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AUTOMOTIVE PRODUCTION CYCLE

10 February 1948

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COLONEL CRANE: Gentlemen, in wartime industry is faced with the problem of producing for the Armed Forces new products which have no counterpart in normal commercial production. In normal times, the industry which faces most frequently the problem of preparing for the production of new products is the automotive industry, with its periodic change of models. Consideration of the automotive production cycle, therefore, should reveal some of the problems and delays which industry, generally, will experience in time of war.

Our speaker this morning is well qualified to discuss this subject. Being a graduate mechanical engineer, with considerable production experience, he is well versed in the technical aspects of this problem. As Detroit Editor of "Automotive Industries", he has been in close contact with the industry and has interpreted technical developments in terms which readers of this publication can readily understand.

I take great pleasure in presenting to you this morning Mr. Joseph Geschelin.

MR. GESCHELIN: Thank you, Colonel Crane. Gentlemen, it is a great pleasure for me to be here. I hope I can contribute something to your background; at least I shall try. Some of the things I can tell you about are based upon the experiences that many of you had during the late war.

The subject of mobilization and preprodness is a very big one, extending into so many avenues, that I have selected, as Colonel Crane mentioned, only the automotive mass-production aspects because I assume that is where a good deal of the material will have to come from.

Before I get into the subject, I would like to define what we mean by mass production. I think all of us sometimes use the term "mass production" rather loosely. There is a difference between mass production, as we think of it in Detroit, and simply large-volume production because it is possible to take a product which is not particularly adaptable for mass production and by simply adding enough units of machine tools you can step up the productivity of a given plant or a given product.

But that is not mass production from the standpoint I am discussing here. My viewpoint of mass production is that it is a completely integrated process. It is a philosophy, if you will, in which you have, first of all, a product so designed as to lend itself to manufacturing by the most advanced methods. Unless you have that to start with, you do not have mass production.

You will note that that was probably one of the reasons why it was so difficult during the late war to begin mass production of certain military items, the simple reason being that the product, as it was given to industry, was never intended for mass production. There were items of ordnance equipment, for example, that had never been built in any large volume.

So you have, first of all, the concept of unique design which is intended specifically to take advantage of advanced manufacturing techniques.

Then you have manufacturing processes which, in themselves, are designed to reduce the amount of labor. Or, to put it another way, to increase the productivity of labor on a given task at the lowest possible cost but at the same time to get the highest possible quality. In essence, it is a highly repetitive process.

Another characteristic of the mass-production process that distinguishes it from any other manufacturing technique you can think of is the fact that, for any given setup, you have in a production line the equipment required for every process required to complete the part. Most of you, who may be familiar with manufacturing plants, know that in job-shop operations you have a departmental setup. That is to say, you have a department in which you do grinding, another for milling, drilling, etc. Normally, you subdivide the work in such a way that everything required grinding is transported to the grinding department, then it is routed progressively to other departments. That is the job-shop process.

In the mass-production field you can tool the most minute part. That part may require metal-cutting, grinding, honing. It may require electroplating. It may require a corrosion coating or some kind of chemical process. Regardless of how many processes are involved in the finishing of one part, all of the necessary equipment is set up on a single line. The part then progresses from one operation to another, all being so timed that each operation takes about the same amount of time. Or, to put it another way, you have to slow down the entire line to keep pace with the slowest operation. That is one of the problems of a mass-production setup.

I would like to tell you in advance what I shall emphasize in the discussion--part of it was a little startling to me after I had begun writing this talk--and that is this: The mass-production process has so many advantages that we think of it as being the most important thing we have. And it is! But, just like any other mechanical process, it also has some pretty serious limitations. I don't know whether any of you realize how serious the limitations are.

For example, in industry today, beginning with the end of 1945--and I am judging entirely by the automotive industry because that is the only one with which I am thoroughly familiar--manufacturers have been progressively changing their production setup. They are beginning to bring in more and more automatic machinery. I think we are pretty well at the stage now where you could call certain operations "push-button operations."

At Buick, for example, you will see a cylinder-block line which runs about a thousand feet in length for machining the block from the raw casting to the finished product. It is about as completely automatic as you can make them. All the equipment is of transfer type. In each machine, the operation involves an automatic movement from one station to another. The only place where you have operators is between machines. They serve the function, primarily, of visual inspection, just to make sure the part does not look visually bad. All you do is shove the work into the machine, press a button, and the machine automatically picks it up and pushes it through.

