEL WEAVER: Dr. Steiner, in our conference the other day with our people who are studying item characteristics and how they can influence requirement determinations, we had several fundamental proble which had to be decided. I would like to ask Captain Robinson to present to you the gist of the discussion and get your comments on the basis of the solution at which they arrived.

CAPTAIN ROBINSON: I think that the principal part of that discus sion centered around where you will begin your study, and also the agencies that are concerned with considering item characteristics as affecting requirements. The consensus, I believe, was that we should consider an item past the research stage and ready for development-- an end product, a component--and continue our study from that point. I don't know of other questions that came up at that discussion, Colone that are particularly applicable to this particular lecture.

COLONEL WEAVER: The point was that item characteristics certainl influence the decision as to how many of certain items a given organiza tion is going to use long before it gets to the stage of being an accep item of usage, because somebody has to figure out that, regardless of the desirability of having it from a military standpoint, let us say-- "We can't have it because we have investigated and there is not sufficie capacity to produce it." We are wondering where you would break into th circle.

DR. STEINER: As I understand the question, what it amounts to is, "Where does this kind of situation fit into this procedure?" Long before you can calculate the material content you have to decide whether or not you really want or can have that equipment. I think the answer to that is simple. You pull out your crystal ball, and for the purpose of the requirements-resources analysis, estimate the quantities of mater that are likely to be needed.

COLONEL WEAVER: Would you say that the characteristic of the item then, at that point begins to influence it or not?

DR. STEINER: Well, the characteristics of the item from this poin of view would begin to influence it in terms of feasibility of produc- tion and in terms of quantities of material needed. For example, if you were considering an item that used, say 75 percent of our tin supply, then there would have to be a very important basic policy decision, probably in the Joint Chiefs of Staff, as to whether, if we produced this item using 75 percent of our tin supply and had to forget many othe items, the cost would be worth it.

COLONEL WEAVER: Other members of our committee are a little bit timid. Colonel Oxrieder, what sort of question would you like to pose?

COLONEL OXRIEDER: Our committee would like to know what you mean by characteristics? There are several questions. We tried to find out the other day among ourselves and with our consultants just what was meant in the question as asked and we are not quite sure as yet.

DR. STEINER: The concept of item characteristics can be illustrated by asking yourself, "What are the characteristics of a man?" His hair is either black or brown; his eyes are either blue or brown; he has five fingers--things of that sort. In other words, it is a description of the characteristics of an item.

In the use of the resources-requirements balance sheet approach you can have all different types of varying characteristics and still do the fundamental job that has to be done. Item characteristics vary a great deal. What I have tried to do for you is to establish a uniform common denominator among all the vast variety of item characteristics and to focus them on the resources-requirements balance sheet approach so that you can do the program balancing that has to be done.

It may be that one of the things that bothered you, Colonel, is that item characteristics have very important implications in many other areas of industrial mobilization planning. For example, if the fire hydrants in Chicago have different threads from the fire hydrants in San Francisco, you have a problem if you are going to try to centralize the production of hose. Does that make any sense to you?

COLONEL OXRIEDER: Yes, although that last illustration you gave is not quite along the lines some of us are thinking. For instance, earlier you mentioned producibility and inferred by the way you mentioned it that it was not an item characteristic. Now, at least some of us on the committee decided that producibility is very definitely an item characteristic, that producibility of the component parts is a necessary item characteristic. The amount of use, who used it, whether it was used in winter or summer, whether it was used ten times a day or once a year, each one of those is an item characteristic, is that correct?

DR. STEINER: The answer to that would depend on how fine you wanted to draw your conclusions. Certainly if you are studying the wide problem of item characteristics I should think you could include all of those. You might call them, for example, conditioning factors, or you might say that they are all part of "item characteristics." I couldn't argue about the definition whichever way you prefer to do it.

QUESTION: Isn't it true that you have to take some of those things into consideration when you try to find out how much you are going to need?

DR. STEINER: The problem, as I see it, is the same problem that Colonel Weaver mentioned here, "Where are you going to break into the circle?" My answer to that is this: The only realistic way to break into that circle, it seems to me, is to present the requirements for your item in terms of common denominators whether you have precision in the calculations or not, and then when you get your final resources-requirements balance sheet you can determine over-all feasibility. The problem of determining balance among programs is still a difficult one, but it can be resolved. I should like to make the observation that you cannot be absolutely precise in this kind of calculation.

QUESTION: I would like to ask a question for clarification, as to whether the use of substitutes enters in. We start with resources and requirements of your raw materials in terms of the common denominato: Then when we come out we must have so many peaches and bananas, but we find that apples will do; that will go back and influence the number of peaches and bananas. It looks like a vicious circle.

DR. STEINER: It is not so much a vicious circle as it is the problem of administering this methodology. You are talking about the types of problems that are involved in what I mentioned in balancing the balance sheet. All I have tried to develop for you is the methodology for getting the facts before those who have to make basic policy decisions.

