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Sequential Production Planning Optimization Model in Sustainable Manufacturing Industry

Hasanul Fahmi[1], Adli Abdillah Nababan[2], Muslim[3], Sukarni[4]

[1,2,3,4]STMIK Pelita Nusantara, Jl. Iskandar Muda, No.1, Indonesia

E-mail: h.fahmizuhri@gmail.com

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ABSTRACT

Creation arranging models in the assembling business are expected to limit creation costs. An organization can be said to enjoy a cutthroat benefit assuming it has a full grown creation plan so the organization can offer items or administrations to clients with the equivalent or better caliber, however at a lower cost than its rivals, so to turn into an unrivaled organization, it should be considered in arrangement of creation arranging and things that should be considered are creation advancement so the most minimal expense level can be accomplished for the execution of the creation interaction itself. Consecutive creation arranging streamlining model in maintainable assembling industry can tackle the issue of coordinated successive creation wanting to limit the absolute costs brought about in the creation interaction. The successive creation arranging model is demonstrated to have the option to limit the absolute expense of creation and the creation cycle can be done consecutively as per the progression of exercises so the satisfaction of purchaser request is satisfied in the briefest conceivable time, so the all out creation cost is least.

1. Introduction

The rapid development of science and technology forces companies to continue to innovate on the goods and services offered. In this case the company innovates on existing products and innovates in issuing new products by maintaining product quality and providing competitive prices in the market. A company is said to have a competitive advantage if the company can offer products or services to customers with the same or higher quality, but at a lower cost than its competitors [1] [2] [3]. This is done to keep up with business progression considering the rising number of contenders because of innovative improvements that make it more straightforward for business entertainers to enter the market and proposition quality items. To beat the extreme contest because of globalization and mechanical turns of events, each industry player endeavors to work on its best quality. The most compelling thing that is finished by industry players is to increment usefulness in their creation exercises by further developing item quality to come by ideal outcomes. To come by ideal outcomes, great, compelling, and proficient arranging is done for every creation movement.

Creation arranging is an arrangement about what and the number of items will be delivered by the organization worried in one period to come. Creation arranging is important for functional preparation inside the organization. Total arranging is normally completed by tasks directors worried about deciding creation, stock, and work levels to satisfy fluctuating need [4] [5] [6]. Total arranging gives the most effective way to fulfill determined need inside the following 3-year and a half, by adapting to customary and additional time creation levels, stock levels, work levels, subcontract and delay purchase rates, and other controlled factors [7]. In the readiness of creation arranging, what should be considered is the enhancement of creation so the least expense level for the execution of the creation interaction can be accomplished. Creation arranging can likewise be characterized as a cycle to deliver products in a specific period as indicated by what is anticipated or booked through getting sorted out assets like work, unrefined substances, hardware, and other gear.

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Creation arranging requires a gauge of the interest for items or administrations that the organization is relied upon to give from here on out. Consequently, anticipating is a vital piece of creation arranging [8].

Brauner et al., In making a creation arrangement there are three components that should be thought of, to be specific shoppers, items, and assembling processes. This creation movement arranging incorporates how much creation, creation time, creation costs, the quantity of creation machines utilized, and the accessibility of creation unrefined components. The accessibility of unrefined substances is supposed to be ideal in the event that the organization can limit creation costs. Each part of the creation interaction is interconnected so that booking arranging in the creation cycle turns out to be more perplexing. Notwithstanding the creation cycle, the arranging must likewise focus on the accessibility of unrefined components before the creation interaction is completed in light of the fact that the lack of natural substances when the creation cycle is running will disturb the creation interaction and can likewise cause higher startling expenses. To lessen creation costs, increment efficiency, and work on the nature of the items delivered, it is vital to work in ideal circumstances [9] [10] [11].

Creation planning and unrefined substance stock are significant things that are interrelated in a creation cycle to figure out how much creation and kinds of items to be delivered as well as the hour of request, and the quantity of orders for unrefined components [12] [13] . Creation arranging is vital to do to accomplish the creation work appropriately and definitively. Creation arranging should be joined by great stock administration [14]. How much stock should generally be satisfactory so as not to hamper the pace of creation so the organization can generally fulfill client needs. The arranging will keep the organization from delivering products at some unacceptable time, the cost isn't suitable, and the quantity of merchandise that are in overabundance or deficiency when wrapped up. The issue that is regularly found in assembling organizations, particularly those of little and medium scale, is wasteful creation arranging because of the absence of human asset abilities in executing these plans [15]. Great creation arranging starts with anticipating customer request so it is realized the number of products should be delivered in a timeframe. The ideal creation arranging system can handle great distribution center stock and keep away from pointless unrefined substance stock acquisition. Guarantee stock is dependably at a satisfactory level, as well as keep the right stock and as per customer interest. With a decent stock administration framework, the organization gets a warning when the stock is close to the base level.