That is marvelous! As a matter of fact, if you have war production in large volume that is the kind of setup you would like to have. But what happens if too much of industry goes to that kind of advanced equipment? I think you will find, if we had another emergency, there is no possibility of a conversion of this Buick department to make another type of product. That is what startled me when I began to think about it. This type of equipment has no possibility whatever of conversion.

It seems to me there is as much difference in the aspect of mechanization between the end of the late war and now, in that short period, as there was between the First World War and the Second. Our problems in the First World War were not nearly so serious from the production standpoint. Most of the materiel was made in fairly small quantities and we used general-purpose machinery. Today, as plants begin to mechanize more and more, there is very little general-purpose machinery used except in the tool rooms; of course, you cannot get very much production out of them.

Another problem is--unless we have learned the lessons of the late war--the people have not realized the value or importance of time as an element in planning for procurement. During the past war all that appeared necessary for a procurement agency to do was to decide they wanted something, prepare a contract and put a date on it. That had no relation whatever to the possibility of making the product.

Now you cannot operate that way. You can on a tool-room basis only if parts are required in small quantity; but you have to take time into consideration.

The third point I want to make is one that I think is really the vital link between the first two--the utilization of facilities, and the problem of time. It is something that is being used to a slight extent in industry today. I have in mind a very definite step--the liaison between the product-development branch of the Armed Forces and people in industry who are thoroughly familiar with mechanical developments, particularly developments in machine tools and production processes.

There is nothing more certain than the fact that the designer, whether he is designing a military product or a civilian product (particularly the industrial designer), pays very little attention to the possibility of producing a particular product. His job is to create a functional design. Today, in the era in which we are living, it is absolutely impossible to figure on any manufacturing program unless functional design is tempered to a slight degree so as to make it practical to produce by mass-production methods.

This is no reflection on the designer, of course. After all, the designer has his particular job of research and development, to meet functional requirements. The fact of the matter is that, even within the automotive industry, we have specialists who do nothing but concentrate on machine-tool developments. Mainly they are people in the Master Mechanic's Department.

Even in the Master Mechanic's Department of a large plant the work is subdivided into a number of functions, depending upon the size of the plant. There may be a man who follows nothing but grinders--there are so many things happening in that field--milling machines, drilling machines, and so on. How can you expect an engineer to be able to follow all of these advances when the people in the mechanical end of the plant cannot do it except through a number of specialists?

That is why it is imperative to have this link between the development branch and people in industry who are thoroughly familiar with mass production. Then you are certain that everything that can be done to the design of a product to lend itself to mass production has been done in advance. Once you have frozen the design of a product it is too late.

I do not know how familiar you gentlemen are with the latest developments in the machine-tool field; but in the automotive industry, in particular, where much of this development is taking place, we have the so-called transfer type of machine which I mentioned briefly at the start. It is a specialized machine in which the "transfer" part of the definition refers to an automatically controlled conveyor system of some kind built as a part of the machine. It is as much a part of the machine as fixture is.

You can have a machine with as many stations as you wish. For example, on this Buick line the rough-milling machine, which is the first operation on the block, has eight stations. The machine automatically mills the engine block in a number of dispositions--top, bottom, sides, and so on. The shifts from one side to another are made automatically by the fixture at each station. Where heretofore you had an operator with a trunnion type of fixture, who had to shift and move it into another machine where the tooling was so arranged so as to take another part of the block, in this machine you simply push it in and when it comes out at the other end it has been completely milled all the way through.

As a matter of fact, this type of process could be extended almost indefinitely in a number of operations. The only reason it isn't is because practical people in the manufacturing department realize if you make these things too complicated you are likely to get into difficulty. For example, at Buick, the cylinder block department consists of a number of units of these transfer machines linked together by a gravity roller conveyor at various points. If just one of the units goes down--it doesn't matter which one--the entire department is down. So they are approaching the problem very cautiously until they know more about this equipment.

Actually, it was within the past two years that we had real production experience with the transfer type of machine. The first major example of a transfer machine during the war was the one built by Greenlee for automatically machining cylinder heads for Wright engines. There were three or four units of that type in use.

Actually, I think Nash was the first manufacturer in our industry to have the transfer type of machine for engine-machining, this being installed at Kenosha in 1940.

