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"The Machine Tool Industry"

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The industry embraces about 250 companies, but many of these are extremely small, and some of them only make an occasional machine tool, so that we may say that the distinctive machine tool building companies number about 150. Some of these companies are of course quite large employing as many as 5,000 men, but the average company represents an investment of about \$200,000 employing about 200 to 250 men.

The importance of the machine tool industry, then, does not lie so much in its size as in the critical value of the service that a good machine tool can render and its fundamental importance in a country so largely given over to mass production. Economists generally state that the machine tool industry's relative importance is equivalent to about ten or fifteen times the normal size of its sales because of the length of time that machine tools are in effective use in production.

Most machine tool companies are owner-managed. That is, they are owned by one man or a small group of men who have been brought up in the business, who have spent their lives in it, and are thoroughly familiar with the varied problems involved, whether it be in purchasing, sales, design, or management. Some of our plants are now being operated by the third and fourth generations of the founders' own families.

The sale of machine tools is handled either through machine tool dealers, who have established themselves for the purpose, or by direct selling. The machine tool dealer usually has the exclusive right for the sale of several different lines of non-competitive machine tools in the territory in which he is active. His salesmen are thoroughly familiar with the plants in that district, and usually have a shop or technical background so that they are in position to advise intelligently with their customers on manufacturing problems. An outstanding advantage to the machine tool industry of selling through dealers is the fact that a manufacturer can in this way take advantage of what you might call an existing sales organization without going to the trouble and expense of employing his own men and training them and sending them out into the field.

However, where there is a concentrated market, as there is in the City of Detroit, for most machine tool builders, a great many firms do employ their own salesmen and maintain their own direct selling offices. While these salesmen may not be as intimate with the customers in that territory in some cases, they have the off-setting advantage of being far more skilled in the construction and use of the particular machine on which they are specializing. They have only one line to sell.

Some companies use both methods of selling, depending on the nature of the particular territory under consideration.

The manufacture of machine tools is concentrated in the northeast section of the United States between the Mississippi River and the Atlantic Ocean, and for the most part north of the Ohio River. The industry started in New England in a very small way over a century ago. Skilled workmen from these New England plants drifted west and a group of them started in Cincinnati before the Civil War to found what is now one of the principal machine tool centers. Another large machine tool center is in Cleveland, and in the last half century a great number of outstanding companies have developed in Rockford, in Milwaukee, and in some of the smaller western cities. It is obvious that machine tool plants have been located near to sources of cast iron and steel and especially with reference to their consuming market. They started in New England because practically all of our metal-working was carried on at that time in New England, the rest of the country being agricultural. The machine tool industry has moved west as manufacture has spread. A great many of the plants are located in small communities where they have the advantage of being less likely to lose men to other manufacturers in the same line of work, but face a corresponding handicap when it is necessary to increase their working force, as trained men must be brought from other cities or developed in the machine tool builder's own shop.

Again referring to the extreme variation in the demand for machine tools, I draw your attention to the very difficult personnel problem that we face. The gradual development of higher speed and refinements in the accuracy of the work that machine tools do, make it more and more important to have available highly skilled mechanics in our shops. It is a tradition in our industry to develop these men from apprentices or so-called learners. Apprentices are youngsters with a grade school or high school background who are put through a definite, well-developed course, being shifted from department to department with a view to developing all-around men from whom we can select our demonstrators, our salesmen, our foremen, superintendents, and works managers. The learners are usually men of more mature years, who are trained to run some particular machine and who therefore become machine operators, or "specialists".

When business falls off sharply, the machine tool builder maintains, if he possibly can afford to do so, a nucleus of his older, more experienced, better-trained men, but it is sometimes difficult for him to retain the apprentices and learners who are in the process of training. After a recession, when our business improves, we find it very difficult to get back the men whom we have released. The training they have had makes them desirable

for a host of other activities, such as operating machine tools in metal working plants, repair of automobiles and trucks, and many other forms of industrial employment. The machine tool industry has trained a tremendous number of men for other industries. As you go through the great automobile plants, the refrigerator plants, and similar new industries, you will find a surprising number of executives, engineers and mechanics who got their training in the machine tool industry.

It is obvious, therefore, that one of the serious problems that we must face in connection with the possibility of a national emergency is how we can retain in this industry these men who are so essential to the manufacture of modern machine tools and who are so difficult to replace once they are lost. Our committee has suggested to our Procurement Planning Division that steps be taken to provide for a "service reserve" or an organization of a like nature which would take over all of the men in the machine tool industry on M-Day so that they will not rush off and enlist in the enthusiasm of the moment, to keep them on the job in machine tool plants until such time as the draft board can review each individual case and decide whether or not that individual is essential to the production of the machine tools that are needed.

We find that when a depression comes we feel it immediately in the orders for machine tools. Obviously few industrial executives have the courage to spend money on better equipment or additional equipment when sales are falling off day after day. Lowering the price does no good. He does not know how long the depression will last or how far it will go. He must conserve his resources to ensure that his company will survive. When the recovery comes, it is usually felt first in consumer goods and is then reflected in the plants of our customers, but the resumption of machine tool purchases lags until the improvement has been so well-defined and so long-sustained that companies are justified in

1. planning on increasing production,
2. the replacement of obsolete equipment, or
3. the development of new products to stimulate the market,

all of which are reflected in increased machine tool sales. It is, of course, possible to find executives here and there who are wise enough to realize that it is during a depression that they can best renovate their manufacturing equipment, but they are few and far between, and not sufficient to enable us to maintain our normal working force.

