APPROACHES ON THE MANUFACTURING PRODUCTIVITY OPTIMISATION IN THE FOOTWEAR INDUSTRY

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Abstract. The paper presents how to establish an optimum capacity of a continuous flow technology for manufacturing a moccasin shoe. There has been analyzed the work productivity for different values of production/8hours, the correct equilibration of the workstations etc. The case study results indicated a value of 0.0045 for the degree of non occupation that corresponds to a production of 750pairs/8h.

1. INTRODUCTION

The footwear manufacture starts in the assembly room which is usually organized in continuous flows with a mechanized transport between workstations.
Thus for the mass production there can be used transport assembly lines with imposed rhythm or assembly lines with free rhythm.
The flow production is characterized by a continuous movement of the products from one operation to another, the layout of workstations allows a certain cycle order. The work rhythm indicates the functioning of the machines, the aptitudes and the qualification of the workers. It is defined as the time period elapsed between two successive passing of the same patterns.
Though these assembly lines are not always used at their maximum capacity. The optimum capacity of an assembly line is the capacity that assures the best indicators of the work productivity, of the work volume, of the machines use, etc.
The work productivity illustrates the efficiency of human resources management.
The elapsed time for different operations varies usually between two limits:

t_{min} – the minimum time necessary for the most productive operation;
t_{max} – the maximum time necessary for the least productive operation.

The equilibration of the work volume is obtained through a variation of the total workstations, of the work productivity in pairs/worker/8 hours.
Considering different values of production per shift there can be calculated the necessary number of workstations (N_{mi}) that leads to a certain number of workstations (Ni), resulting a varied degree of non occupation (δ_i). In the footwear manufacture a work flow is used at an optimum capacity when the workstations number assures a minimum degree of non occupation.
The paper presents a way to establish the optimum capacity of a transport line with controlled rhythm for the closing room where the upper components are assembled.

2. STUDY CASE

There has been analyzed a moccasin shoe for men in order to establish the optimum capacity of the transport line, fig.1

Fig.1. The moccasin shoe

Thus there have been taken into consideration the manufacturing operation sequences in the assembly room, the time rate and production rate for each operation.
The case study has resulted in the following values of the minimum and maximum time (fig.2):

t_{min} = 0.61 min/per, the time corresponding to the most productive operation–

glueing and fixing the lining on the apron (6m) ;

t_{max} = 2.7 min/per, respectively the maximum time necessary for the least productive operation – stitching the quarter and the mudguard patterns (14M).

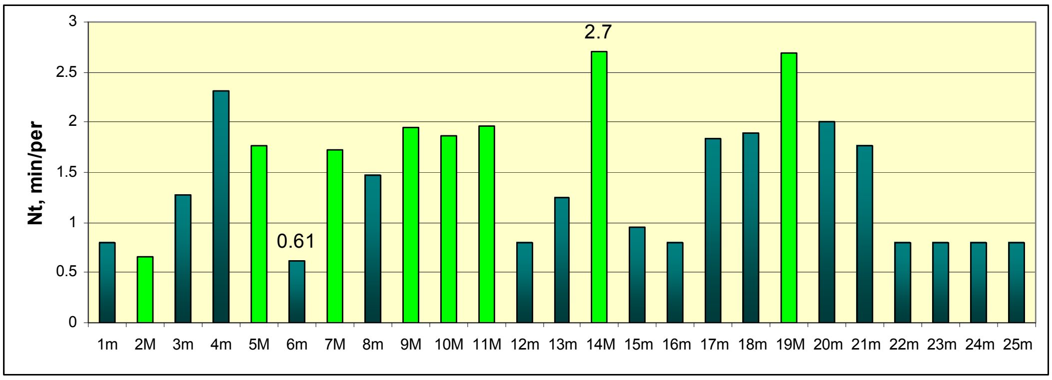

Fig.2. The rates for each operation (m-manual; M-mechanical)

In these conditions the work productivity of the technological process is not uniform, so it has different values per operation.

The work productivity is calculated with the relation:

$$W = \frac{P}{N_a} \tag{1}$$

where: P- technological line`s production;

N_a- total number of the chosen workstations;

$$N_a = \sum_{j=1}^{n} N_{a_j} \tag{2}$$

N_{aj}- the number of workstations chosen for the operation *j*

The variation of the production rate is illustrated in figure 3.