The reason I have placed so much emphasis on the development of advanced machinery is because at the beginning of the late war--in fact, during the course of the so-called defense period in 1940--the people of this country, certainly the legislators in Washington, were greatly confused by proposals such as the Reuther plan. I don't know whether any of you remember what the Reuther plan was. It was evolved by Walter Reuther, present president of UAW (CIO), in Detroit. He had a brilliant plan in which he proposed that, inasmuch as automobile production was being cut back, all you had to do was set aside a certain portion of floor space in an automobile plant--presuming you had sufficient cut-back in production to leave some floor space--put some machinery in this floor space and begin building aircraft and aircraft engines. Many people in the Government, at the time, thought it was wonderful.

The other thing that was confusing was to have a major executive in the automobile industry tell the public that, if and when the time came, he could build something like five hundred airplanes a day in his own plant. There, again, everybody leaned back and said, "If that can be done, then why should we worry? We're not in the war. We can wait." And so we did.

When the time came, look what we actually had to do. Sure we won the war. We had all the facilities. But in order to build tanks we had to build a tank arsenal in Detroit. You could not build them in an automobile plant at the start. Willow Run, with four million square feet, had to be built to produce B-24's. It took a long time to build it, and it required a super highway to feed it. Right after that, when the B-29 program came in, we had to build some nine million square feet in Chicago for producing the engines for B-29's.

If you take a look at the small-arms program you will recall the very sizable plants built at various times during the war. Certainly it was not completely a conversion of peacetime facilities to wartime uses. And yet I think a lot of people will say we actually did convert. Consider just one case: the Plymouth plant in Detroit. Its representatives converted 100 percent to war materiel. But when the war was over there wasn't a thing in the plant that could be used for reconversion to passenger cars. In shifting to war production they ripped out all of their conveyors and filled in with concrete all of the space that was open for these conveyer lines. When they reconverted to peacetime production, they had to dig all of this stuff out and put the conveyers back in. So, you see, the production process is not a reversible one with respect to conversion and reconversion. We might as well recognize that as a part of the problem in addition to the question of time.

I just want to make another point about this problem of liaison in designing for mass production.

An engineer may feel at the start, if this thing is proposed, that perhaps what we are talking about is something that will actually affect the functioning of a part. It isn't that at all. It is, rather, the small, subtle changes that can be made. Take, for example, the broaching process. Surface broaching, which makes it possible to finish the exterior of a part in any form, whether it is flat or curved or a complex curvature of some kind, can be done in the broaching machine. The broaching machine, as has been demonstrated by actual experience during the past ten years or so, does the job in about one-seventh or one-tenth of the time of milling. As a matter of fact, if it were not for surface broaching Allison would not be able to make the turbine wheel for the jet engines they are building.

Frequently you may have a part which lends itself beautifully to surface broaching except that it has a boss on it. Suppose that boss will interfere with the travel of the tool because, after all, the tool has to traverse completely. If the designer were to present this to the man who has to do the manufacturing and ask him for his criticism, the first criticsm the man would make is that "Well, we would like to surface broach it because that is going to be much faster and we can do the job very well, but this boss is in the way. Can you eliminate it in some way." That is not too difficult. If it affects functioning, you have to make a compromise and do it some other way.

I will leave with you, Colonel Crane, a copy of a paper that was presented at the S.A.E. meeting, giving the functions of the Production Engineering Department at Buick. That is one of the best and latest setups I know of. You can get more copies of this from the S.A.E. But they have done at Buick the very thing I am talking about, except that the problem of the Armed Forces, of course, is so much greater and will have so many more ramifications; but the principle is there. I just want to give you some of the topical headings; I won't read the contents at all.

Here are the functions of this Production Engineering Department: It acts as liaison between the Car Engineering and Master Mechanics Department, Production Department, Purchasing Department, Inspection Department, and Service Department. So, you see, it links with engineering everything that has to do with the manufacture and distribution of the product.

In the production activities they follow new designs to be sure, that features likely to prove troublesome or difficult from the manufacturing viewpoint are avoided or properly evaluated. They investigate and report on engineering changes required by the factory.

You must remember, gentlemen, that the only value of this kind of a setup is before the design is frozen; while it is still in the fluid state.

"To process all changes regardless of origin, so that no change is made unless this group approves it or handles it.

"To write and distribute experimental and production releases.

"To write and obtain cost comparisons.

"To investigate requests for deviations in material and construction.

"Write and distribute engineering information books for factory use.

"Supply resident engineers for assembly plants."

Out of that group you get specialists who can be used to operate a plant.

They make 100 percent and unit inspection checks and report on them.

"Recommend the proper shipping methods."

That will give you a general idea of the things this one commercial department does.