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THESE DEPRESSION PERIODS ARE THE IDEAL TIME FOR THE GOVERNMENT TO REPLACE A VERY SUBSTANTIAL NUMBER OF OBSOLETE TOOLS THAT ARE STILL IN USE IN GOVERNMENT ESTABLISHMENTS AND A VERY WISE PROVISION IN THE GOVERNMENT PLANNING PROGRAM WOULD BE A POLICY OF BRINGING GOVERNMENTAL ARSENALS AND YARDS INTO GOOD CONDITION AT A TIME WHEN GOVERNMENT BUYING WOULD NOT COMPETE WITH THAT OF PRIVATE INDUSTRY.

As to the nature of the machine tools themselves, they range from a small bench tool that could be readily set up on a desk to those which weigh as much as 40 or 50 tons and require a space as large as this room. In general they represent five basic arts of machining metals.

- (1) Milling, in which we would include the hobbing of gears, and which covers the machining of metal by means of a rotating tooth cutter;
- (2) Planing, shaping, and slotting, in which we machine the metal by means of a reciprocating tool, or by holding the tool stationary and reciprocating the work,
- (3) Turning, which is familiar to you in the form of the ordinary lathe and which is also exemplified in the many modified forms of lathes which are now in common use, such as turret lathes, automatic lathes, single spindle automatic screw machines, and multiple spindle bar and chucking machines;
- (4) Boring, drilling or honing, with either single or multiple spindle machines, and
- (5) Grinding (internal, external and surface grinding), and lapping

These rough classifications of course do not tell the whole story, as there are many subdivisions of these classifications and many refinements of method.

The life of a machine tool depends a great deal upon the accuracy of the work that must be done. You can readily conceive that a very fine, accurate, tool room lathe, that might be in use in a tool room for ten years, at the end of that time, in spite of occasional overhauling, is no longer sufficiently accurate for that work. It might, however, still be acceptable in the manufacturing departments where work need not be held to such close tolerances or produced with a very fine finish. After a few more years in the manufacturing department, it would still be an excellent machine tool for a garage mechanic whose occasional requirements are not exacting. In general, machine tools must be replaced because of the gradual wear that affects their accuracy and because of obsolescence.

Let me stress the importance of obsolescence. Our rapid development as an industrial nation, and the improvement in our standard of living, are largely due to our willingness to discard a tool as soon as we can find a better one, whether it is worn out or not. It is not economical to keep in operation an old style machine tool when a new tool offers faster production, a better finish, a higher degree of accuracy and perhaps greater safety to the operator as well. However, a study made by the "American Machinist" shows that 65% of the machine tools in use in this country were more than ten years old in 1935. That percentage has not been substantially changed since that time.

In general it may be said that any given design of machine tool will remain in standard approximately seven years. It is then rendered obsolete by the development of a newer and a better machine of that type. If, then, a production machine has been in use for more than seven years, it is a pretty safe statement that the time has come to consider its replacement. It is hardly necessary for me to point out that the average age of machine tools still in use in government establishments is higher than 7 years. This is the extremely serious problem that rests in your hands and for which some solution must be found unless we are deliberately to neglect a link of critical importance in the chain of national defense. Modern war involves, more and more, the products of the machine tool. There is a constant tendency to work to closer limits of accuracy. It is extremely difficult, if not entirely impossible, to secure the necessary accuracies in quantity production on machines that have been in use ten or fifteen years. In the first place, they were not built to manufacture to modern standards, and there has been a tremendous improvement in that regard in the last few years, in the second place, even if they were in operating condition, wear naturally affects the accuracy of their output.

Machine tool builders are constantly engaging in the process of research, development and invention. This process is retarded when we are extremely busy with customers' orders, and gets proportionately more attention when business falls off and the men are kept busy by working on the development of new machine tools and attachments. May I stress the fact that because of the extreme peaks and valleys in the orders that come to our industry it is essential that a machine tool builder should enter a depression with adequate cash reserve, accumulated during periods of good business, which must not only carry his organization through the depression, but must make it possible for him to engage in that process of development, research and design which will keep his machine in the forefront of the market. I need hardly add that the net marginal profit in our industry over a period of years has always been extremely limited.

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In general we seem to travel in about ten-year cycles. The first part of the cycle is the three-year rise from depression to what might be called a normal volume. There is then a period of about three years of good business, during which deliveries steadily get longer and machine tool builders accumulate a backing of unfilled orders. This is followed by a decline of about three years into the depression area, with very few new orders coming in, and one year at the bottom of the curve with practically no business at all. Three years of good business, therefore, must provide the strength which will carry the organization through seven years of business of small volume or no business at all.

The trend of development in the design and manufacture of machine tools has been toward the use of better materials, such as the modern alloy steels, and a development toward greater weight, because we have found that this tends to eliminate vibration, gives us longer tool life, and the possibility of more accurate work. There have been refinements in every part of the machine. Gear teeth today are usually cut from alloy steel, which is heat treated, and the teeth are then ground after heat treating to remove any distortion that might be caused by the heat treatment. The shaving of gears is now carried on to extremely close limits, and is a satisfactory alternative method of manufacturing them. Shafts that run at high speeds are supported by anti-friction bearings, and practically all of the moving parts of modern machine tools operate in a flood of filtered oil. A generous flow of coolant over the cutting tool prolongs its life and accuracy.

