RESTRICTED

INDUSTRY'S METHOD OF DEVELOPING REQUIREMENTS

5 December 1950

CONTENTS

Page

INTRODUCTION--Colonel N. A. Matthias, USA
Chief, Requirements Branch, ICAF..... 1

SPEAKER--Mr. Frank C. McCoard, Director, Office of Production Programming and Control, Ford Motor Company.....1

GENERAL DISCUSSION.....11

Publication No. L51-65

INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

RESTRICTED

Mr. Frank C. McCoard, Director, Office of Production Programming and Control, was born in Payette, Idaho, in 1906. After completing grammar and high school in various points in the western part of the United States, he studied engineering and later journalism. In 1929 Mr. McCoard turned to the field of accounting and after study and experience became a certified public accountant. This work led to merchandising in which he became associated with a large mail-order organization. There for some years he worked in accounting, credits, inventory control, budgetary control, and retail store operation. In 1942 Mr. McCoard joined the Purchasing Division of the Army Service Forces and worked on various special assignments until the formation of the Readjustment Division. At that time he was assigned the post of Chief of the Control Branch of this division. After leaving the Army, Mr. McCoard became Administrative Assistant to the Director of Purchasing for the Ford Motor Company and, upon formation of the Office of Production Programming and Control, was made Director of that activity, the office he now holds.

INDUSTRY'S METHOD OF DEVELOPING REQUIREMENTS

5 December 1950

COLONEL MATTHIAS: Gentlemen, each year in our Requirements course we try to take one look at industry for several reasons: First, to see if there isn't some of its technique which we can apply to our own problems; and, second, to get a little better appreciation of what our requirements do to industry, particularly when we start changing our minds.

Last year on a field trip to Detroit we went through the Ford Motor Company and heard an excellent talk that fitted into this subject. I made up my mind then that I was going to try to put my hooks on the speaker and get him down here this year to address the whole class. His biography is known to you, but it does not fully portray all his military experience. He was involved in the Service Forces through most of the war and has a good understanding of the military problem. Naturally, he has an understanding of industry or he wouldn't be in his present position. Therefore, I feel we are particularly fortunate to have a man of his experience to deal with this problem today.

I take great pleasure in presenting Mr. Frank C. McCoard, Director, Production Programming and Control, Ford Motor Company, Mr. McCoard.

MR. McCOARD: Gentlemen, I appreciate very much the opportunity to come down here. I hope that I can make this smooth enough so that each of us can get something out of it.

To begin with, the success of mass production in industry depends upon two things. The first is specialized, automatic machinery which runs at a high rate of speed. The second is the bringing of the job to the man rather than the moving of the man to the job. The thing I am going to talk about today is that second principle, which is the bringing of the job to the man.

This job in industry, we call production control, and one of the basic factors in production control is the computation of requirements. The production control job consists of having the right parts and materials available at the right machines at the right time, after having allocated the right manpower to those machines so that their product moves smoothly along the chain to meet the other components of the eventual end product, so that it in turn can be delivered in accordance with the production plan.

American industry, in producing a major product, operates as a single assembly line. The various operations may be located in many different plants, under many different ownerships--but to the man, or group of men, that we will call the "master scheduler" the entire operation from raw material through the finished product is treated as though all operations were under one management and under one roof.

This peculiarity is both the great advantage and disadvantage of the American mass production industrial system. You might represent this system by a long freight train and that of other industries as a group of motorcycles. The make-up of a freight train must be carefully planned; it starts very slowly; as it gets up momentum, it is nearly as hard to stop as it was to start; and it just can't make a right-angle turn. These problems don't exist with the motorcycle. But, when that freight train gets rolling it can deliver a lot more goods, a lot faster, and a lot cheaper than a fleet of motorcycles.