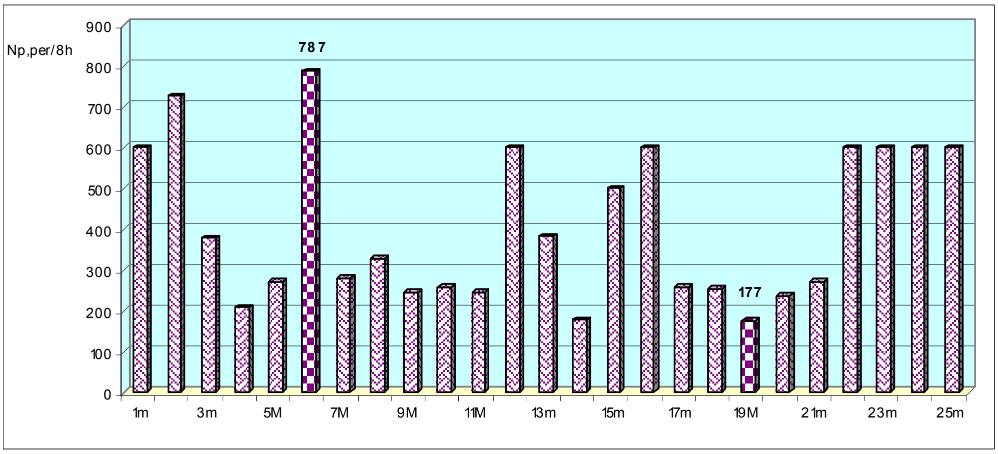

Fig.3. The production rates for each operation of the technological process

The graphics indicate a maximum shift production of 787 per/ 8h corresponding to the minimum time and 177 per/8h corresponding to the maximum time.

There has been calculated the necessary number of workstations (*Nmi*) and then chosen a number of workstations (*Ni*), for different production shifts- 650, 700, 750, 800, 850, 900, 950, 1000 pairs/8h, resulting a different degree of non occupancy (δi).

The degree of non occupancy has been calculated with the relation:

$$K = \frac{\sum \delta_i}{\sum N_i} \tag{3}$$

The variation of the non occupancy degree is illustrated in fig.4.

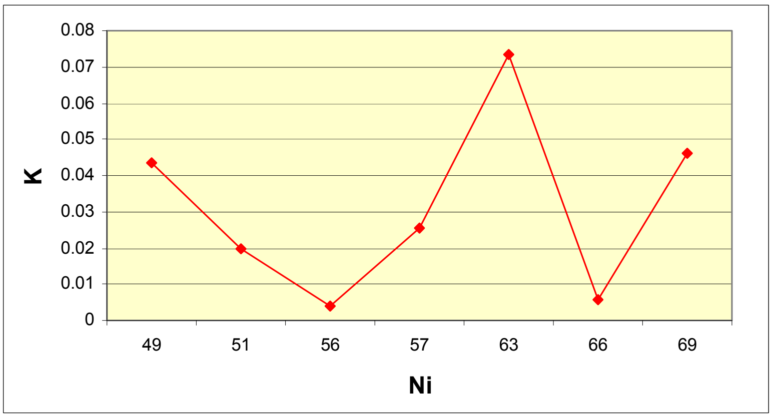

Fig.4.The variation of the degree of non occupation

The graphics indicate a minimum value of 0.0045 corresponding to a flow production of 750 pairs/8h.

The work productivity, calculated as a ratio between the flow production and the chosen number of workers, measured in pairs/worker/8h, is illustrated in figure 5.

As figure 5 shows the highest value of the work productivity is obtained for a production of 750 pairs/ 8 hours which corresponds to a minimum degree of non occupancy.

As the work stations are equilibrated there has been recalculated the work productivity, obtaining better results, figure 6.