Recently there has been a decided trend toward the simplification of the outline of the machine, so that it can be kept clean more easily, to avoid sharp corners that cause trouble in the foundry, and also to enclose the moving parts to protect them against damage. Incidentally, we also protect the operator against injury and simplify his work. Electric drive, which was first applied to machines designed for operation by belt, has now become an integral part of the machine, and a great many refinements in the field of electric control have been developed in order to render the operation of the machine as nearly automatic and fool-proof as we possibly can.

In recent years there has been a marked development in hydraulically-operated machinery. This is by no means a solution of all our problems, but the hydraulic operation of certain machine parts has proven very satisfactory on certain types of equipment.

There has been a constant effort on the part of the machine tool builder toward the standardization of tools and

attachments, spindle noses, chucks and other parts, and this process is still going on. It is an economy for our customers, who do not have to carry so large a line of tooling and attachments in stock, but the process involves a great many difficulties and is a matter of development over a period of years.

In general, the development of machine tools has constantly made it easier for the operator to get good work and made it possible for the employer to use men of less skill in the operation of the machine, while securing greater production and a higher degree of accuracy. In other words, we build the skill into our machines, so that to that extent the machines in themselves have become more complex and more expensive to build. On the other hand, we have made it possible for operators without so long a period of training to produce accurate work in substantial quantity so as to make possible higher wages and shorter hours of work and better conditions of work. This is the great contribution that the machine tool industry has made to the progress of our country.

In general, the raw materials used by the machine tool builder are available in this country, with the possible exception of tungsten, which for the most part is still being imported from China. In regard to cutting tools, however, I should like to point out that although many American machine tool builders have spent a great deal of time and money in experiment, our industries are still not able to secure a uniformly satisfactory cemented tungsten carbide cutting tool, although the use of such tools has become standard in European shops. The price of these tools is still very high, and their application is still very limited. I suggest that this would be a valuable field for governmental investigation. If materially greater production is being secured abroad by the use of these new cutting metals, it is a matter of utmost importance to American industry that we should assure the same advantage.

One of the factors that you will wish to consider in your study in connection with the manufacture of the munitions needed in a national emergency is the transportation facilities for getting raw materials to our plants and the complete products to their ultimate destination.

The price of a machine tool does not change frequently or over a very wide range. The industry has always stood for a one-price policy. That is to say, the same price, without quantity discount and without concession to any customer. However, the largest single factor in the machine tool price is the cost of labor, not only in the machine tool builder's own plant, but the labor that is represented by the electrical equipment, the anti-friction bearings, the ground steel shafting, and the castings that the machine tool builder buys. When the labor market goes up, the price of the finished machine tool must go up as well.

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It has long been a tradition in the machine tool industry that we must keep our prices as low as it is possible to in order to widen our market and make it possible for us to manufacture in larger quantities. Consequently, our industry enjoys the doubtful distinction of furnishing the very means by which marvelous mechanical devices are created for our comfort and our daily use at an average profit on the invested capital scarcely equal to bank interest.

While there is no monopoly in the machine tool industry, the tendency in general is for each company to specialize on one type of machine and develop that to a high degree. In years past any machine tool builder would build any type of machine tool that the customer wanted to buy, but a company who tried to do that today would face in every division of its work the competition of a group of specialists which would make successful operation practically impossible.

Competition between machine tool builders is very keen, not only between builders of the same type of machine, but also because, on many parts, various types of machines can do the work, and it is a close question as to what method of manufacture can most economically be adopted. The purchaser's decision is almost invariably based on economy in operation of the machine tool, the accuracy to be secured, and the production that the machine tool will give. Price, as you see, is secondary in such a transaction. It should be secondary in government buying.

In an industry where a typical order calls for just one machine tool, it is obvious that if we ourselves are to secure economy in production, machines must be put through in quantities. Thus the machine tool builder will order a dozen sets of castings from the foundry and will plan to build a dozen machines of a certain size, although on his order book he has only orders for three or four of those machines. Still further to secure the advantages of quantity manufacture, certain parts are made interchangeable over a range of sizes. Thus, one hexstock may serve for lathes of various lengths, and may even be employed on two sizes of lathes. A hydraulic feed system might be employed on each of several sizes, or on several types of grinders, etc. Wherever possible, we manufacture small elements like gears, pins, shafts and levers in quantity and put them into stock. These small parts are then drawn out for manufacture into sub-assemblies, which again are put in stock. These in turn are drawn out for the main assembly as fast as the base or bed of the machine comes to the assembly floor. The very extensive use of gauges, jigs and fixtures in machine tool plants affords complete interchangeability of parts. Every operation is followed by inspection in order to detect errors at their source and to avoid further work on spoiled parts.

In some divisions of the industry special machines are developed for unusual needs by applying standard units or heads to a welded steel base. The use of welded steel eliminates the cost of the wooden pattern and makes possible great flexibility in the arrangement of the machine.

I should like to point out to you that under this system of manufacture the need of developing special machines or departures from normal commercial standards, or of meeting unusual specifications, seriously interferes with normal manufacturing processes. It means confusion in the engineering department, and the danger of misunderstanding and error in the shop and on the assembly floor. The manufacture of a special machine involves complicated production control and makes it much more difficult for our men to earn a wage incentive, because the job is unusual and slows up production.

IT IS THEREFORE IMPERATIVE THAT GOVERNMENT PLANS FOR AN EMERGENCY BE BASED SO FAR AS POSSIBLE ON USING MACHINES BUILT TO COMMERCIAL STANDARDS. WE WILL HAVE NO TIME TO PRODUCE SPECIAL MACHINE TOOLS IN AN EMERGENCY.