2. Method

Incredible creation organizing begins with expecting client demand so it is understood the quantity of items ought to be conveyed in a time span. The ideal creation organizing framework can deal with incredible circulation community stock and avoid trivial raw substance stock procurement. Ensure stock is constantly at a good level, as well as keep the right stock and according to client interest. With a fair stock organization structure, the association gets an admonition when the stock is near the base level.

W : Announce the timeframe with W
I : Announce handled meat items with I
P : Announce factory with *P*
S : Announce raw meat resources S
M : Announce machine with M

a. Variabel

j_{ip}^{w}: Total product produced to be tracked in time period *w* at factory *p* (tons).

h_{imp}^{w}: Total products that qualify for production on a machine 1 *m* at factory *p* in the time period *w* (tons).

b_{sp}^{w}: Total additional raw meat resource s that must be purchased at time *w* for the factory *p* (units).

c_{p}^{w}: Total workers needed in the time period *w* in factory *p* (man-period).

c_{p}^{w-}: Total workers fired in the time period *w* at factory *p* (man-period).

c_{p}^{w+}: The total addition of workers in the time period *w* in the factory *p* (man-period).

$E_{sp}^{w\leq\tau_f}$: Amount of raw meat stock *s* at factory *p* in time period *w* consider shelf life τ_f (unit).

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$E_{sm}^{w \le \tau_g}$: Amount of products *s* to be produced on a machine 1 in the time period *w* consider the shelf life τ_f (unit).
A_{ip}^{w}: Insufficient fulfillment of processed meat products *i* in time period *w* at factory *p* (units) (unit).
K_{im}^{w}: The demand for processed fish product *i* is not fulfilled in the time period *w* in machine 1 m (unit).
l_{ip}^{w}: A binary variable denoting whether a type of processed meat product *i* is set to track at factory *p* in the time period *w*
k_{ip}^{w}: the level of processed meat product *i* that will be rejected at factory *p* in the time period w (units).
$x_{imp}^{w} = 1$, if processed fish product *i* is produced on time at factory 1 and machine 1 then sequential, and = 0, otherwise

b. Parameter

dp_{ip}^{w}: The expense of producing processed meat products at factory p in time period w (Rp.)

dy_{sp}^{w}: The expense of purchasing additional raw meat s at factory p in time period w (Rp.)

dkr_{p}^{w}: The expense of permanent employees at factory *p* in time period *w* (Rp.)

dkt_{p}^{w}: The expense of additional employees at factory *p* in time period *w* (Rp.)

dkl_{p}^{w}: The expense with fired workers at the factory *i* in time period w (Rp.)

dim_{sp}^{w}: The expense of raw meat stock *s* at factory p in time period w (Rp.)

dng_{ip}^{w}: The expense of fulfilling processed meat product *i* at factory *p* in time period *w* (Rp.)

dm_{imp}^{w}: The expense of using machine 1 *m* for processed fish *i* from factory 1 *p* in time period *w* (Rp.)

$did_{im}^{w<\tau_s}$: Production cost of processed fish *i* in machine 1 *m* at time *w* considering shelf life τ_s

dtk_{im}^{w}: Costs associated with disposing of unfulfilled quality of processed fish product *i* in machine1 *m* in time period *w* (Rp.)

dtp_{ip}^{w}: The expense of tracing processed meat product *i* at factory *p* in time period *w* (Rp.)

dtf_{ip}^{w}: Disposal expense of rejected meat products at factory *p* in the time period *w* (Rp.)

F_{ip}^{w}: Demand for processed meat products *i* at factory *p* in time period *w* (Unit)

H_{ip}^{w}: Upper limit of additional resource of processed fish *i* in factory 1 *p* in time period *w* (Unit)

n_{sip}^{w}: Amount Resources needed to produce 1 unit of processed meat product *i* at factory 1 *p* in time period *w* (Unit)

k_{sw}^{p} : Amount resources *s* available at time *w* in factory 1 *p* (Units) (Unit)

l_i: Amount workers needed to produce one unit of processed meat product *i*

$TU_{sp}^{w<\tau_f}$: Upper limit of raw meat resource supply s at factory p in time period w before shelf life τ_f (Unit)

Dj_{ip}^{w}: production cost related to scheduling raw meat processing *i* at factory *p* in time *w*.

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3. Result and Discussion

3.1 Result and Model

Subsequent to tackling issues underway anticipating handled fish items by applying the proposed successive enhancement model, the consequences of the model are as per the following:

TABEL 1.