Here are some things I noted from just getting around in the different plants during the war; things that would have been facilitated if there had been such a setup. For example, AC Spark Plug and Delco were two of the companies I studied during the war. They had the first contracts for the volume manufacture of Browning guns. So far as I know--I may be wrong; I don't know the whole history of it--I think the Browning guns were an arsenal product during the period between World War I and World War II.

COLONEL CRANE: A Colt product.

MR. GESCHELIN: Was it built in large quantity?

COLONEL CRANE: No.

MR. GESCHELIN: Let's say originally it was an arsenal product, built in small quantity. By the time it got to AC and Delco it was required in real large volume. Yet, nobody had the know-how, certainly not in the Detroit area. But they had to take a product that had been built in limited volume--whatever that volume happened to be--and step it up considerably.

The first thing they did was the very first process I mentioned--the difference between what we mean by mass production and simply high volume. The only machines AC had were the machines taken out of arsenal stores; machines that had been in arsenal stores for perhaps twenty-five years. There were Pratt & Whitney profiles that had not been used since 1917 or 1918. They simply added more of them. When they started, they had to take this product and do the best they could with it. But as they worked with it, as they manufactured it, and as they established a trickle of production, they began to suggest changes in design and manufacturing procedures.

For instance, I think Colonel Crane was still in Detroit when, Pontiac, making Oerlikon guns and AC or Brownings recommended the substitution of Arma steel castings for forging. On the Oerlikon gun you had a large breech block weighing, I suppose, around 200 pounds in a solid forging. This had to be completely whittled out, inside and out, and that was done very laboriously by milling-machine methods. Then, after

they had worked on it for a while, someone got the bright idea of using an Arma steel casting which would require the very minimum of metal-removal operations.

I mentioned that time is an important element. I have just listed some of the time-consuming steps. Of course, you will understand that, while I list these separately, many of them can and should be done concurrently. Nevertheless, they are time-consuming steps. I am starting now from the concept of a design before anything has been built; before you have had pilot production.

You have a consumption of time in experimental production, testing, and research. After all, you cannot really test a product until after you have built it in experimental production.

The next step is the translation of product design into production design and the application of manufacturing tolerances. These things all take time in the drafting room and consultation with the manufacturing department.

The next stage is to release the drawings for production, at which point they go into the Master Mechanic's Department. The Master Mechanic's Department develops the sequence of operations that will be performed, and determines the equipment required. Those are all purely preliminary steps, just studies. They contribute nothing to the actual manufacture of the product.

After that, you have to design the tooling, fixtures, dies, molds, whatever is required. As this design work is completed, of course, the tooling can be thrown into the hopper for its production.

Then you have to start worrying about the plant layout. You may decide that you can use the existing plant. In that case, you have to relayout the entire plant and position the machinery. That is determined by the sequence of operations, materials handling devices, and so on.

Then you begin the process of ordering tools and machines. Under normal circumstances—today, for example—it takes three, six, or nine months to get a machine tool. During the war people waited for eighteen months or two years before they got a machine tool. Incidentally, that is going to be a major problem because if there is a lot of transfer equipment around that we cannot adapt, there will be the job of ordering entirely new machinery.

On the other hand, suppose an existing plant either is not available or not suitable, or not big enough. Then a new plant is needed. There is another type of problem. You have to pick a site, acquire it, design

the building, and build it. During the war Albert Kahn did a good job. They put up some of the biggest structures in our country in about ninety days. But you cannot always bank on that.

After all of that is done, after you have done this preparatory work, after you have your plant all laid out, and so on, you still have to take time for the installation of machinery. You still have to dig foundations for the presses and heavy machines. Then you have to cut out places in which to install the floor conveyers; put up the structures for supporting monorail conveyers, and so on.

Then you have to prove the machines and tools. They do not work right the first time. In fact, under normal circumstances, if you walk into an automobile plant about the time they put in a new machine, it may be three months before that machine is really perking properly. On press work, it frequently takes a matter of days or several weeks to have a large-sized stamping produced properly.

These details all take time. You simply cannot beat the game. All I submit to you is that under normal conditions in the automobile industry the manufacturer plans ahead about eighteen months for any new model, even if the changes have not been extensive. You may have read just recently that Lincoln is in the process of change-over and will close down for a month. Well don't think for one moment that the period of a month is the period in which this actual change-over is made. That simply is the time they have given themselves for getting the machines and tooling installed; that is, having jigs and fixtures put on those machines. It takes them a month do do it. But if they had not started back in the early part of 1947, or even the latter part of 1946, to order tools that have been designed for this job, they would not be building it today. Certainly they would not be building it in this month's period.