It is of utmost importance in the event of war that our contracting officers learn to distinguish between freight trains and motorcycles. Freight trains are no good for use as motorcycles, and there are good motorcycles. During the last war many very good motorcycles were serving as freight cars in a big train. They weren't usually much good as freight cars, and we were failing to make use of their ability to start fast, turn corners, stop fast, and operate economically under light loads.

My discussion will be confined to one piece of the freight train type of operation--production control.

As I first stated, the production control job consists of having the right parts and materials available at the right time at the right machines, and to have allocated the right manpower to those machines so that their product moves along the chain to meet the other components of the eventual end product, so that it in turn can be delivered in accordance with the production plan.

The usual form of organization to accomplish this function is one very familiar to you--a general staff directing policies and methods and containing the master scheduler plus a small group of trouble shooters; a line organization in each plant handling the requirements for that plant; and sometimes a secondary or field headquarters staff functioning over a group of plants known as a division.

The functions have the same coverage regardless of level. The first is material handling, which includes the physical receiving, warehousing, and shipping. The second is what we call supply control, which is the procurement, disbursement, and maintenance at proper levels and locations

of those items other than machines which are required for production, but which do not become a part of the eventual end product. The third function is production scheduling, which includes the procurement of the parts and materials required for manufacture, and the cycling of the machines and manpower availability to meet the shipping schedule. I will try to keep this discussion in the field of this part of the third function and also try to avoid complication, even at the risk of over-simplification.

The method of accomplishing this particular task is simply by adjusting in terms of time each component and material, based upon the end product requirement. These adjustments are what we call floats and consist of "in process," "operational reserve," and "transit time." These floats may extend through many operations and many plants, but they do not change quantity; they simply divide quantity into time compartments for ordering and scheduling purposes. The proper establishment of these time compartments and the policing of actual production to maintain adherence to the time schedule is the key to good production scheduling.

If we looked at a consolidated manufacturing schedule as seen from the viewpoint of the master scheduler, it might seem to be a hopelessly complicated maze--with all its various operations, prime contractors, subcontractors, floats, cycles, and so forth, extending all the way back from the finished product through the steel mill. I'm not going to pretend it isn't complicated, but it's not so bad as it looks. Remember that each stage of operations carries its own responsibility and that each is scheduled to produce its part of the end product by a formula stepped back from that end product in terms of time.

To return to our freight train for a moment, you can calculate when a certain box in the fifteenth car is going to pass the point which was previously passed by the locomotive, because that box is contained within the fifteenth car which is a part of the string attached to the locomotive which is moving at a certain speed. That speed is controlled by the engineer who is the master scheduler. If a car jumps the rails or develops a hot box, it stops the whole train. Probably someone selected an unsatisfactory car in planning the make-up of this train.

Now let's get away from theory and follow first an actual civilian program and then a specific component of that program.

The General Management of a company decides to introduce a new product having certain general characteristics. Product Engineering develops the product and releases the detailed specifications for the components which make up that product to Plant and Tool Engineering and to the Production Control organization which is responsible for

producing the end product. We will let Plant and Tool Engineering work out plant layouts, processing, and tools and just take care of our part of the job in this discussion, although we couldn't do that in practice.

Production Control for the end product issues requisitions to its Purchasing organization for the components of the end product to be delivered in the form required by the end product operation. Production Control of the prime contractors in turn issues requisitions to their Purchasing organizations, and so on down to the last subcontractor.

At the same time, Production Control of the end product operation is obtaining time estimates on each component from Engineering, Purchasing, and Production so as to set an estimated effective date for production of the end product. This estimated effective date is then referred to General Management for approval.

Assuming approval of this effective point, each Production Control organization in the chain, from final assembly back to steel ordering, time phases each component back to the preceding operation so as to set the effective point at each stage of the operation for each component. A mistake in this can be fatal. This is where the master scheduler really does his work because this is the make-up of our train, upon which depends its entire performance.