It will be evident from what I have told you that the machine tool industry is very adaptable and can do almost any job in iron, steel or non-ferrous metal for which the varied equipment in our plants can be used. A machine tool plant may be producing lathes today, but it could probably build hydraulic presses with the same equipment if it were necessary to do so. The same thing is true of our engineers, who through years of actual experience are resourceful in meeting new problems. However, in case of an emergency the demand for machine tools will be so great that it is of critical importance that machine tool builders should immediately concentrate on the production of the greatest possible number of the machines for which they have found a demand in industry, because we are going to need these machines in tremendous quantities and we cannot afford to divert the resources of the machine tool industry to the manufacture of munitions of war, or other products, if those can possibly be secured elsewhere.

It is hardly necessary for me to dwell on our working conditions, as you will understand that the kind of men who do accurate work naturally are orderly in their habits, and accuracy cannot be secured in a plant that is not kept clean and well lighted. In general, working conditions in our plants are excellent, and the men are of a very high type. The machine tool builder has always been proud of paying wages that would compare favorably with any other industry, and when business conditions are good we

have a low rate of turnover. The machine tool mechanic is not of a roving disposition. Many plants have fostered housing plans, and practically all the good workmen own their own homes and live in communities together and take a pride in good citizenship. They are men of a high native ability, and the training that they get in the building of machine tools develops qualities of thoroughness and accuracy.

It is only when a depression empties our shops of work that we have any problem in retaining these men.

We have been very slow as a nation in recognizing the need of changing our educational systems to meet the needs of an industrial nation. Our high schools are still fitting boys and girls for college, although few of them can go there. Our colleges are producing too many students who have a general cultural background which is of little use to them in establishing themselves, and we are overproducing such professions as law, while our factories are in need of men with mechanical training. Better facilities for manual training are needed, as industry is not primarily equipped to carry on this work and many small plants either do not attempt it or do it very badly.

The market for our machine tools is normally 75% to the domestic customer, 25% to foreign nations. Since the end of 1936, because of vast armament programs abroad, this ratio seems to have changed, and at the present time about half of our business is from our own country and half of it from abroad. If you will refer to the index of machine tool orders you will note that the shaded portion of the vertical bars represents domestic business, while the upper portion of each bar represents the business from abroad for that month. You will note that the proportion has remained relatively unchanged for about eighteen months.

In foreign markets the American machine tool builder meets with very intense competition, notably in England and in Germany. Both British and German machine tool builders have copied American designs and taken advantage of developments of the American industry, and in some types of machine tools they are making machines of very creditable quality. It can be stated almost without qualification that the price of the American machine tool is always higher than that of its German competitor, sometimes twice as much, and this has resulted in very serious competition in Russia and in England. That the American machine tool has retained its ascendancy in these foreign markets is a very high tribute to the skill of the American designers, the willingness of the machine tool builder constantly to keep his products in the forefront of development, and the quality of material and the workmanship that are used.

The Russian government has built up a large machine tool industry of its own, building copies of American models for its own plants. This has greatly reduced the Russian market for American machine tools, but we have not as yet met Russian machine tools in competition in other countries, as Russia has never been able to make all that she needed for her own requirements.

The Japanese government has made strenuous efforts to establish a large machine tool industry in Japan. Some Japanese machine tools have been exported, but they are not made with good material and the workmanship is of an extremely low order. If Japan's campaign in China gives her access to better ore and a better supply of coal, we may some day find ourselves facing extremely serious competition from Japanese sources, but her chief difficulty at the present time is the lack of competent engineers to design and to superintend the manufacture of machine tools.

Referring to the domestic market, we find that for many years the most important single customer we have is the automotive industry. In combination with the manufacturers of accessories and equipment, who make parts and furnish material to the automotive industry, it would be conservative to say that one-third of the machine tool business of our country normally is devoted to this field. To the manufacturers of motor vehicles and trucks themselves would go about 25% of our output. The next largest single field is the machine tool manufacturer himself, as we not only recommend to our customers that it is a profitable measure to modernize their shops and to use up-to-date tools, but we practice that policy ourselves in the management of our own affairs. Manufacturers of agricultural implements, tractors and road machinery absorb about 4-3/4% of our output, and the manufacturers of industrial electric equipment come next with about 4-1/2%. Our remaining customers in the order of their importance to us and the percentage of our output that they take, would be as follows, in round numbers.

Steel mills and forge shops	3%
Railroad Equipment	2-1/2%
Construction Mining & Oil Well Equipment	2-1/4%
Domestic Electric Appliances	2%
Aircraft Manufacture	1-1/2%
Office Equipment	1-1/4%
Textile machinery and parts	1%

The figures I am using are for the complete year of 1937. For the first half of 1938 the order of these industries would have to be changed. While the automobile field remains our best customer,

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at 15%, the machine tool builder himself has slipped into second place at 7%, with Government purchases (Federal, state, and municipal) into third place with 4-1/4%. The aircraft industry is buying more in proportion than it has before, and is now in 4th place with 4%. You will recognize the fact that all of the industries who are normally our best customers are those very industries to whom you would turn in time of national emergency for greatly increased output, and we will at that time therefore face the difficult problem of not only furnishing a tremendously increased volume of machine tools to government establishments, but also to these industries. From the point of view of national defense, it therefore becomes of extreme importance to keep our Government plants and arsenals and our large industrial plants in a high state of efficiency in order that the demand that must be suddenly met in time of national emergency shall not be so great as completely to swamp the machine tool industry.