TOTAL OF EACH PRODUCT TO BE MANUFACTURED (TON)

Time Period	Prod 1	Prod 2	Prod 3	Prod 4	Prod 5
1	705	500	500	500	500
2	1141	1347	500	500	500

TABEL 2

AMOUNT OF RAW FISH RESOURCES TO BE USED (TONS)

Time Period	Resource 1	Resource 2	Resource 3
1	550	550	500
2	550	550	450

TABEL 3.

TOTAL WORKERS REQUIRED

Time Period	Regular Worker	Lay-off Worker	Additional Worker
1	54200	0	0
2	54200	0	0

TABLE 4.

TOTAL PRODUCTION WASTE PRODUCED (TONS)

Time Period	Prod 1	Prod 2	Prod 3	Prod 4	Prod 5
1	152	110	110	110	110
2	222	311	110	110	110

TABLE 5.

TOTAL INVENTORY AT FACTORY SITE (TONS)

Time Period	Prod 1	Prod 2	Prod 3	Prod 4	Prod 5
1	21212	10400	3999	4999	3450
2	21212	10400	3999	4999	3450

TABLE 6

QUANTITY OF PRODUCTS TO BE PRODUCED AT THE FACTORY (TONS)

Product	Factory	Machine	Period 1	Period 2
Product 1	Pabrik 1	M 1	0	0
		M 2	2501	0
		M 3	20002	0
	Pabrik 2	M 1	40001	6003
		M 2	0	20010
		M 3	0	20002
	Pabrik 3	M 1	0	14000
		M 2	14003	0
		M 3	4005	0
	Pabrik 4	M 1	0	0
		M 2	15005	0
		M 3	0	0
Product 2	Pabrik 1	M 1	0	0
		M 2	0	11503
		M 3	0	0
	Pabrik 2	M 1	11011	0
		M 2	15022	0

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Product	Factory	Machine	Period 1	Period 2
		M 3	24012	0
	Pabrik 3	M 1	5503	0
		M 2	0	0
		M 3	0	4002
	Pabrik 4	M 1	0	11511
		M 2	0	0
		M 3	0	0
Product 3	Pabrik 1	M 1	502	0
		M 2	8004	0
		M 3	0	0
	Pabrik 2	M 1	0	4007
		M 2	0	4007
		M 3	0	0
	Pabrik 3	M 1	0	0
		M 2	0	0
		M 3	9008	0
	Pabrik 4	M 1	15022	0
		M 2	0	0
		M 3	0	4007
Product 4	Pabrik 1	M 1	0	5008
		M 2	0	0
		M 3	0	5008
	Pabrik 2	M 1	0	0
		M 2	10001	0
		M 3	15511	0
	Pabrik 3	M 1	8503	0
		M 2	0	0
		M 3	1001	0
	Pabrik 4	M 1	0	0
		M 2	0	5008
		M 3	0	0
Product 5	Pabrik 1	M 1	0	3501
		M 2	0	0
		M 3	0	0
	Pabrik 2	M 1	7509	0
		M 2	8508	0
		M 3	0	3501
	Pabrik 3	M 1	0	0
		M 2	0	3501
		M 3	0	0
	Pabrik 4	M 1	0	0
		M 2	0	0
		M 3	7001	0

TABLE 7
UNDER FULFILLMENT EACH PRODUCT (TONS)

Period	Prod. 1	Prod. 2	Prod. 3	Prod. 4	Prod. 5
1	818	1102	601	601	601
2	1855	3128	1203	1203	1203

3.2 Discussion and Model

The object of this issue is to limit the absolute expense of creation, numerically so that everything expenses can be limited. So it very well may be efficiently composed as follows;

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$$Minimize\ z = \sum_{i\in I}\sum_{p\in P}\sum_{w\in W} dp_{ip}^{w} j_{ip}^{w} + \sum_{s\in S}\sum_{p\in P}\sum_{w\in W} dy_{sp}^{w} h_{imp}^{w} + \sum_{p\in P}\sum_{w\in W} dkr_{p}^{w} c_{p}^{w} + \sum_{p\in P}\sum_{w\in W} dkt_{p}^{w} c_{p}^{w+} + \sum_{p\in p}\sum_{w\in W} dkl_{p}^{w} c_{p}^{w-} + \sum_{s\in S}\sum_{p\in P}\sum_{w\in W} dim_{sp}^{w} E_{sp}^{w\leq\tau_f} + \sum_{i\in I}\sum_{p\in p}\sum_{w\in W} dng_{ip}^{w} J_{ip}^{w} + \sum_{i\in I}\sum_{p\in P}\sum_{m\in M}\sum_{w\in W} dm_{imp}^{w} h_{imp}^{w} + \sum_{i\in I}\sum_{m\in M}\sum_{w\in W} did_{im}^{w<\tau_s} E_{sm}^{w\leq\tau_g} + \sum_{i\in I}\sum_{m\in M}\sum_{w\in W} dtk_{im}^{w} K_{im}^{w} + \sum_{i\in I}\sum_{p\in P}\sum_{w\in W} dtp_{ip}^{w} j_{ip}^{w} + \sum_{i\in I}\sum_{p\in P}\sum_{w\in W} dtf_{ip}^{w} k_{ip}^{w}$$