In the meantime, Purchasing at all contracting levels has completed its contracts establishing the source and price of each item and has furnished its Production Control with a copy of each contract. Production Control then issues its part of the contract which authorizes these specific sources to procure the necessary raw stock and purchased components, fabricate their product, and to ship in the quantities and at the time required by each operation to meet its effective point. These authorizations, or releases, as they are usually called, must be followed up to make sure that each supplier is taking the steps necessary to meet the schedule and that he actually meets it. In this type of operation it does no good to be 99 percent right. You must be 100 percent right. Even in the final assembly stage it takes approximately 1,000 different subassemblies to build an automobile. The arrival of any one of these subassemblies two days late may close down your entire operation.

Production Control must then schedule its own machines and its manpower to meet its releases. Upon receipt of its materials or components, it must deliver them to the machines scheduled for production, either directly from the receiving deck or through storage areas. After each operation, it must again take over to accept the product and move it on to the next stage. Throughout all these processes,

Production Control must maintain complete accountability in both time and quantity. Failure to maintain accountability in quantity will result in incorrect releases to suppliers. Failure to maintain accountability in time results in lost man and machine hours.

There is a little point of definition at this point I would like to bring out. From time to time, the ordering cycle or the production cycle is confused with what is known as lead time. Lead time, going back, as we were discussing this initial program, may be governed by several things. You have to procure machines; you have to procure materials; and you have to place orders. So total lead time consists of the longest of any of those three components of time. Perhaps your material in one operation can be procured more rapidly than machines. In that case your machine time is the lead time. It is quite a different thing from the ordering time required once an operation is under way.

Probably the simplest means of explaining the ordering time cycle is to use a specific example of a single component. Let us assume that we desired to build on X day in a certain assembly plant 100 custom Fordor sedans with overdrive transmission. For the assembly plant to build a custom Fordor sedan with an overdrive transmission it is necessary for it to order 1,099 different components to be assembled into the vehicle.

One of these components is the overdrive transmission which is shipped to the assembly plant from a transmission plant. About one-half day elapses between the start of the car assembly process before the finished cars come off the end of the line. We must maintain in the assembly plant about a two-day stock of overdrive transmissions ahead of the first assembly operation. This operational reserve is necessary to protect against minor failures in the transmission plant or failure of the material to move quite as rapidly as planned. Under normal shipping conditions, it requires three and one-half days for the overdrive transmission to move from the transmission plant to the assembly plant. The overdrive transmissions must, therefore, be ordered by the assembly plant to be shipped on (X-6). These six days represent the sum of the in-process time, the operational reserve, and the in-transit time.

In the transmission plant one of the 31 subassemblies of the overdrive transmission is the overdrive assembly. It takes about one-half day in process of transmission assembly, two days in operational reserve ahead of the first transmission assembly operation, and two and one-half days transit time from the overdrive assembly plant. That adds to five days. The 100 overdrive assemblies must thus be ordered shipped from the overdrive assembly plant on (X-6)--which we required for the assembly plant--minus these additional five days, which brings us back to (X-11).

One of the 97 components used by the overdrive assembly plant in making an overdrive assembly is the overdrive shaft, which is procured from a machining plant. The time in process of overdrive assembly plus the desired operational reserve plus transit time from the machining plant to the overdrive assembly plant add up to seven days. The 100 machined shafts must thus be ordered shipped on (X-11-7) or (X-18).

The machining plant operates on a slightly different basis since it buys bar stock rather than assembly components. Since the machining process is rather long and since other items must go through the same machines, it is necessary to maintain a small shipping bank of about a three-day stock. The machining process requires about five days. The operational reserve of the particular type of bar stock must be maintained at 20 days ahead of the first machining operation because this particular type of stock is shipped only once each month from the steel mill, and even this production may be delayed. Thus the machining plant must order the bar stock shipped on (X-18-28) or (X-46).

The bar mill converts billets into bars, and the standard pattern provides about 7 days in process from billets to finished bars with an operational reserve of billets amounting to another 7 days, or a total of 14 days. The bar mill must thus order billets delivered on (X-46-14) or (X-60).