It is hardly necessary for us to point out that the situation in the railroad industry is particularly unfortunate. Railroads buy about 1% of our output. The "American Machinist" survey shows that the railroad repair shop has the highest percentage of obsolete equipment. In an emergency they would be called upon to take up a tremendous load immediately, in the transportation of men and materials. As they are equipped today, they could not begin to cope with the transportation problems that will develop. This is an extremely serious bottle-neck in our national picture, because if locomotives and cars are not available in sufficient quantity and in reasonably good repair to furnish transportation, the material that is turned out by industry will not be of any value.

The situation as regards our merchant marine is even more serious, and is undoubtedly giving our Navy deep concern. The condition of shipyards may be guessed from the fact that for several years their portion of our output has ranged from 3/4 of 1% to 1/10 of 1% - and the trend has been steadily downward.

You may be interested to have me tell you briefly about the work of the National Machine Tool Builders' Association. This organization has 134 members who produce about 85% of the machine tools built in the United States. There are a few concerns, most of which build machine tools as a sideline or occasionally, who do not belong to this Association. The work of the Association is to keep the membership informed on market conditions, to bring them useful information in the field of production and sales, and through its committees to study and report on the various problems that the industry must face from time to time. Two meetings each year afford opportunity to discuss these matters quite thoroughly. At intervals of about four or five years

we have a machine tool show, and this has developed into a very important part of our work. Executives from metal-working plants from all parts of the world come there to study the developments in our machine tools. During the NRA regime the Association office carried on the necessary work smoothly and effectively.

Through our "Committee on Cooperation with Government Departments" this Association has been in touch with the Procurement Planning Division of the Munitions Board. We had a two-day meeting with their officers in January, 1938, and visited the Springfield Arsenal in June of this year.

We have cooperated with the Procurement Planning Division in the preparation of a complete nomenclature list, which is a list of all of the types and sizes of machine tools on the American market today, and have also made a survey of the capacity of machine tool plants insofar as this rather elastic term can be definitely defined and established, so that in case of emergency there is on file here in Washington information that will permit the Procurement Planning Division to distribute the load, so far as machine tool production is concerned, and avoid delay in the manufacture of machine tools that will prove so important a part of our defense. It is our hope that the entire capacity of a machine tool builder's plant will not be absorbed by the direct needs of Government, so as to leave a substantial portion of his capacity for the rapidly increased needs of industry.

Out of this conference certain points seem to be clearly established. The first is that machine tool builders should not engage in the manufacture of munitions but should confine themselves to the manufacture of standard machine tools.

Second, that some arrangement should be made so that on M-Day every machine tool builder without delay will proceed with the manufacture of as large as possible a quantity of the machines which he has just been building for the industrial market, with the assurance that they will be taken off his hands and allotted where most needed by the Munitions Board.

Third, that single purpose machines required for the manufacture of munitions should be designed by machine tool builders in time of peace, the Government paying for all the necessary drawings, jigs, and fixtures, and aids to manufacture, and that these machines could then be built in substantial quantities, not in machine tool plants, but in plants with similar equipment, when the emergency arises. If these special machines are not developed in time of peace we will not be able to do it when the emergency comes, because of the time required to design,

develop, and build the first machine, to say nothing of producing them in quantities.

No doubt priorities will be arranged for the purchased materials that are necessary to keep the machine tool builder going. Electric motors and anti-friction bearings present serious problems, as deliveries on these sometimes get extended when business conditions are good.

A survey of our companies indicates that probably 10% of our employees are between the ages of 21 and 30, are in good physical condition and unmarried, and would therefore be eligible for draft. I have already spoken of our hope that a definite arrangement can be made to set these men aside in a "service reserve" so that they would stay at work in machine tool plants until the draft board has an opportunity to review the status of each man.

A serious problem is the old machines of very large size in use in Government arsenals and yards. Some of these are of types that are not sold to the individual consumer today. Gun boring lathes, large rifling machines, the huge boring mills for turning battleship turrets, are not machines of commercial type. Furthermore, because of their size it is a difficult thing to design, build, and test and ship a machine of such size in less than 18 to 24 months. It seems obvious that these extremely large machines must be purchased in time of peace. THERE ARE VERY FEW COMPANIES WHO WILL UNDERTAKE THE MANUFACTURE OF THESE MACHINES, AND IT THEREFORE BECOMES AN ITEM OF CRITICAL IMPORTANCE IN OUR PROGRAM TO SEE THAT THESE MACHINES ARE INSTALLED BEFORE THE EMERGENCY ARISES.

We are very glad that the War Department has been authorized to place educational orders for the manufacture of munitions. Under each of these orders it should be possible to develop the proper method of manufacturing that particular item in quantities in time of war. The amount of munitions actually produced under those educational orders is not a matter of interest to us, but the development of the very best possible methods of manufacture is of great importance. We believe that the equipment selected for the educational order program should not be intended merely to manufacture the quantity of munitions covered by the program, but should be adapted to the manufacture of large quantities such as are needed in time of war, and by the use of women operators insofar as that is possible, because we are going to have a tremendous shortage of skilled mechanics and machine tool operators during the emergency.

It seems to us that the greatest needs may be summarized as follows:

1. Big machines for guns, gun mounts, mortars, etc.
2. Special equipment for the manufacture of gun sights
3. Single purpose, simple machines for the manufacture of shell
4. Special rifling and barrel drilling machines, for the manufacture of rifles
5. A tremendous number of gauges for all of the operations involved in the manufacture of munitions.

