

PRODUCTION WORKSHOP OPTIMIZATION

ABSTRACT. In this paper, we propose a way to model and optimize the cost of production workshop.

1. MATHEMATICAL MODELING

sec: model

1.1. Notation and definition. Given a batch of order b , it will contain the size of this batch, a set of production process $S_b = \{s_{b_1}, s_{b_2}, \dots, s_{b_n}\}$ and each process has an according standard processing time t_{bs} . Thus, given a set of b as \mathcal{B} , we can obtain a set of all the production process S_b as $\mathcal{S} = \bigcup_{b \in \mathcal{B}} S_b = \{s_1, s_2, \dots, s_n\}$.

The first task is to assign these process to the workers fairly. For worker w , he/she can be described with parameters that

- (i) The ability to complete the production process $s_i \in \mathcal{S}$ as e_{ws} .
- (ii) The proficiency in completing the production process $s_i \in \mathcal{S}$ as f_{ws} .
- (iii) The limitation of the number of assigned production process as M .

If we denote the production process set of worker w as $S_w = \{s_{w_1}, s_{w_2}, \dots, s_{w_n}\}$ and the according quantity as Q_{s_w} , then the total time cost will be

$$T_w = \sum_{s_w \in S_w} Q_{s_w} * f_{ws} * t_{s_w}, \quad (1.1) \quad \text{cost_w}$$

subject to

$$\sum_{s_w \in S_w} Q_{s_w} \leq M, \quad (1.2) \quad \text{subject_w}$$

and

$$\sum_{w \in \mathcal{W}} Q_{s_w} = \sum_{b \in \mathcal{B}} n_{bs}. \quad (1.3) \quad \text{subject_b}$$

Here, n_{bs} is the number of process s contained in batch b .

To assign these process fairly and efficiently, we try to minimize the maximum of the time costs around workers that

$$\min \max_{w \in \mathcal{W}} T_w. \quad (1.4) \quad \text{loss}$$

After this step, the assignment of the batch set \mathcal{B} has been decided. The next step, we will assign the workers to the seru $c \in \mathcal{C}$ (workshop) efficiently. Assume we have the workers in seru c as a set $W_c = \{w_{c_1}, w_{c_2}, \dots, w_{c_n}\}$, then the labor time of seru c will be

$$T_c = \sum_{w_c \in W_c} T_{w_c}, \quad (1.5) \quad \text{cost_c}$$

subject to

$$\|W_c\| \leq N. \quad (1.6) \quad \text{subject_c}$$

And the total labor time will be

$$T_{total} = \sum_{c \in \mathcal{C}} T_c. \quad (1.7) \quad \text{total}$$

1.2. Integer Programming. Follow previous definition, we have three variables that

- (i) The assignment of process s from the batch b to the worker w as z_{ws}^b .
- (ii) The quantity of process s assigned to the worker w as Q_{sw} .
- (iii) The assignment of worker w to the seru c .

REFERENCES