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Data-Driven Decision Making In Large Scale Production Planning

Dea Christefa[1)] Herman Mawengkang[2)], Muhammad Zarlis[3)]
[1,2,3)]University of Sumatera Utara, Medan, Indonesia
deachristefa04@gmail.com

Abstract. Production planning is a very important part for a company in making the right decisions before carrying out production activities in order to obtain maximum profit with a minimum level of production costs. Production planning is defined as a process in producing goods and services within a certain period by considering resources such as labor, materials, machinery and etc. In this research, a production planning model is produced based on several variables and parameters that can assist in making production decisions.

INTRODUCTION

Planning is one of the important functions where, based on the planning, it is determined the efforts or actions that can be taken to achieve the goals of a company. Production planning is a tactical purpose in making decisions based on the company's resources in meeting the demand for a product produced. Determining the optimal number of products to be produced is the key to proper production planning. Production planning is carried out with the aim of meeting demand with a minimum level of cost (Alarcón et al., 2016).

Production activities are closely related to the availability of raw materials and the amount of demand. Raw materials are one of the inputs that will be processed to produce products. Production planning and control has an important role in inventory management, capacity and scheduling. With many available resources, it can help production planning so that it can meet consumer demand within a certain time. Production planning aims to adjust production with decision sources to meet future consumer demands, such as production capacity, labor restrictions and overtime restrictions, which are optimization problems. Another goal of production planning is to minimize total costs or maximize profits. (Bassett et al., 1996) presented a model spanning a longer time period providing more details towards the intermediate future than the distant future. (Orçun et al., 2001) develop an integrated continuous time model that results in the MINLP formulation for planning problems. (Castro et al., 2003) modified the short-term scheduling formulation to suit the periodic scheduling requirements for industrial applications. In the previous work, we presented an efficient continuous-time formulation for the periodic scheduling problem, resulting in fewer variables and constraints.

METHODS

In completing this research, the method used is literature study. The literature study method is a series of activities related to the methods of collecting library data, reading and taking notes, and processing research materials (McLafferty, 2004). The stages to be carried out in this research are as follows:

Literature Review

Literature review related to the concept of production planning, decision making, data driven and other concepts related to the topic to be discussed sourced from journals and other research results as references for previous research, textbooks, online sources (interners) and other sources.

Define Variables and Parameters

Determine the variables and parameters that will be used in the formulation of the production planning model

*Corresponding author

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Model Formulation
Modeling
Creating a large-scale production planning model based on data driven

RESULT AND DISCUSSION

The description of the problems that will be discussed in this study related to large-scale production planning are:
A company performs large-scale production in each time period t,t=1,2,…T. In this case, the production period is four times a year. Based on the description of the problem above, the parameters and decision variables that will be used are:

Set
$T : Production\ Quantity$
$N : Product$
$M : Resource$
$S : Production\ Scenario$
Variables
$X_{jt} : Quantity\ of\ product\ j \in N\ in\ period\ t\ \in T\ (ton), j - 1,2, \dots, N$
$u_{it} : Quantity\ of\ resource\ i \in M\ \ for\ purchase\ t\ \in T\ (unit)$
$k_t : The\ number\ of\ workers\ needed\ in\ the\ period\ t \in T\ (man - period)$
$k_t^- : Number\ of\ workers\ laid\ off\ in\ the\ period\ t \in T\ (man - period)$
$k_t^+ : The\ number\ of\ workers\ added\ in\ the\ period\ t \in T\ (man - period)$
$I_{jt} : Number\ of\ j \in N\ Products\ to\ be\ stored\ in\ the\ period\ t\ \in T(unit)$
$B_{jt} :\ Product\ that\ is\ not\ fulfilled\ j \in N\ in\ period\ t\ \in T(satuan)$

Parameters

$\alpha, \beta, \gamma, \delta, \mu, \rho, \lambda, \eta$ is the total cost
$D_{jt} : Product\ Demand\ j \in N\ in\ period\ t\ \in T\ (unit)$
$U_{jt} : Product\ availability\ u_{jt}$
$r_{ij}\ : Amount\ of\ i \in M\ resources\ to\ produce\ a\ product\ j \in N$
$f_{it} : Number\ of\ i \in M\ resources\ available\ in\ the\ period\ t\ \in T\ (unit)$
$a_j\ : Number\ of\ workers\ needed\ to\ produce\ a\ product\ j \in N$
$w_{jt}^p : Number\ of\ failed\ products\ j \in N\ in\ period\ t\ \in T\ (unit)$
So, based on the problem definition described as well as the parameters and variables above, a large-scale production planning model can be formulated as follows:

Minimize Cost

$$\sum_{j \in N} \sum_{t \in T} \alpha_{jt} x_{jt} + \sum_{i \in M} \sum_{t \in T} \beta_{it} u_{it} + \sum_{t \in T} \mu_t k_t + \sum_{t \in T} \gamma_t k_t^- + \sum_{t \in T} \delta_t k_t^+ + \sum_{j \in N} \sum_{t \in T} \eta_{jt} w_{jt}^p + \sum_{s \in S} p_s \sum_{j \in N} \sum_{t \in T} \rho_{jt}^s I_{jt}^s + \sum_{s \in S} p_s \sum_{j \in N} \sum_{t \in T} \lambda_{jt}^s B_{jt}^s + \sum_{s \in S} p_s \left\{ \sum_{j \in N} \sum_{t \in T} \left(\rho_{jt}^{s'} I_{jt}^{s'} \right)^2 \right\} + \sum_{s \in S} p_s \left\{ \sum_{j \in N} \sum_{t \in T} \left(\lambda_{jt}^s B_{jt}^s - \sum_{s' \in S} \lambda_{jt}^{s'} B_{jt}^{s'} \right)^2 \right\} \tag{3.1}$$