Even a superficial check of the situation reveals that when you compare the munitions that will be required and the capacity of the machine tool builders to produce machine tools, when you consider on the one hand the tremendous number of obsolete machines that are still in use in Government plants and on the other hand the length of time it will take to replace them, it seems quite clear that we must begin by making a study of the munitions that will be needed and the machines that will be required for their production in large quantities. It is evident that there will be a limited supply of skilled labor and we must therefore bear in mind the necessity for simple, single operation machines for this work. We have therefore suggested that a board of machine tool engineers should be set up as soon as possible to review these requirements in detail; such men to be furnished by the machine tool builders. These men will study each item of munitions and establish the best methods of manufacture under war conditions.

I have mentioned the fact that in June we visited the Springfield Armory at Springfield, Massachusetts. Our committee there had an opportunity of inspecting the new automatic rifle, and went through all of the departments of the armory. We were very much impressed by the splendid work that has been done by the staff, not only in developing an extremely satisfactory weapon, but also by the manner in which they have tackled the difficult job of properly tooling up for the manufacture of the rifle.

Old buildings have been cleaned up, the floors replaced, the walls and ceilings painted, and the departments put in first class modern manufacturing shape. One by one old machines have been replaced by new machines, although of course a great deal still remains to be done.

The procedure followed after the weapon had been tested and approved was to consult engineers from the machine tool industry, and their sales representatives as to the methods of manufacture that they recommended for each part of the rifle.

These methods were appraised by the officers and a certain procedure or sequence of operations was then decided upon. Based on this sequence inquiries were then sent out for bids on the necessary units required to manufacture the rifle in the quantities that will be needed.

We sincerely hope that the results secured in the Springfield Armory in tooling up for the new automatic rifle will inspire the Government to proceed with the same modernization of other plants so that we may lose the accumulated obsolescence of years, and put each of them on a reasonably modern manufacturing basis.

In conclusion, may I say again that it would be planning of a very enlightened kind if the government were to engage in an extensive program of replacing obsolete machine tools during business depressions. The money so expended will help to keep intact the highly trained personnel in machine tool plants and the wages paid will be spent by our workers and those engaged in steel mills and foundries for consumer goods. There would be ample time to give proper attention to each project in our engineering departments. If, then, an emergency should come, we could face it properly equipped and without waste or confusion. In this most important work we pledge you our loyal cooperation.

Discussion

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Mr Howard W Dunbar

"The Machine Tool Industry"

September 29, 1938

Mr Tell Berna I hope Colonel Miles doesn't go any further into my earlier years I'd like to say a few words about these graphs This one is sent out at monthly intervals to machine tool builders so that they will know the trends in the industry This curve (pointing to graph) is an averaged curve, in other words, we'll take the index for January, February and March, average them, and plot the average for the middle month, February That gets us away from the extreme variations from month to month, and gives us a curve that is easier to read This one shows actual monthly sales

You will note that when business falls off, the tendency of the machine tool market is to go off very rapidly There are, in any large industrial project that may be under way during these years of growth, hangovers that must be bought in order to round out the project, and there are still some machines to buy, but every force tends to push the sale of machine tools further down

In the first place, there is need -- the need that Mr Dunbar spoke of -- for the customer to conserve every bit of cash he has He must protect his own company There is the possibility that his business may fall off, and that the machine tool builder may develop a better type of machine tool So, for many reasons there is an extremely steep falling-off

Right in this valley here (graph) we face the other problem that Mr Dunbar spoke of, we have to keep these men -- the whole backbone of the machine tool industry is the trained mechanics, you can't develop them over night You must find those men who have the qualities of accuracy, persistence and industry, who will stand by you and acquire the very nice manual skill and the degree of judgment it takes to build machine tools of this sort

If you will go over to this curve here (graph) you will note that we have here a blue line, that is a curve prepared by the Federal Reserve Bank of New York City of producer goods sales, that is an index curve to such things as steel, locomotives, etc , That gives you an accurate picture of the orders for that type of material Now you will note that producer's goods, while they fluctuate, do not fluctuate as violently as our curve does

There is a red line with white dots, this is a line of consumer goods The consumer goods line does not vary as much as the other two, because no matter how much business falls off, people do still eat and they still buy clothing, although not in as large quantities as they did when business was better As soon as one of these curves falls off, the others do so too

Producer goods sales fall off for the same reason as consumer goods, but fall off further, for while the man who is making a suit of clothes must buy cloth, as long as there is any business, he won't buy a new sewing machine until he reaches the point where he feels there is a definite sustained upward trend that will carry him through

That is why the machine tool builder's problem is so much more serious than the problem of industry engaged in some other fields When the National Government distributes money by PWA projects or in similar ways in order to stimulate consumer buying, you do get an immediate effect in the sale of consumer goods They all go to the store and buy the things that they must have When it comes to producer goods and machine tools, that is a different story The man who is making suits of clothes may need sewing machines, but he has to plan for a long period ahead He doesn't know how long this peak in consumer buying will last

Between the expenditure of Government funds and the purchase of productive equipment by industry, there is interposed a human judgment, and if the people who run industry are frightened, if they are uncertain as to the

future, no power on earth will induce them to buy new productive equipment or expand their plants. They just won't do it, and that is why this vast indefinite thing that we call fear is just as real a factor in industry as the cast iron we put into our machine tools.

I would be very happy to deal with any questions.

Q - What effect does the turn-over of second-hand machinery have on long-term production of machine tools? We know that in the automobile industry it doesn't make any difference how good the times are, the second-hand car gets turned in.