QUESTION: We have one other point that we have discussed--whether or not the characteristics that apply to weapons, say, in the weapon characteristics that the Services are interested in--some fellows insisted that those should be excluded entirely. I think the majority of us felt that they should be among the characteristics considered. That is just one, performance characteristics. That is an item that is considered as affecting the requirements when you make the adjustments that you speak of in WPB or anywhere along the line. We feel that is one that enters in. I wonder what you think of that?

DR. STEINER: I think there is no question about it. Would you visualize with me a big circle. Maybe I can clarify my thinking in terms of your thinking. Could you visualize a big circle which you would call item characteristics. Now, running out from that circle at various tangents you would find many implications of item characteristics that would definitely affect the resources-requirements balance sheet approach, item characteristic which would definitely affect balancing the balance sheets, item characteristics which would affect

the allocation of productive facilities, item characteristics which would affect military strategy and defense. There are a great many of them.

All I have done has been this: I have defined another circle which partly overlaps this circle. The overlap area pertains to various strategic item characteristics which would influence the evolution of our methodology.

You are very correct in your assumption, I think, that item characteristics have very widespread implications, limited only by your definition. All I have tried to do is to show you that these item characteristics do influence in certain ways actual methodology of resources-requirements calculation as I have given it. At the same time, this methodology channels the impact of item characteristics in various areas.

QUESTION: Dr. Steiner, you have presented a methodology which seems to me illuminating so far as the problem of balancing the resources against the requirements is concerned. You reduce them to a common denominator of basic materials. When you reach the National Security Resources Board level with your requirements, it seems to me that the only item common to all of those is that someone has determined that those things are essential--that bobby pins are essential, that tanks are essential, that airplanes are essential, and hundreds of thousands of other items; the essentiality of these items has put them on the list--somebody has made a bill of materials and put these in the basic materials. So far as determining that 500,000 of these items are required, it would seem that in balancing resources against requirements, the National Security Resources Board doesn't care whether it is a truck wheel, whether it is bobby pins, or whether it is something else when it gets to working with that problem.

DR. STEINER: Yes, it would, because inherent in this approach is the understanding that these data ultimately will go to a top-policy board where it will be necessary to thrash out what we will get, because we know for a certainty that the requirements will be much beyond our resources. You have a very important question at that point as to just which requirements shall be reduced and in what quantity in order to get balanced production. At that point it will be necessary, therefore, for somebody to say, "Well, we must have so many bobby pins or the hair of the women will be falling down, their morale will be lowered, and we won't get as much production." Somebody will have to support that level of requirements.

QUESTION: Then, possibly the point that needs to be determined is this: In this discussion, when can it be said that the requirements have been determined? Is that the final thing which is the outcome of all the balancing, the readjustment of the program which finally comes out and says, "We will produce so many thousands of tons of steel allocated to that fellow, so much for this purpose, and so much for the other? Is that the requirement, or is the requirement the first stage, when you have received from all the claimants their demands, their requirements in basic materials, or when you have reduced them to a common denominator and added them up? Have the requirements been determined by the Military Services when they take their program to the National Security Resources Board and say, "This is what we want in items and here is the bill of materials that goes with it?" Then they have to wait for the National Security Resources Board to go through the adjusting process. In other words, are we over in the adjustment process when we send in the determination of a requirement--I think that is where we are probably in confusion--the adjustment of the demands to the resources is one problem, are we in that area or in the other?

DR. STEINER: I think it may be that I am partly responsible for the confusion because I have been talking about both actual wartime operations and about peacetime planning operations of the NSRB. Maybe I can straighten the matter out for you.

The result of this approach in the NSRB will be different from the result of this approach in active warfare. In active warfare you unquestionably will have the problem of precise cutbacks in individual areas. The NSRB operations at the moment, on the other hand, as I understand them--I have not been in Washington for a few months--will be an attempt over a long period of time to get a resources-requirements balance sheet for several purposes.

One is to determine over-all feasibility, which is the point that you mentioned. Obviously in attempting to determine over-all feasibility the NSRB is going to have to make some very precise assumptions, particularly with respect to the level of the civilian economy--will it be on an austerity level, or will it be on a very liberal level, or somewhere in between? It is the problem of over-all feasibility that the NSRB is attempting to tackle now.

Also it is attempting to develop a methodology that can be used in the event of an emergency so that we are not caught short with a lack of knowledge of how to do this job.

In addition, the methodology is used as a focal point for other types of mobilization planning, particularly planning with respect to labor, transportation, strategic materials, and also actual administrative programs, an allocation plan, a priorities plan, and matters of that kind.

In a war period the problem is a little bit different because one of the important elements lacking in the NSRB approach is the pulling and tugging in the requirements committee itself on the basis of military strategy, on the basis of civilian needs, and many other bases as to how much you will cut , where you will cut, and what the precise impact of a cut will mean or what it will be. If you look at it from those two points of view, I think you can move some of these concepts or item characteristics and center them.

COLONEL WEAVER: I think we have imposed on Dr. Steiner sufficiently as far as questions are concerned.

DR. REICHLEY: Dr. Steiner, you certainly have revealed the depth and complexity of this problem this morning and have given us much food for thought. I am sure that every student will find your comments of great aid in solving this particular problem.

Thank you very much for the time you have given us.

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