Subject to :

$$\sum_{j \in N} r_{ij} x_{jt} \leq f_{it} + u_{it}, \forall i \in M, \forall t \in M \tag{3.2}$$

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$$u_{it} \leq U_{jt} \ \forall i \in M, \forall t \in T \quad (3.3)$$

$$\sum_{j \in N} a_j x_{jt} \leq k_t, \forall t \in T \quad (3.4)$$

$$0{,}10 x_{jt} \leq w_{jt}^p \leq 0{,}20 x_{jt}, \forall j \in N, \forall t \in T \quad (3.5)$$

$$\sum_{j \in N} \sum_{t \in T} w_{jt}^p \leq C^p \quad (3.6)$$

$$\varepsilon_1 \leq \frac{\sum_{s \in S} P_s \sum_{j \in N} \sum_{t \in T} I_{jt}^s - \sum_{s' \in S} P_{s'} \sum_{j \in N} \sum_{t \in T} I_{jt}^{s'}}{\sum_{s \in S} P_s \sum_{j \in N} \sum_{t \in T} I_{jt}^s} \leq \varepsilon_2 \quad (3.7)$$

$$\varepsilon_3 \leq \frac{\sum_{s \in S} P_s \sum_{j \in N} \sum_{t \in T} B_{jt}^s - \sum_{s' \in S} P_{s'} \sum_{j \in N} \sum_{t \in T} B_{jt}^{s'}}{\sum_{s \in S} P_s \sum_{j \in N} \sum_{t \in T} I_{jt}^s} \leq \varepsilon_4 \quad (3.8)$$

$$u_{it} = k_{t-1} + k_t^+ - k_t^-, t = 2, \dots T \quad (3.9)$$

$$x_{jt} + B_{jt-1}^S + I_{jt}^s - B_{jt}^s = D_{jt}^s, \forall j \in N, \forall t \in T, \forall s \in S \quad (3.10)$$

$$x_{jt}, u_{it}, k_t, k_t^-, k_t^+, I_{jt}^s, B_{jt}^s \geq 0 \quad \forall j \in N, \forall i \in M, \forall s \in S, \forall t \in T \quad (3.11)$$

Model Description:

Equation (3.1) is an objective function formed from several decisions, namely:
Number of products to be produced in each period
Amount of additional resources used for production
The number of employees either added or subtracted in each period.
Minimize costs used in production and minimize variability.
Equations (3.2) to (3.10) are constraints. Equation (3.2) states that to produce $j \in N$, the required amount of $i \in M$ resources is at least the same as the available resources at time $t \in T$ and also the additional resources needed.
Equation (3.3) states that additional resources need to have an upper bound.
Equation (3.4) states that the number of workers needed for the production of $j \in N$ in each period.
Equation (3.5) states that the number of failed products is 10% - 20%.
Equation (3.6) states that the product processing process fails with a capacity of C^p.
Equations (3.7) and (3.8) express the range for the variability.
Equation (3.9) states that the number of workers needed in a period is equal to the number of workers from the previous period plus a change in the number of workers in the current period, which changes in the number can occur due to the addition or reduction of workers.
Equation (3.10) determines the amount of production goods that will be stored or purchased from outside to meet the shortage in market demand.

CONCLUSION

This research produces a large-scale production planning model based on data driven with several variables and parameters. This model can be useful as a consideration in making decisions in order to achieve company goals. This model is a model to minimize production costs so as to maximize profits.

REFERENCES

Alarcón, F., Perez, D. & Boza, A. (2016). Using the Internet of Things in a Production Planning Context. *Brazilian Journal of Operations & Production Management*, *13*(1), 72.

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https://doi.org/10.14488/BJOPM.2016.v13.n1.a8

Bassett, M. H., Dave, P., Doyle III, F. J., Kudva, G. K., Pekny, J. F., Reklaitis, G. V, Subrahmanyam, S., Miller, D. L. & Zentner, M. G. (1996). Perspectives on model based integration of process operations. *Computers & Chemical Engineering*, *20*(6–7), 821–844.

Castro, P. M., Barbosa-Póvoa, A. P. & Matos, H. A. (2003). Optimal periodic scheduling of batch plants using RTN-based discrete and continuous-time formulations: a case study approach. *Industrial & Engineering Chemistry Research*, *42*(14), 3346–3360.

McLafferty, I. (2004). Focus group interviews as a data collecting strategy. *Journal of Advanced Nursing*, *48*(2), 187–194.

Orçun, S., Altinel, I. K. & Hortaçsu, Ö. (2001). General continuous time models for production planning and scheduling of batch processing plants: mixed integer linear program formulations and computational issues. *Computers & Chemical Engineering*, *25*(2–3), 371–389.

*Corresponding author

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