I would like to touch just a bit on the subject of subcontracting. I had a lot to do with it for the Navy during the war. We found it quite an unmixed blessing. I do not think the historical record will show that all of the subcontractors performed well. One of the troubles was that during the war you were forced to put certain people in business as subcontractors. When the War Manpower Commission came into being, it designated certain areas as "distress areas." Civilian production had been stopped arbitrarily by the Government; here were buildings standing and men idle. By that process it was decided these areas would become subcontractors.

It did not always work out well. Unless people are accustomed to working with mass-production methods, it is very difficult for them to become accomodated to subcontracting. In any event, subcontracting will

always be with us. No manufacturer can possibly build everything that goes into the end product. The automobile manufacturer is far from being the manufacturer of a complete vehicle. He buys the accessories—tires, wheels, and any number of things—from the outside. The big problem is to decide at the outset just how much the manufacturer can build and how much he will have to buy outside. From that moment on the subcontracting program begins. From a perusal of the historical record that our Armed Forces, in general, built up you can get a fair appraisal, I think, of the performance of many of the contractors and subcontractors.

Here is the final point I wanted to touch on, the machine tool problem. I touched on it a little in my opening remarks.

We know that during the war the demand for machine tools—and I assume it was all justified—simply exceeded our ability and capacity to produce. The machine tool industry, no matter how much it could expand, simply could not handle the volume of business. That was primarily the reason why some manufacturers waited for eighteen months, two years, or more, to get a special machine tool.

I remember in the Bureau of Ships' program for making cylinder liners for the big Diesels that we could not get a large honing machine. I think that, with all of the priorities and all of the directives that could be brought to bear, it took almost a year before the machine was finally installed. Of course, in the case of special machines, the situation is even more difficult.

What I am leading up to—going back to the first point I made—is that I believe a great deal more machinery will be unavailable next time than was the case in the late war. I think it was a very wise move to have earmarked, as I understand it, something like ninety-three thousand pieces of machines for JANMAT out of WAA store. The only trouble is I have heard from some of the people concerned with it that they started picking this machinery a little too late and the selection was not so good as it might have been.

I do not know whether JANMAT really has enough machinery earmarked to carry forward a program. Our only hope of initiating any program is to have as big a stock pile as possible of general-purpose machinery. With general-purpose machinery you can start any project very quickly, with simple tooling and good operators. Then, as you get a trickle of production, you can study the advanced methods and have machinery built that is capable of giving a higher rate of production. But unless we have a very good stock pile, a very good warehouse-load of essential machinery of all kinds, we will be up against it if we ever need production in a hurry.

(Discussion off the record.)

Gentlemen, I think I would like to stop at this point. I have covered all of the high-spots I wanted to cover. I am now open for questions, if you wish.

COLONEL CRANE: Are there any questions?

QUESTION: I have three questions, sir. These apply to what the College calls military motor transports, that is, vehicles primarily for military transportation as compared with combat.

You mentioned that the transfer type machinery could not be converted to anything else. If you wanted to make a truck, or jeep, or something like that, could you use those machines to build the engines for those, or does that stigma still apply? That is the first question.

The second: What percentage of the automobile industry produced military motor transports during the war? You mentioned about their producing ammunition, tanks, and various other things. I just wondered what was left.

And the third one--

COLONEL CRANE: Just a minute! Let's take these questions up one at a time.

Mr. GESCHELIN: Perhaps I should have made myself a little more specific. Of course, your question does require a little time to answer.

What I had in mind particularly was this (I should have defined it): The transfer machine is a unique type of machine which is adaptable only to the type of product for which it is originally designed. Not only type, but even size. For example, the fact that Buick has a cylinder-block line does not mean that the machinery at Buick can be adapted to make another type of engine or another size of engine.

On the other hand, that would be a problem for later consideration. You might be forced to develop an engine which had almost similar physical characteristics in order to utilize the machinery; it could be done.

But I was thinking beyond that. During the war all of the passenger car building facilities were converted to products that the industry had never built before; products that were entirely dissimilar. That is the thing I had in mind. They could not take a transfer line design

for making cylinder blocks or transmission cases and produce components, say, for a rifle or machine gun. That is what I had in mind, primarily.

The General Motors truck had no particular problem of conversion at all. Studebaker was a passenger-car builder, but they were building the Weasel and 25-ton trucks. They had no problem of conversion whatever. In fact, they never ripped out a single conveyer line.

