Chapter 16
Using the Multi-Serving System in Textile Industry

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ABSTRACT

Using polyservicing in the textile industry takes into account the distinctive particularities of this branch compared to the automotive industry, in terms of materials and processed materials, production equipment, manufacturing process, etc. Performers’ random interventions are specific to polyservicing in the textile industry during the unlimited duration of the manufacturing cycle. In case of servicing several knitting machines, the structure of the machine and servicing time is taken into account, calculating the constant value and use coefficient of each machine serviced. Polyservicing the knitting machines should also take into account the maximum number of jobs corresponding to the performer’s maximum load, maximum number of machines serviced and their optimal number established according to the production costs incurred, level of soliciting the performer, and its increase, etc. A special situation in the textile industry is the case of polyservicing several machines at certain random time intervals. In this case, mathematically modelling the polyservice is based on the theory of waiting strings or on Markov chain and takes into account the inputs or arrivals in the system, the performer’s service or effective action, the service factor in the system, the waiting discipline in the system, etc. Studying the polyservicing conditions in the textile industry implies calculating some indicators of the waiting times, the machines serviced in the system, the performer working in the system, etc.

FEATURES OF THE MULTI-SERVING SYSTEM USED IN TEXTILE INDUSTRY

Textile industry has differences compared to automotive industry, in terms of the materials to be processed, production means, as well as in terms of the technological process used.

In the history of developing the materials goods, textile industry has been subject to a continuous improvement, in fact being the industry where mechanisation and even automation have been applied since ancient times.

Even nowadays, there is a permanent improvement of the production means, in terms of mechanisation and automation, as well as in terms of constructive structure, which provides a continuous increase of productivity, diversification of products and their quality (Askin & Standridge, 1993).
Using the Multi-Serving System in Textile Industry

Although there are flexibility problems in realising the ranges of products in this industrial sector, there remains however a characteristic of the manufacturing process, serial or even mass production.

In terms of multi-serving, there occur problems particularly in operator’s random interventions, at undetermined cycle durations. It is worth noting that the production means operate in automatic cycle, the worker’s intervention being required only on the occurrence of some defects in the processing procedure.

In order to efficiently apply the multi-serving system, it is required in principle to take into account the following problems, and namely: optimal use of the processing capacity of the production means, loading under optimal conditions and providing the economic use of materials and energies, providing the highest possible economic efficiency (Courtois, Pillet, & Martin, 2000).

SERVING SEVERAL KNITTING MACHINES

In order to study the possibilities to apply the multi-serving, it is required to also know in these cases the structure of the machine and serving time. Machine times may be divided into:

- \( t_f \) : Machine operation time;
- \( T_{Mb} \) : Machine basic time;
- \( T_{Ma} \) : The auxiliary time where the machine standstill time while it is served, and this time is equal to the worker operating time \( (t_{eg}) \);
- \( T_{Ms} \) : Machine standstill time for various other reasons (failures, not served on time, etc.).

The structure of the worker’s serving time (Dima, 2010):

- \( t_s \) : Direct driving time
- \( t_{tg} \) : Monitoring time
- \( T_e \) : Waiting time, where auxiliary, monitoring, etc. times can also be included;
- \( t_{ep} \) : Preparation time (reels, shuttles, etc.); this time shall be in fact overlapped with the machine operating time;
- \( t_{eg} \) : The time for driving a machine that is stopped (e.g., needle, shuttle changing, removing a defect, etc.).

Among the indicators showing the efficiency of applying the multi-serving method, the following are considered: serving constant, \( k_d \); coefficient of worker’s activity; coefficient of using the capacity of the machines.

In order to determined the number of machines that are to be served, a study shall be run on the variation of times, \( t_{eg} \) and \( t_{ep} \), respectively, of standstill times \( T_{Ms} \), by taking a certain number of machines into the calculation and setting the condition that \( t_e = 100\% \).

Before proceeding with the calculation of times, one must specify which are the operations that do not correspond to the aforementioned times.

We calculate:

The serving constant \( k_d \) (Dima, Marcincin, Grabara, Pachura, Kot, & Man, 2011) is given by the relation:

\[
k_d = \frac{t_{Ma}}{t_{Mb}} = \frac{t_{eg}}{n} = \frac{1}{100 - t_{Mb} - t_{Ms}}
\]

For calculating the standstill time, it is required to determine the serving constant for the case when the number of machines served by a worker is different than the existing case.

The standstill time \( t_{Ma} \) corresponding to \( k_d \) depending on \( n \) is between 0.01 and 0.1. The values have been established as shown in the diagram of Figure 1, by means of the theory of waiting strings and by assuming an exponential
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