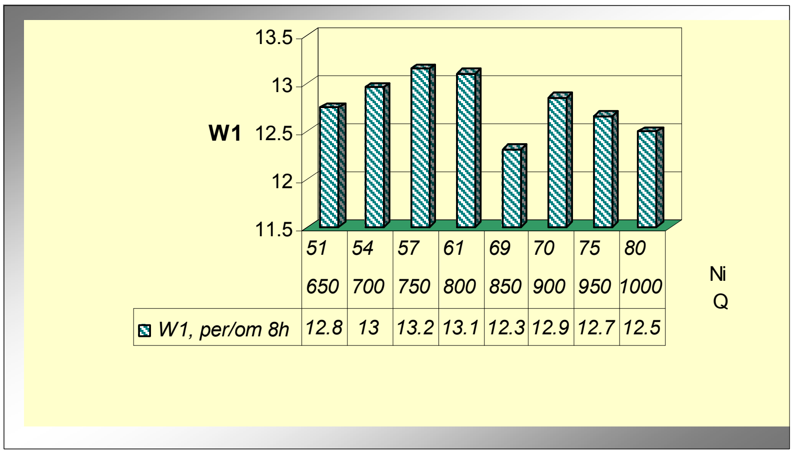

Fig.5. The work productivity before equilibrating the workstations

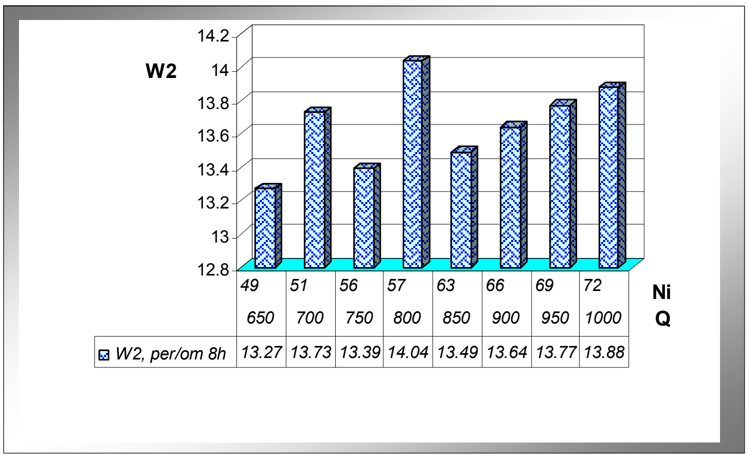

Fig.6. The work productivity after equilibrating the workstations

As figure 6 shows, the productivity growth for a flow production of 750 pairs/8hours is only of 0,23 pairs/worker/8 hours; the biggest flow productivity growth is of 1000 pairs/8h, respectively a rise of 1.38 pairs/worker 8 hours.

The difference of productivity after equilibrating the work stations is illustrated in figure 7.

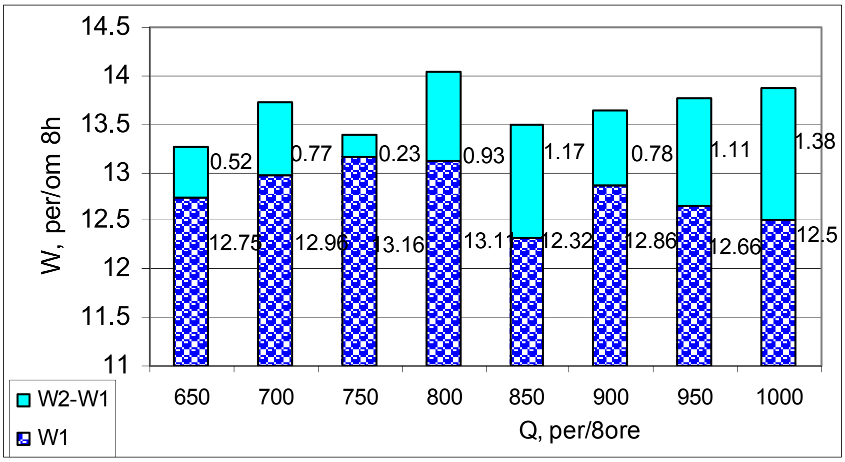

Fig.7. The productivity W1 and difference of productivity W2-W1

The maximum value of the work productivity is 14.04 pairs/worker.8h, corresponding to a shift production of 800 pairs/8h, respectively a growth of 0,93pairs/worker/8h, after the workstations are equilibrated.

3. CONCLUSIONS

The variation of the production volume per shift Q (650 pairs/8h, 700pairs/8h,.., 1000pairs/8h) has lead to the modification of the non occupancy degree of the workstations. Thus it results a minimum value for the non occupancy degree of 0.0045 corresponding to a production of 750pairs/8h.

Taking into account the way of organization the transport line with imposed rhythm there has been tried to balance the work stations where it has been possible, and for a series of operations N_i there has been adopted the N_{mi} in order to use the qualified workers.
There have been obtained bigger values of work productivity through equilibrating the workstations; the best variant is the one corresponding to a shift production of 800pairs/8h, resulting thus a work productivity of 14,04 pairs/worker/8h compared to an initial productivity of 13,11 pairs/worker/8h.
The growth of the work productivity has been possible as a result of a correct equilibration of the work stations, the type of machines used and the employers qualification.

REFERENCES:

[1] Rusu C., Frunzã V. , Management şi ingineria sistemelor de producţie, Ed.Gh.Asachi, Iasi, 1992
[2].Volocariu R.,Procese de fabricaţie în industria confecţiilor din piele şi înlocuitori, Ed. Gh. Asachi, Iasi 1999
[3] Volocariu R., Mărcuş L., Indrumar pentru lucrări practice la disciplina Procese de fabricaţie în industria confecţiilor din piele Editura PIM, Iasi 2007, ISBN 978-973-716-606-7
[4] Harnagea F.,Studiu privind optimizarea capacităţii de producţie a benzilor transportoare din industria de încălţăminte, A X-a Conferinţa română de Textile –Pielărie, Iasi, 1992