Ford was in almost the same position. Ford had the jeep contracts; it had truck contracts. Ford really did not reconvert as much as some of the other manufacturers did. What Ford did was to put in new plant facilities. For instance, right now Ford has the building in which the Pratt & Whitney engines are being built. They went out to Willow Run and built a plant for making the B-24 airframe.

Buick, after the war was over, had to make a complete change-over. It was not a reconversion program but just like building up an entirely new establishment. It had no semblance of an engine plant or transmission plant left. Buick was operating the engine plant at Melrose Park but many parts for that plant were made in Flint. It built the transmission for the M-4 and also for the M-24 tank. So, you see, Buick had quite a sizable program.

I think it is very important to plan the mode of attack in advance. If you are going to have trucks in the program, by all means try to keep the people who have been building trucks from the time they started in business to continue building trucks for the military program. Don't go out and find some one in the country somewhere who saw a truck only on the farm and put him in the business of building trucks.

That is precisely what happened in some cases during the war. At the beginning of the war, the Navy decided that because of some of its bad experience--some of you will recall this--there would be no cast iron used in Navy construction. It seems there had been some cases of explosion where cast iron flew apart. So, because of this, the Navy decided there would be no more cast iron used. Immediately, many foundries, in anticipation of this business, reconverted to steel. By the time we got around to making engines out of cast iron, we had very little cast iron foundry capacity available.

Even in the case of the Arma steel program, Saginaw Malleable converted most of its malleable-iron facilities to steel. When the war was over, it had no demand for steel. In fact, the primary reason for converting to steel was because of the tank-tread parts it needed.

There was an awful lot of capacity lost because we had to shift from iron to steel; then we could not shift back again.

That is my answer to your first question.

COLONEL CRANE: There is one point I would like to interject here that illustrates what can be done and that was the development of the M-5 light tank from the M-3, which utilizes the Cadillac engine as it was produced in the commercial facilities. In other words, the M-5 tank used a twin Cadillac installation with very slight modification over its existing line--

MR. GESCHELIN (interposing): And with the hydromatic transmission.

COLONEL CRANE: Which, again, was a commercial item. So it is possible to do those things.

MR. GESCHELIN: When the Navy went to the LVT program, it took those same components as part of the LVT. So there is a good deal to that. But you have to do it in advance.

QUESTIONER: That answered my first and third questions. I still have the second, though.

I would like your estimate as to how much of the automotive industry was still building trucks, Weasels, and one thing or another in the transport line during the war. In other words, it was left still building automotive things.

MR. GESCHELIN: I could not honestly give you any percentages. My general impression would be that only a minor percentage of the industry was left operating on products with which it was familiar. I can almost catalog them. The truck manufacturers whose production was very small normally remained in the truck business, that is, Diamond T, Ford, Federal, Mack, White, and Studebaker. Then, of course, Willys was building the jeep. Ford was also building the jeep. That is about all. Chevrolet was building trucks; also GMC.

The people who were established in the truck business were building trucks. Nobody in the passenger-car business--don't forget that that is the major part of the employment--was building anything they had built before, with the exception of the fact that Chevrolet was still building some trucks. Ford still built jeeps and trucks. Studebaker was building some trucks. But manufacturers like Nash, Packard, the Chrysler Corporation units, except Dodge truck, which, of course, has separate facilities, all swung over to entirely different products.

The interesting thing is, if you read the historic record, look for the amount of war product that was built, rated in terms of dollars. It was terrific as compared with the peacetime production of any given

plant. But that was only by dollar volume. Actually, in the number of units, it didn't begin to approach the civilian production.

I have in mind a specific case to illustrate that, Delco-Remy. Delco-Remy did not have a single conveyer operating during the war. They did not have enough volume of anything to justify the operation of conveyers. Their conveyers were stopped. Yet the volume of business per product line for the plant was many times what they ever did during ordinary peacetime years. So there is a difference in productivity at the same time.

You had a third question.

QUESTIONER: You covered that in your first answer. Thank you.

QUESTION: Will you discuss the customary practice in the automotive industry of manufacturing spare parts for both current models and past models for which the current production is not interchangeable?

MR. GESCHELIN: Yes, sir.

In the first place, so far as current production is concerned, that is a relatively simple matter. All of the spare parts production is stolen from current production. Or, to put it better, you estimate how much you want and you simply add it to the number of parts you need for current production. That is an estimate. That is made by the Sales and Merchandising Departments. Then, as the parts are produced, they are taken right out of the manufacturing department, before they get to assembly, and shifted directly to the distribution department. That part of it is very simple.

