MASS PRODUCTION

Some Factors Affecting Its Achievement

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WAR in Europe has created a tremendous demand for military and training aircraft, a demand so great that aeroplane factories the world over are busy striving to satisfy it. To increase production is the immediate concern of the whole industry. This concern, however, is not limited to the aircraft companies. So pressing is the need, that aeroplane production has become a matter of national interest and national urgency for neutral and belligerent countries alike. The drive for production is such as the industry never before experienced; yet the accomplishment falls far short of the demand and the output of aeroplane factories the world over is comparatively small. National production figures for aeroplanes would undoubtedly substantiate this last statement. It is difficult, however, to obtain actual figures, especially those for the belligerent nations. However, experts have prepared estimates of probable outputs. Thus T. P. Wright (Reference 1) places the output of military aeroplanes in 1939 at about 22,000 for Germany, 3,600 for the United States, 7,600 for Great Britain, 4,100 for France, or, say, 12,000 for the Allies[1] (including purchases from the United States). Another estimate (Reference 2) of the total number of aeroplanes (all types) produced during the same period, gives 4,775 for the United States, 17,475 for Great Britain, 5,550 for France, 22,550 for Germany, 5,450 for Italy and 9,410 for Russia. That mass production has not hit the aircraft industry is very apparent.

That mass production methods can be applied at will to aeroplane manufacture has been accepted without question by the general public. A production engineer can put anything on a mass production basis, they say, whether it is aeroplanes or baby carriages; it is assumed that there is a close parallel between the automobile and aeroplane industries.

If these statements are true, why then is not the industry on a mass production basis now? Why does aeroplane manufacture lag so far behind automobile production? Three million automobiles were produced last year in the United States in the time it took to turn out five thousand aeroplanes there. Mr. Wright's figures for 1941 show that he does not expect the gap between cars and 'planes to close in the near future, no matter how great the demand. Thus, if the popular conception of the ready applicability of mass production methods to aeroplanes is correct, governments and the public are entitled to an explanation of the delay.

The delay is due to no negligence on the part of the aeroplane manufacturers. Some mass production features have been introduced into the industry. But before the full range of manufacturing technique which transforms quantity production into mass production can be introduced successfully, certain fundamental factors which govern the production *en masse* of all commodities must obtain in the aeroplane industry.

Factors Governing Mass Production, and Examples

Mass production may be defined as the rapid manufacturing of a commodity in large quantities at a decreasing cost per unit produced (within reason). Before mass production techniques can be introduced successfully in an industry, the following factors must govern:

1. Tooling for mass production must be undertaken when the market for the commodity is expanding rapidly.
2. The commodity must be designed for cost and production.
3. The basic design of the commodity must be stabilised.

The automobile and railway freight car are excellent examples of mass-produced commodities and of the operation of the factors listed above.

Some thirty or forty years ago, when the railways were building, there was a growing demand for freight cars, and at that time tooling for mass production was undertaken. A production order for freight cars in those days averaged about 10,000 units, to be completed in a year's time. Similarly, when the demand for automobiles was growing, the motor car companies introduced mass production methods and tools, with the result that from 10,000 to 20,000 units of a single model could be turned out annually. In all industries, once the change is made and the cost of it absorbed, production remains on that basis, even though the demand no longer provides work to plant capacity.

Twenty or thirty years ago, when mass production methods were introduced in the automobile and freight car industries, the design of these two commodities was primarily for cost and production. Design for performance, design for beauty, design for comfort, design for any other specific requirement was given but secondary consideration. Until the emphasis was placed on cost and production, mass production in the two industries was unknown. To elaborate this point—one important step in the design for production is the reduction to a minimum of the number of separate and different parts of the commodity. Comparison of the early automobiles and those of to-day show what has been accomplished along this line. The first motor car bodies were assembled from many different frames, angles, brackets and built-up panels. The modern automobile body is made from four steel pressings. Even though the scope of the automobile has increased, the separate parts of a modern car number only between 500 and 2,000.

When the engineering approach to the problem of the design of a commodity is crystallised, the basic design of the commodity remains stable and unchanging. Stabilised basic design does not imply, however, a similarity of detail design, materials or methods of construction throughout the industry or down the years. These matters must keep abreast of the times, taking advantage of increased engineering skill, new materials developed and new manufacturing processes evolved, even though the fundamental pattern of the commodity to which they are applied remains unchanged. Only when basic design is stagnant can the production engineer function effectively. The basic patterns of the automobile and the freight car were stabilised over twenty-five years ago. Since that time there has been no fundamental change in the design of these two commodities, and this has enabled the production engineer in these two industries to solve his problems with some degree of finality.

Having established the factors governing the successful introduction of mass production methods, we will use them as a yardstick to gauge the feasibility of the mass production of aeroplanes. If these factors obtain now in the industry, we might consider it an indication that mass production of aeroplanes was just around the corner.

Aeroplane Orders and the Expanding Market

That the aeroplane market is undergoing a period of rapid expansion at this time is very apparent. Thus it is astonishing to learn that purchasing orders and production orders are rather limited. Mr. Wright, in his analysis, assumes the average production order for an all-metal aeroplane of modern type to be 400 in the United States, 800 in Germany. Another investigator places the English figure at 1,000. Such production orders result from limited purchasing orders, and that the latter should be restricted appears extraordinary in these times. The paradox of

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[1] He estimates that in 1941 the Allies will catch up with German production (which is still growing) and each will produce about 40,000 aeroplanes annually—providing that bombing of aeroplane factories does not occur.