(Mr. Dunbar) A - The second-hand machine tool has a very definite place in our picture. It is sometimes viewed as a serious one and on the other hand, it is sometimes a God-send to us. I think that the general performance in the history of the use of the second-hand machine industry parallels pretty well the history of the automobile.

The average of the whole life of an automobile is placed by the automobile statisticians at about nine years, and it has about three owners. In that period of nine years three different people own it. One of the most serious things in the automotive industry today is the fact that this three-step process of carrying the automobile from the production line to the junk yard has been stretched out to a point where now about two individuals are using the automobile. In other words, the original owner is using it for a longer period of time, and that cuts down the sale of new cars, and the second owner wears it out.

In the machine tool field, of course, that is also true. A machine tool has to produce certain quantities, live up to certain requirements, usually requirements of accuracy or of production. The older the tool gets the less accurate it gets, the less accurate it becomes, the less useful it becomes in certain lines of endeavor.

On the other hand, where production isn't a factor, accuracy, in a measure may be extended by the rebuilding of the tool and a great many machine tool builders actually do rebuild used tools. We have the problem of trade-ins and we can convert those into useful tools for another period of time by rebuilding them in our own plant and oftentimes can send them out with a "factory new" guarantee. We find there are more sold into foreign markets than domestic, although there are still a great many uses for second-hand tools in the domestic market, in places where accuracy or production are not such important factors. Where the use of the tool is intermittent -- as in garages where repair work is done, and so on -- we find them very useful.

It might be interesting to know that the first machine that my company ever built is still in operation. It happens to be in the Ford Museum in Detroit, but it's still in operation. Does that satisfactorily answer your question?

Q - Sir, you spoke of the stability of your labor. I would like to inquire as to their reaction toward the C I O and other similar organizations.

(Mr. Dunbar) A - Our industry has probably been as free from labor problems as any industry in the United States. We attribute that to the fact that our men are of the skilled type, of the higher, more intelligent type. The fact is that in our industry we recognize the importance of our labor, that we do not slight them, that we pay them just as high wages as it is possible to pay. In fact, our average is very very high (it's no secret) the average in my own plant is 92 6 per cent an hour. That does not include any department head or executive or foreman, that is just the mechanic employed in the production of our machines. That is quite a substantial wage even on the forty-hour-week basis, and that is only indicative of all the other plants in our industry.

Of course, different sections of the country have different levels of wages, because they have different levels of costs of living, but I think that

the fact that we have always operated our individual plants as a sort of family affair in which the employees were just as important to the plant as the owners of the plant is responsible for our freedom from these problems I think this could be pretty well said of the entire industry, the men don't wish to organize There have been very few plants that have a union though there are some, it is true, and those few have had their problems brought home to them largely because they were in a community where other types of industry have brought up the question Where a community gets in the throes of that trouble, it can spread even to a plant that is in good shape

Q - You spoke of this machine built for Russia We all know that the Russian government is in the manufacturing business Now when they ask for the type of machine that was built do they furnish you with the specifications for the machine that they want, or do they supply you with the needs of the machine? When you furnish them the machine do you sell them design rights plus specifications?

(Mr Dunbar) A - I can answer for myself, and I think that I am in the same position the rest of the industry would be in That machine of which I spoke would best illustrate the answer to your question

There was no such machine We had to create it They trusted us to create it They told us their needs, and we created the machine They reserved the right, of course, to reject it on their inspection

The other part of your question may be answered by saying that they have nothing but the machine, and we have the money, we had it before the machine left our plant A very strenuous effort was made to bring to our plant members of the various government service departments, and happily, we did have two or three who got over to see the machine before it was shipped We thought our Army and Navy departments ought to know about it I think it is something they will want to have some day

It might also be of interest to know that when the inspectors arrived to inspect the machine, contrary to their usual procedure they waived about half of the inspection, because this performance of which I spoke was so impressive that they said "everything must be all right if the machine will do that"

Q - Mr Dunbar, I recently heard a purchasing agent make a statement to the effect that he went to the machine tool market at this time to secure a number of precision lathes, and that the deliveries were virtually out of the question for a quantity order of or over a hundred or a hundred and fifty Would you care to discuss that?

(Mr Dunbar-) A - I can discuss it and then I think I will ask Mr Berna to comment on it a bit because he has the broad contact with all the lathe builders

But again using myself as an example, you could order from us today a quantity of grinding machines that we couldn't deliver to you in less than twelve months That is one of the things we are trying to stress here, that the war is going to be over before you gentlemen get some of the machine tools you need to fight the war with They just can't be produced The average time for building a grinding machine, from the paper order to the shipping platform, is three and one-half months in our plant This covers all types of machines This machine of which I have just spoken was taken on a ten-months delivery and we were late about six weeks, but that was largely due to the fact that they didn't supply us with a lot of the electrical equipment

We are at the mercy of other things that we must have to build our machine tools and motors seem to be the most difficult things to buy and get in any reasonable length of time Why that is, the Lord only knows, I don't Because it does seem that motors ought to be turned out on a quantity basis, and they ought to get faster production than we do when you compare a motor to a grinding machine that weighs 200,000 pounds We hung our hat on this ten-months

delivery because we didn't believe they'd get the electrical equipment there In this case motors were available quickly enough but the control apparatus had to be designed for the machine, and the control apparatus would occupy half of the area of this platform clear to the ceiling The thing almost had to talk

Mr Berna I'd like to meet Colonel Jones' purchasing agent friend We'd take that order Relatively small machines are turned out in considerable quantities Probably it would require about sixty days to complete that quantity