So far as the older models are concerned, of course the problem is not so simple. In the first place, the manufacturer, in order to reduce the amount of things he must make of the old stuff, puts a ceiling as to how far back he will go. There are certain models for which no spare parts are ever available unless you cannibalize them from a junk dealer.

The average life right now of an automobile is about eight and a half years. That is a nation-wide average. So, principally because of the war, the manufacturers are going back further than they ever did. They will recognize perhaps a 1937 or 1938 car as being in the picture. Normally they won't go back that far.

To make spare parts for these cars they handle them in different ways, depending upon the size of the organization. There are some plants that have just a little department where they can set up some general-purpose

machinery and produce spare parts. In other cases--take General Motors, some of its parts divisions must accomodate a flow of spare parts in small volume for the benefit of the division that it supplies.

COLONEL CRANE: We have Mr. Fred Bahr, of Chrysler, coming down to give us a talk on spare parts later on in the course. I would like to lay off that and take some other questions.

QUESTION: I am interested in hearing your estimate of the length of time it would take for automotive companies like Nash or Buick, if they could get sufficient general-purpose machine tools out of the JANMAT program, to tool up and get converted to the production of, say, turbojet engines for aircraft.

MR. GESCHELIN: Well, how long has Allison been working on its experimental job?

QUESTIONER: It has been working for a long time.

MR. GESCHELIN: I was in Allison's place just about a month ago. It has put through some production changes there.

I wonder if you have enough equipment in JANMAT of the kind you want for jet production?

QUESTIONER: I don't know. But assuming you have.

MR. GESCHELIN: Judging by what I saw at Allison--I have never seen jet production except on this trip to Allison--I don't believe we have the necessary machinery in stock pile.

Allison has the J-33 and J-35 engines there. Assuming the design doesn't vary, we do not have machinery available of the type it needs--for example, for milling the compressor. I don't believe we have milling machines of that type because those are all special Cincinnati mills. Of course, they might have some other way to weld the turbine to the shaft.

Assuming you have the machinery in JANMAT, and assuming that the storekeeping will be handled more efficiently than it has been under WAA--let's assume very ideal conditions--then you must have a period, I would say, of three to four months to clear out the existing facilities. Then you have another period of three, four, or five months in which to install the new machinery. Don't forget; even if the machinery is available, the tooling isn't. You have the problem of tools and fixtures. During the past war so many tools and fixtures were required we didn't have enough facilities in the country to make them. Programs had to wait. That is why there was a system of directives and priorities to try to allocate according to the relative importance of a program.

So, I would say that if you can do that in a year you would be very fortunate. I think Allison has been working for more than a year, it is up to what it calls mass production. I think it amounts to five engines of each type per day, which is mass production in that industry.

But the fact still remains if you don't have general-purpose machinery, then you will never start the program at all. I don't see how you can.

QUESTION: Is it feasible to stockpile tools? Supposing you bring in a new tank, for instance. Is it feasible to stock up on so many sets of tools in case you should want them?

MR. GESCHELIN: I don't believe so. I would not speak for the Armed Forces but considering the fact that you have no way of knowing when an emergency begins, and considering the further fact that all design is in a state of flux, it certainly would not be good business to take anything we have today, for instance, and tool for it when you know in a period of two or three years your design has changed so radically there is nothing about it comparable to the original design.

That is why I do not think you can prepare too much on the actual, practical aspect. But you do have to prepare yourself in advance on the design as you go along.

The only answer to your question is, this JANMAT stock pile should be made sufficiently adequate. For instance, it took almost two years, or more, before Congress finally authorized JANMAT to get those tools. By that time a great deal of the really good stuff was frittered away, to people who really did not need it. The same thing is happening to plants. I just heard recently that in Buffalo, where Chevrolet built engines during the war, the WAA facilities were turned over to the Playboy corporation to make a three-wheel motor car.

QUESTION: Sir, are you acquainted with the reasons for the decision of the Ford Motor Company to eliminate a lot of its mechanized conveyers and use palletizing?

MR. GESCHELIN: I am thoroughly familiar with what Ford is doing. Let's put it that way.

Have you been up there, or are you speaking from what is in the literature?

QUESTIONER: There was a very vague reference to it in the newspapers.

MR. GESCHELIN: That is the difficulty. You see, the newspapers can't get the complete story.

