Chapter 15
Using the Graphical–Analytical Principle to Use Multi–Serving in Operational Management

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ABSTRACT

When organising the system of polyservicing the machines and equipment, the graphical-analytical procedure is successfully used, which basically emphasises those factors that condition the simultaneous service of several jobs, factors that can be production substitutable and production limitative factors. When the technological operations are identical, they have the same duration and structure, the organisation of polyservice is based on establishing the cyclogram for servicing all machine tools that have been taken into account. If the operations are different, but have the same manufacturing cycle duration, the use of polyservice implies the determination of the optimal number of machines that are to be simultaneously serviced and the preparation of the servicing cyclogram for all simultaneously serviced machines. Should the operations be multiple, but some of them have the same duration and the same cycle, each machine has a different cycle, but in between these cycles, there is a ratio established between the maximum and the minimum duration influencing the polyservice cycle and the number of machines to be possibly serviced. When the machine tools perform different operations, the way to achieve polyservicing is based on determining the polyservice working cycle, taking into account the longest working cycle of the machines and the amount of servicing times of every machine tool. When the machine tools are grouped, by duration of processing operations for various machines, polyservicing several machine-tools at the same, polyservicing cycle is achieved. Regardless of how polyservicing is done, a system of aggregate indicators whose level is calculated based on mathematical formulae is used in order to assess polyservicing.
FACTORS THAT INFLUENCE THE SERVING OF SEVERAL WORKSTATIONS AND THEIR INTERDEPENDENCE

Applying the multi-serving system requires the elaboration of a study of how to organise the workstation. This case study shall cover all aspects, from how to spatially organise the machines, technical and technological equipment, the system of supplying the materials and tools, etc. in order to create the best conditions for performing the production process. At the same time, the technical, physiological, psychological and social factors shall however be taken into account. The need to prepare the labour force, workers—operators shall also be taken into account in order to provide the technical, technological and intervention knowledge in the processing procedure (Chase, Aquilano, & Jacobs, 2004).

In terms of organisation—the human, the production machine and object to work—these aspects shall be taken into account in this study.

In terms of providing these requirements, the interdependences between the main factors existing within the system can be studied. To determine the interdependence, the serving times and machine times shall be firstly analysed, which shall be related to the product unit, the ratio of variation of times shall be taking into account, by increasing the number of stations (n), starting from the situation of serving one station and until a number of stations such as to achieve a worker’s appropriate temporary load. For the machine time, the main components, basic time $t_{Mb}$, auxiliary time $t_{Ma}$, and stationary time $T_f$ shall all be taken into account. It may be considered that the basic and auxiliary time within the processing procedure in automotive engineering are not influenced by the increase of the number of machine tools, because, by assuming a homogeneous production, each product unit of the same kind needs the same technological operation time of the machine tools and the same auxiliary time.

The stationary time of the machine shall increase as the number of served stations increases, because the worker’s overlapping times also increase. With this increase, the worker is increasingly busy with the serving activity and shall not be able to intervene immediately once a machine stops, but with some delay.

The serving time ($t_e$) related to the product unit has a reverse increase compared to the increase of the machine time; it increases as the number of served machines drops, because the loading index decreases, meaning there occurs an incomplete loading of the worker (Kelton, Sadowski, & Sadowski, 2002).

The interdependence between the serving times $t_e$ and machine times $t_f$ are shown in Figure 1. A dashed line was drawn in the diagram for the constant volume production curve, as being an isoquant q. In the most general case, $n = \frac{t_f}{t_e}$, when a whole number is obtained, the isoquant shall be a continuous curve.

The isoquant has a convex descending shape, starting from the point corresponding to one single machine where $t_f = t_e$, until the point corresponding to the operator’s maximum load, meaning when $T_e = 0$.

The isoquant curve also shows us that the total manufacturing time decreases as the operator’s time $t_e$ drops.

If the manufacturing time is maintained constant per product unit and the number of served machines is introduced as variable, then we get a curve indicating the interdependence between this variable and production volume per that time unit (Figure 2).

In order to establish the optimum multi-serving conditions ($t_e$ and $t_f$), they shall be considered as they actually are, conditions of participation of main production factors, “human” and “machine.”

The worker’s and machine’s qualitative factorial participation is stated in “time.”
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