The constraints that must be met are as follows:

$$\sum_{s\in S} n_{sip}^{w} j_{ip}^{w} \leq k_{sw}^{p} + b_{op}^{w} \qquad \forall s\in S, \forall w\in W, w<\tau_r, \forall p\in P \qquad (2)$$

Constraint (2) presents the number of raw meat resources needed to produce processed meat products i which must have the same total raw meat resources at the same time as the additional raw meat resources needed. Note that raw meat resources are in storage and have gone through a traceability process.

$$j_{ip}^{w} \leq Dj_{ip}^{w} \qquad \forall i\in I, \forall p\in P, \forall w\in W \qquad (3)$$

Constraint (3) ensure that all types of production for processed fish products *i* occur at the factory *p* within the scheduled time *w*.

$$b_{sp}^{w} \leq H_{ip}^{w} \qquad \forall s\in S, \forall p\in P, \forall w\in W \qquad (4)$$

Constraint (4) represent that the additional amount of raw fish resources *s* has an upper limit on processed fish sources *i*.

$$\sum_{p\in P} l_i j_{ip}^{w} \leq c_{p}^{w} \qquad \forall i\in I, \forall w\in W \qquad (5)$$

Constraint (5) represents the number of permanent workers required expressed in the constraint.

$$E_{sp}^{w} = E_{sp}^{w-1} + \sum_{m\in M} h_{imp}^{w} - F_{ip}^{w} \qquad \forall s\in S, \forall w\in W, \forall m\in M, w<\tau_r \qquad (6)$$

$$E_{sp}^{w\leq\tau_f} \leq TU_{sp}^{w\leq\tau_f} \qquad \forall s\in S, \forall p\in P, \forall w\in W \qquad (7)$$

$$E_{sm}^{w\leq\tau_g} \leq TU_{sp}^{w\leq\tau_f} \qquad \forall s\in S, \forall m\in M, \forall w\in W \qquad (8)$$

Constraint (6)-(8) presents inventory at factory *p* and machine 1 *m* associated shelf life in the expression.

$$c_{w}^{p} = c_{w-1}^{p} + c_{w+1}^{p} - c_{p}^{w-} \qquad w = 2 \ldots .W, \forall p\in P \qquad (9)$$

Constraint (9) represents that the amount of workers available in any time period w is equal to the amount of the previous period plus the change in the amount of types of workers during the current period.

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$$j_{ip}^{w} + A_{ip}^{w-1} + k_{ip}^{w} - A_{ip}^{w} = F_{ip}^{w} \quad \forall i \in I, \forall p \in P, \forall w \in W \quad (10)$$

Constraint (10) establish the quantity produced to be stored in factory inventories or to purchase from other firms to meet shortages in meeting demand.

$$\sum_{i \in I} h_{imp}^{w} \leq \sum_{i \in I} TU_{sp}^{w} \quad \forall m \in M, \forall p \in P, \forall w \in W \quad (11)$$

Constraint (11) ensure that the number of all types of processed fish products from all factories can be processed on the machine 1.

$$h_{imp}^{w} + k_{im}^{w} \geq F_{ip}^{w} \quad \forall i \in I, \forall m \in M, \forall p \in P, \forall w \in W \quad (12)$$

Constraint (12) represents that the number of products produced on machines at the factory for each additional unfulfilled demand must at least be equal to the total market demand.

$$j_{ip}^{w}, b_{sp}^{w}, h_{imp}^{w}, k_{ip}^{w}, E_{sp}^{w \leq \tau_f}, E_{sm}^{w \leq \tau_g}, A_{ip}^{w} \geq 0 \quad \forall i \in I, \forall s \in S, \forall p \in P, \forall m \in M, \forall w \in W \quad (13)$$

$$c_{p}^{w}, c_{p}^{w+}, c_{p}^{w-} \geq 0 \; and \; integer, \quad \forall p \in P, \forall w \in W \quad (14)$$

$$h_{imp}^{w}, l_{ip}^{w} = \{0.1\} \quad \forall i \in I, \forall m \in M, \forall p \in P, \forall w \in W \quad (15)$$

Constraint (13)(14)(15) state the nature of the variables used in the model

4. Conclusion

The successive creation arranging enhancement model in the feasible assembling industry is demonstrated to have the option to tackle the issue of consecutively incorporated creation results to satisfy buyer need. The successive creation arranging model is shown to have the option to be done consecutively as indicated by the progression of exercises so the satisfaction of buyer request is satisfied in the most brief conceivable time, so the complete functional expenses are least.

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