If you wanted them all of one make, that would make it a little more difficult

But when you get into the machines that are not standardized, it begins to approach what Mr Dunbar has on his hands The other day one of our members showed me a rifling machine for the United States Navy I don't want to exaggerate, but it looked like the father of all machines It was about 200 feet long, and naturally a thing of that sort requires first, that you sit down at your drawing board, design it, and get these enormous patterns made The big castings must be given time to cool, then you have a relatively limited number of planers on which these enormous pieces can be handled Delay, delay, delay

We can't replace those big machine tools in a hurry even with the best will in the world They don't exist in industry, if you do find a big lathe here and there you will very likely find it in a steel mill and they have got to have it Those big tools represent a problem that should be tackled immediately We can't do much about it after the emergency comes

Q - Mr Dunbar, you stated that about fifty per cent of your orders were now coming from foreign sources and that you had considerable competition Yesterday we were discussing the gold standard and I notice that your curve rises beginning along in 1933 and 1934 If we had not gone off the gold standard as we did would competition have been more difficult for you or would there have been no change?

(Mr Dunbar) A - I don't think it would have had any effect The fact that our dollar is 59 cents, or whatever it is, doesn't touch us We used to say that everything was "as sound as a dollar", but you haven't heard that for about six years now They went off the gold standard in England back in the thirties I happened to be there when it happened

The great problem in competition with makers of English tools and German tools is the fact that, as I have said, one-third of the cost of a machine is labor Their labor is about (on an average) one shilling six In other words they pay around 35 or 40 cents per hour That is the average compared with what I told you about my plant We make up for that, in a measure, because our labor is very much more productive than the labor in English shops We make up for it in a measure, but we can't close the gap entirely

Then we have the problem of duty We have to pay duty on all types of machine tools that are sent to England We can get exemption on some types that are not made there, that is not known when we take the order, that has to be met when the machine arrives in England We gamble, and our representative in England gambles on it

Again, the overhead expense in their plants is lower than the overhead in our plants, they don't do the same amount of development work we do Their engineering operations are not as costly Let me give you a very good illustration of conditions as of today and conditions a few years ago In June I was over in England with a line of my machines in a little show An exact duplicate of one of our machines was compared with a Churchill machine made in England That is a very good machine Our price was 51 per cent higher, equipped the same as ours In 1934 when I was over there that percentage was slightly lower, it was about 42 per cent Our increased ratio today as compared with 1934 is due, I think, entirely to the increased wage rate in the United States, and the lower number of hours of operation, because say what you will, you don't get as

much production in 40 hours per week as you do in a 48-hour week. Your "stop losses" are just as much -- you stop and start a shop in the same length of time on 40 hours as on 48. If that represents three-quarters of an hour per week you have three-quarters of an hour as to 40 hours, or as to 48 hours.

Those factors are all involved. I don't think the influence of the gold standard is any more than a mere incident in the problem. That is my own personal opinion.

Q - Mr. Dunbar, to what extent do you think that these so-called educational orders will be truly educational, that is, will that industrial concern that turns out these small quantity orders be required to use general purpose machines?

A - I am very hopeful that the educational orders will be strictly what they are intended to be. There is just a little feeling on the part of the machine tool industry that there may be some slip. But the evidence that we have up to date -- if Springfield Armory is any criterion is that they are truly intending to make them "educational orders" and that the proper equipment will be selected for the educational run, although that may be one-tenth or one-twentieth of the production that is expected. The work will be run on types of machines and the kind of tools that would be necessary on the production that you are going to require in time of emergency. We yet have that to realize, but the indications are that this idea is being carried out, and we hope that nobody slips to prevent it.

Of course, limited funds are the thing that would prevent it. Because you may have to buy a lot of special equipment and special machines, or machines especially adapted to that particular class of work, and if you don't have the necessary appropriations to carry it out, then the educational orders may not become educational orders. Now we are waiting to be educated ourselves in whether the department will actually carry out this proposed plan of educational orders.

Col Miles - Do any of our guests care to ask a question?

Q - Colonel Rutherford - I am sorry I didn't get down to hear all of Mr Dunbar's talk It certainly was most interesting I think we probably all appreciate that an army of a certain size is established There are only two sources from which the supplies for that army can come -- one, war reserves, and the other new products of which in our present state, the supply that can be produced is problematic When we begin to speak of new products, the machine tools enter the picture very strongly

The more mechanized our army becomes, the more that problem comes to the fore

Mr Dunbar was probably too modest to tell you that the National Machine Tool Builders' Association have done some wonderful work in connection with finding out the capacity of the industry to produce machine tools It has been a very serious problem with us for years and we are getting the thing rounded up pretty well The National Machine Tool Builders' Association undertook the problem of finding what the capacity of the industry was and they have just about finished that job in a one hundred per cent manner I'd like to mention that this is a fine example of the support that we are receiving from industry in this problem of ours, and I'd like to thank Mr Dunbar and Mr Berna personally at this time for the fine work they have done in this connection

Col Miles - Well, in closing this meeting I certainly want to thank Mr Dunbar and Mr Berna for giving us this time It is not only a contribution to national defense but I hope it will have a reflection in their own direction which will be beneficial The question of machine tools is such a vital one that we must give it the consideration which it deserves, otherwise we are going to bog down in our national defense preparations in such a way that we won't get any where and that was thoroughly illustrated in 1917 and 1918

If we need any further evidence we just have to listen to the practical advice of men like Mr. Dunbar and Mr Berna Thank you very much