Under ideal conditions, the blooming mill and open hearth operate as a continuous process so that the billets are produced from hot ingots, which eliminates the necessity of reheating ingots and also the necessity of maintaining an operational reserve of ingots ahead of the blooming mill operation. We will assume this ideal condition so that the blooming mill would add only four days to the chain and must order ingots on (X-60-4) or (X-64).

Throughout this entire cycle we have assumed that no time was required to write orders, schedule operations, or schedule shipments. Under ideal conditions, this is generally true until you reach the first operation. This is because the time required for these actions in subsequent operations is absorbed in the actual production schedule. In the first operation, however, which is the open hearth, the order must be received approximately 30 days prior to delivery of the ingot because each month's cycle must generally be planned in advance since thousands of different types of product must move through this single operation. The order from the blooming mill to the open hearth must be received by that operation and a melt schedule prepared to provide the specific code, quantity, and size of ingot which will be necessary to produce this particular bar stock. We must also remember that an open hearth furnace is a very uncertain thing. In spite of all efforts

to control the chemical content and the physical condition, one cannot expect to produce the right ingot more than 70 percent of the time. If you fail, you must keep on trying until you get that particular code. For our illustration, however, we will again assume an ideal operation, which would require the blooming mill order based on (X-64-30) or (X-94). This last segment is the difference between float and lead time.

In this particular illustration we have made two assumptions which materially decrease the time actually required in the master ordering formula. The first is ideal conditions in the steel operation and the second is the use of an item of such size that it is shipped on to the next plant on a daily basis. For example, in the vehicle assembly plant we stated that we would carry an operational reserve ahead of the vehicle assembly of only two days. Such a small reserve would, of course, require daily shipments from the transmission plant. In many instances, the value of the part is so small or the handling of daily shipments so expensive that shipments would be made once each week, once every two weeks, or perhaps once a month. This shipping frequency would, of course, increase the operational reserve by the number of days in the shipping frequency, which would add the same number of days to the master ordering formula. Likewise, many items are made on a cycle run basis in which the same machines are used to produce a number of different parts and are available for use for the specific part under discussion on the basis of once each week, or perhaps once each month. I would prefer, however, not to complicate our example with any of these factors.

This then is the general pattern which must be followed for ordering and scheduling each item and, as you can see, it is an equation in time rather than in quantity. The quantities develop from application of the time factor to the end product production plan.

In actual practice machines frequently break down, materials fail to arrive on schedule, or are found to be defective upon arrival, or other delaying factors occur. Production Control managers in each plant keep in constant contact with the Production Control managers at the preceding and following stage so as to improvise in some fashion to cover these losses and still maintain scheduled shipment of the vehicle from the vehicle assembly plant. We also maintain a small group of trouble shooters on the central staff to provide emergency expediting service and to develop some means of maintaining production when the operations fail to work out according to plan.

The primary purpose of this discussion is, of course, its application to government procurement. In addition to the supplier selection problem which I mentioned at the beginning of this discussion, the three worst problems in production scheduling are poorly planned

engineering changes, rapidly fluctuating schedules, and the application of purely mechanical methods of computing requirements without sufficient knowledge of the effect of those requirements upon preceding operations.

Poorly planned engineering changes usually result in a failure to deliver on time, the eventual delivery of an unsatisfactory product, and the waste of parts and materials. Although it is very seldom that an engineering change would affect only one component, let us stick to our general principle of using the simplest possible illustration, which was the overdrive shaft in our discussion. Each component must be balanced at each stage of operation to produce a final change if interchangeability of parts is affected. However, if we assume that the only thing we are going to change is some manufacturing detail in the machining of this shaft, and that this change would not affect the interchangeability of shafts made after the change with those made ahead of the change, then the closest point at which the engineering change can be set without waste is (X-26); this represents the point in time at which the bar stock moved into the machining process. If this change required a difference in bar size or in the physical or chemical make-up of the bar stock, then the time would be much longer. The real waste occurs, however, when interchangeability is affected and a number of components must be changed.

