

Abstract

This report describes a research assignment done on what's written about designing mixed-model assembly lines.

First the general context is explained by looking at how assembly evolved throughout history. This goes back to about a century ago, when Henry Ford started the first mass production assembly line in 1913. Since then, customers started asking for products that were more customized to their specific needs. That's how the world of production shifted from single-model mass production lines to mass customized mixed-model assembly lines where complete product families can be assembled in any one-piece sequence, according to short term sales forecasts.

After that the basic terms and definitions are given. An assembly line consists of a finite set of work elements or tasks usually arranged along a conveyor belt or a similar mechanical material handling equipment, and each having an operation processing time and a set of precedence relations, which specify the sequence in which the product has to be assembled. This can be done in many variations, which are best classified by a scheme developed by Boysen, Fliedner et al. This classification scheme became a guide for this report.

Once this is all known, we get into more detail on how assembly lines work in general, and especially what the difficulties are in operating and designing them. This leads us to the first and most basic design approach: load balancing. This is done to apportion the total assembly work among the stations or operators on the line as evenly and compactly as possible, or for any other objective like minimizing the cycle time or the costs.

We then focus specifically on the mixed-model assembly line design problem, where more variables have to be determined. The most common one is the sequence of models that are launched down the line. This procedure is called model sequencing, and is done either to smoothen the workload of the different models among the stations, or it can be done to smoothen the material and part usage. The sequencing is done after the line is balanced to a virtual average model, and has a shorter planning horizon.

A lot of methodologies have been published on balancing-sequencing mixed model assembly lines. The most important ones are introduced, together with currently available software tools.

Once this is all done, an interesting fact is found. A number of recent papers look back on what's published in the scientific world so far and what is done by industrial practitioners in the real world. This makes clear that there is still a gap between both parties. The real world cases are more complex than the methodologies developed, so industrial planners usually don't use them but rather base their design on experience. It can easily be shown however, that no assembly line is similar, and that even the slightest change in characteristics can make a big difference. It is thus important that this gap will be closed soon, to be able to ultimately reach the optimal methodology for designing mixed-model assembly lines. This design methodology should of course include load balancing and model sequencing, but also processing alternatives, flexible station and line characteristics and parallel and team working.