There is no such thing as eliminating conveyers. You cannot get along without them. Today the materials-handling process, which you can consider an integration of a lot of things, is equally as important as any machine tool you can buy. Without the materials-handling device, advanced machinery is useless. The transfer machine is worthless if you don't have conveyerization.

In this connection I might point out Ford is not the only one using palletizing. Chevrolet and all the rest of them are doing it now. Palletizing is a means of organizing the shipment of materials from a supplier to the user; for storing the materials in the user's plant, and for distribution to the areas in which manufacturing will be done on those parts. It does not replace any of the conveyers.

Ford has replaced some of the monorail conveyers; but that does not mean it is doing without the conveyers. Instead of a monorail, it uses a series of belts. For example, its piston line is a completely automatic operation. It is in the form of a rectangle circumscribed by a power-driven belt line. Pistons used to come in on a monorail conveyer. A man would pick them off the conveyer and put them in the machine. It was discovered that picking up the pistons fatigued the man too much. Now that pistons are delivered on a belt all he does is pick them off the belt at the level of his waist.

It is just those little things that make the difference between a good operation and one that isn't. But palletizing is one of the most important devices in industry today. It is done primarily to organize shipping, handling, and storage. It does it beautifully, too.

QUESTION: I understand there is a great deal of research going on in connection with standard engines to bring about a high degree of interchangeability of parts. Do you know anything about that program?

MR. GESCHELIN: If there is such a program, it will be at the Ordnance Arsenal in Detroit. There isn't any in industry.

The nearest approach to that that I can tell you about is that among the builders of commercial engines--people like Waukesha, Hercules, Continental Motors--they have a very large degree of interchangeability in their own line of gasoline and Diesel engines. For instance, they have standard engines today that can be adapted to burn any fuel you want. They can be used as a carbureted engine or a Diesel.

Their engines can be used for burning natural gas. In converting from gasoline or natural gas to Diesel fuel, the major change is in the head. The Diesel head contains the special combustion chamber fuel injectors.

There is that much interchangeability.

QUESTION: With regard to utilizing machine tools, I heard it said during the war that there were no machines made in this country that were comparable with the Swiss jig borers, grinders, and so on. What is your opinion of that statement?

MR. GESCHELIN: I don't think that is true. It may have been true twenty-five years ago. I do not think it was true during the late war.

Now what actually happened was that during the period of normal commercial relations we were getting in considerable equipment from Europe. The Swiss jig borer is a very fine piece of equipment, and it is well known. But I am quite sure you can get jig borers from Pratt & Whitney and others that will do just as good a job. Pratt & Whitney has made it for a great many years.

I am not speaking now as a patriot, but I don't know of an instance in machinery, or anything that has to do with manufacturing, where we are not self-sufficient, or where we have to go outside of the USA in order to get them. I just do not know of a single case.

QUESTION: Could you comment on the effect of this constant process of mechanization (turning to automatic machines) on the supply of skilled labor? Their tendency is to talk their friends into becoming skilled technicians along the same lines they are. What would be the effect of that in case of mobilization?

MR. GESCHELIN: I will be very glad to discuss it. As a matter of fact, the original draft of this paper--which I have not followed at all--contained a comment on that. I deliberately avoided it because I did not know whether or not it was of interest.

But I think that with the increasing move to greater mechanization and automaticity of operations, the same thing is happening to manpower, that is happening to the machine itself. We have only a small reservoir of men who are familiar with, or who are interested in working in plants or have any training in plants. Certainly we have no glut of skilled workers.

Even during the late war we had a paucity of skilled workers. We could not get people for foundries. In certain Navy Districts, when

Selective Service would pull a key man out of a forge-shop, the Naval Inspector would go around the corner and pick him up, and put him back on his job. They simply could not replace them.

Another thing, the unions themselves have not only discouraged but have prevented any apprenticeships. They do not want apprentices because there are always more men available--that is, under normal conditions--than there are jobs. Very few of the manufacturers have re-established the apprentice-training courses they had. You remember many years ago the machine-tool builders always had apprentice training. So did some of the large manufacturers. Very little of that has been re-established.

I would say that that is definitely a serious problem: The fact at a given point in the future, we will have not only less and less men who have been exposed to manufacturing, but certainly a paucity of any trained people except those who work in the tool rooms. That is the only reservoir. That is definitely a problem.

COLONEL CRANE: Mr. Geschelin, our time is running out. On behalf of the College I want to thank you for a most interesting and instructive talk. Thank you very much.

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