You would be surprised to know how many components have to be changed to make what appears to be a very simple engineering change. The ash tray in the 1949 Ford didn't fit very well; we decided to make a slight change in that ash tray so it would fit better--we changed 123 parts. The same thing is true in any type of engineering change.

Now if we assume interchangeability is affected and that a number of components must be changed, a few of them can be changed within 20 days, others in 30 days, and others possibly in 40 days. Unless the change is made effective, based upon the longest ordering formula for the affected components, you have not only wasted materials, but you have also created a gap in the production chain equal to the difference between the effective point and the ordering formula for the longest item in the change.

The second problem was that of rapidly fluctuating schedules. To go back to our illustration, we assumed that we were running at a steady rate of 100 jobs per day throughout the entire operation, at least all the way from the machining plant to the assembly plant. On this basis, the assembly plant would have in stock or in transit a six-day stock of overdrive transmission or 600 pieces. The transmission plant would have 500 pieces. The overdrive assembly plant would have 700 pieces. Each of these plants is shipping at a uniform rate of 100 per day to the next operation. At this point we cut the schedule in half. At a schedule of

50 per day, the assembly plant now has a 12-day stock. For this reason, on a mechanical basis, it would not only cut its order to the transmission plant to a 50-per-day rate, but it doesn't want any stock at all for six days because it will take that long to reduce its stock to the six-day level at the reduced schedule. The transmission plant has a 10-day stock at the new schedule and has no requirements from the assembly plant for six days, so that it is out of business for six days and requires no stock from the overdrive assembly plant for 11 days. The number of days down time for each operation on a 50 percent cut can be measured by the master ordering formula. It is a very serious matter to put a plant out of business for 18 days, which is nearly one month, and at the same time to require it to start up again at a much lower rate. This build-up in the effect of schedule changes creates very serious manpower problems. Sudden increases have the same sort of "crack-the-whip" effect, but are really worse because someone in the chain is almost certain to fail at some stage of his operation.

In civilian production each Production Control manager tries to cushion the shock of changing requirements rather than using the strictly mechanical theory of order placement. Using our example, the assembly plant instead of shutting down the transmission plant for a period of six days would perhaps, after discussion with the transmission plant, reduce its schedule to 40 jobs per day. This schedule would enable the transmission plant to maintain the manpower required for a 50-per-day operation which was the new schedule, but to work these people only four days per week until the effect of the adjustment had been worked out. Each plant in the chain would temporarily have in stock more than its planned inventory, which would be gradually liquidated without causing actual shutdowns. Sometimes it is possible to delay the worst of the shock until a vacation plan can be arranged to correct the inventory conditions. In spite of these efforts, the effects of schedule changes due to sales demand are very serious even in civilian industry.

In government procurement the usual effect upon manpower and morale is much worse than in civilian industry, partly becuase of usually following the mechanical method and partly due to lack of explanation. Each party receiving these changed requirements without explanation which cause them to shut down or double their rate begins seriously to doubt that the organization making the original change has any particular idea of just what it is doing or just what effect the change has in the chain of production. This is particularly true when a cutback is followed by an increased schedule. To use our illustration once more, if we cut our schedule to 50 jobs per day and use a purely mechanical method of handling requirements, our machining plant would have been closed for 18 days. Now let's assume that a month after this first cutback the schedule is raised to 150 per day. The machining plant is now obliged

not only to jump its production from 50 per day to 150 per day, it must also build up the floats in each subsequent operation to the level required for a 150-per-day operation and then slow down to a 150 daily rate.

Nearly everyone in industry recognizes that war needs fluctuate even more rapidly than customer demand for civilian products, but most industry also has a deep suspicion that true needs, even war needs, do not jump around quite so much as government orders. There is an entirely justified belief that some of these changes resulted from purely mechanical calculation of demand passed on to the government contractor without any consideration of the effect of the change not only upon the prime contractor but at all levels of subcontracting effort. A better understanding of these scheduling problems will save the country a great deal of cash outlay and time. The latter commodity probably being the most important in the case of actual war.

The effect upon morale can be bettered by trying to give some explanation for schedule change at the time the change is made, which can be passed down to everyone affected. This technique has two great advantages which we have found in our own operation. In the first place, it requires the individual making the change to know why he is making it and to have some appreciation of the problems involved. In the second place, a great many changes which are indicated as being necessary are never made, because the individual making the change, when required to analyze his reason for the change, frequently finds that there is no real necessity for the change in the first place.

In closing I would like to re-emphasize that American mass productive industry takes a long time to get started but can move very rapidly in a straight line once it is set up; it develops such terrific momentum that it is extremely difficult to stop or to change speeds; and that it cannot turn a corner except by gradual curves. Engineering changes which are mandatory must be made as rapidly as possible without regard to waste, but those which are only desirable should be more carefully planned. The last point is that I believe our government contracting officers can perform a great service through understanding the problems of schedule changes and by trying to supply reasonable explanations for rapid cutbacks or increases in their contracts when these rapid changes are really necessary; so that, instead of a contractor feeling that "Some dumb guy added an extra zero or he doesn't know how this is put together," he knows that this change is being made because some certain item proved to be unsatisfactory and had to be changed, or that the conditions in some particular field of effort have so changed that it is imperative that this change be made. And, believe me, they don't put much stock in this blanket explanation "for the good of the war effort,"

because that simply indicates as a usual thing that the man doing it isn't quite sure why he himself is doing it.

Thank you very much.

QUESTION: Mr. McCoard, I am wondering if you ever used in the civilian industry this modification principle that was put into effect, particularly in the aircraft industry, and I wonder if you would comment on the feasibility of using modification for quick engineering changes that might be deemed necessary?

MR. McCOARD: We have used it primarily in the filling of special orders for, let us say, trucks, because there are probably 200 to 300 different standard trucks. Then, a lot of additional changes are made to fit individual customers' orders. There is, I believe, a much greater possibility in government work of applying the modification center principle than there is in civilian work because the modification center idea speeds up the application of the change. It speeds it up tremendously. There is no question about that; but it frequently results in pretty heavy expense. To use an example, in a civilian situation, let us assume that we put in a modification center on trucks which would require building a standard truck and then for use in high altitudes of a change in the generator and a change in the radiator, and two or three other such things. We have already spent the money to put on the standard item. Now we not only have to spend the money to take it off, we must also put the other one on, and we can either find some way to use that standard item or eventually it is that much loss--and, of course, industry didn't have a Surplus Property Board that it could turn that stuff over to. Industry itself has to take that loss. But I think for fast engineering changes, even though it is expensive, the modification center is a very good idea.

QUESTION: Mr. McCoard, what opportunity or possibility is there of absorbing some of this timing in engineering changes by the making or manufacturing of spare parts? Is that possible, feasible, or is it out of the question?

MR. McCOARD: It is very seldom possible because the alteration usually changes the spare parts required as well as the end product. Let us just go back to this little change I mentioned on the ash tray. When we make an engineering change in an airplane, for example, it is a lot tougher than that, but, let us just take that little ash tray where we had to change well over 100 different parts, processes, and even changed materials. There really is no way that you can simplify engineering changes. They are necessary evils, and all that we can ask the government services to do is to try to evaluate the changes and fit them into groups.

Let us say, there is a change that does not involve interchangeability such as the one I mentioned where there was simply a difference in how a shaft is machined. By giving the machining plant the responsibility for establishing the effective point and of passing that information up the line, the change can be put in with no loss. Even on changes involving interchangeability, there are changes which must be made. It is a safety requirement or it is one which is necessary in the product. Okay, go ahead and set it. Those things happen whether it is in government contracting or in industry. When a change is necessary, it is made. That change is made as rapidly as possible, and there is enough flexibility in industry to make that change so long as industry understands "This is a mandatory change; this is why it must be made." But we shouldn't throw into that same group a lot of changes which--well, it simply would be nice to have changed. There is no way around that particular problem except just in trying to use the best judgment possible in analyzing the reasons for the change and in treating them in the order of their importance rather than assuming that just because the engineers think it would work a little better this way that it is a necessary and divine edict.

GENERAL HOLMAN: Mr. McCoard, we have a pretty good principle in our tactical operations in the military all throughout the system, that is, the warning order and I am sure you have seen both sides of this work. What luck did you have in making changes in your World War II agency with warning orders, and why shouldn't we make more use of that principle in our programming for manufacture?

MR. McCOARD: That is a very good principle. It was a very helpful sort of thing. I think a lot more use can be made of it. The Ford Motor Company uses what we might call a warning order. When an engineering department first begins to think of a change, it prepares what is called a change request and a copy of that piece of paper goes all the way through the operation. Maybe it will cover only materials, but it is a warning, "Somebody is working on this change. Watch it. Keep your inventory under control." When it looks as if very stringent credit regulations or something of that sort is coming up, or a limitation order on the use of aluminum, that sort of information gets down the same way. The more information and the more explanation we can get to our contractors at all levels, the better off we are going to be.

QUESTION: In following through your production management control on all these requirements, does each production control manager control those items that go into his particular item or does the central control office follow all through the chain? In other words, do the people in the first plant try to maintain a production control of 1,099 and the man in the next plant on only 31, or does it go all the way down the line?

MR. McCOARD: That 1,099, for example, was only the number required to build one particular variety of car, and the manufacturer probably makes in that assembly plant 10 varieties of passenger cars and maybe 100 or so variations of trucks. But it is true that the production control manager in that assembly plant worries only about those items which he brings into his plant and the product which he sends out. The same is true there and all the way back. But when we set up our original program, the central office examined each one of these figures to make sure that the time phasing stretched all the way back through the chain, and it was set up fairly well. Once this is established, so long as it is established in accordance with the methods prescribed by the central office, then we keep out of that fellow's business just so long as he is keeping himself out of trouble. But as a check against that, each of these operations prepares behind-schedule reports which show what seems to be slipping a little bit from the preceding operation. Those reports do come to the central office and on each one of those items that are slipping a little bit too much the central office moves in. But so long as the operation keeps itself out of trouble, we can relax very easily in Dearborn.

QUESTION: Mr. McCoard, it seems to me that the automobile industry makes rather radical changes each year in new models. Can you explain how that process fits into the picture without losing momentum?

MR. McCOARD: Yes. We are setting the effective points now for the 1952 models which will come off the end of the line in probably the first two weeks of November 1951. We are engineering the 1953 model but we are already establishing the time sequences for the model which we will put into effect next November. Within this total ordering time, we will establish what we call a balance-out point. From that point forward, no changes in schedule are permitted--no engineering changes are permitted unless that engineering change happens to be one of those which can be effected without loss or which is imperative because of the service in the car. Other than that, when you reach that balance-out point, you decide that you are going to build so many more cars of the 1951 model. If you have a strike or if your production slows down, or regardless of what happens, you still build that many cars, and you adjust your entire production in time. The big reason the automotive industry is able to make those model changes is that the engineering and the effective points are set at least as far ahead as the longest item in the ordering schedule.

COLONEL NIEMI: Mr. McCoard, you have given us a real insight into the problems of industry--relating how industry determines requirements and explaining some of the problems it meets. We deeply appreciate this, so for the faculty and students, I thank you very much.

(23 Jan 1951--500)S.