SPEKTRUM INDUSTRI

Journal homepage: http://journal3.uad.ac.id/index.php/spektrum
ISSN 2442-2630 (online) | 1693-6590 (print)

Aggregate Planning Implementation for Planning And Controlling The Materials in The Beverage Packaging Industry

Indra Setiawan[1,*], Nurdiansyah[2], Muh. Tosin[3], Vivi Lusia[4], Muhammad Wahid[5]
[1]Master of Industrial Engineering, Universitas Mercu Buana, Jakarta, 11650, Indonesia
[2,4,5]Industrial Engineering Department, Universitas Borobudur, Jakarta, 13620, Indonesia
[3]Master of Management, Universitas Borobudur, Jakarta 13620, Indonesia
*Corresponding author: indra.setiawan.2022@gmail.com

ARTICLE INFO

Article history
Received: January 2022
Revised : April 2022
Accepted: April 2022

Keywords
Aggregate Planning
Beverage Industry
Box Bottle Tea
Linear Regression

ABSTRACT

The Beverage Packaging Industry is a company that produce ready-to-drink drinks that produces Box Bottle Tea (BBT) 250 slim products. This product is sent to several customers and distributors throughout Indonesia. During 2020 the demand for this product has increased. In addition, the increasing demand also fluctuated significantly so the company was unable to predict production schedule. The continuity of the production process to meet consumer demand requires good production planning. The purpose of this research is to plan and control the production process of BBT 250 slim to obtain optimal raw material requirements. This study uses the method of Linear Regression and Aggregate Planning. Based on the analysis with Linear Regression, this study resulted in a model Y=319.575+3.723X, meaning that if demand decreases, the amount of production also decreases. This model is very useful for the Beverage Packaging Industry in planning and controlling raw materials for production. Calculation of raw material requirements for BBT 250 slim products results in an efficiency of raw materials than usual forecasting.

INTRODUCTION

The Beverage Packaging Industry in Indonesia is currently experiencing very rapid development and has resulted in intense competition in the industrial market (Tannady & Pratama, 2019). The Ministry of Industry noted that the contribution of the food and beverage industry to the Produk Domestik Bruto (PDB) of the non-oil and gas industry reached 34.95 percent in the third quarter of 2017. This performance result makes the sector the largest contributor to industrial PDB compared to other sub-sectors. Companies need to compete to be able to achieve consumer loyalty that is superior to their competitors (Kirana, 2020). For every industry, demand fulfillment, loyalty, and customer satisfaction are important aspects to compete in the global market (Ning et al., 2019). Every industry to be able to achieve this aspect needs to increase productivity and efficiency in its production process (Dahlia & Andri, 2021). Increasing productivity in this industry is more directed at optimizing the production process, especially in production planning for meet consumer demand and produce optimal production output (Gulsun et al., 2009). In addition, the efficiency applied is more directed at minimizing costs in each production process that takes place for generate maximum profits by utilizing available resources (Magdalena, 2020).

Currently, one of the competing industries in the market is more focused on the food and beverage sector. Beverage Packaging Industry is a soft drink industry that provides ready-to-drink products for packaged tea products. This industry is a company that produces the first packaged tea in Indonesia with one of its leading products being Box Bottle Tea (BBT) 250 Slim. Based on initial observations, production demand continues to increase and the amount fluctuates (can be seen Figure 1). However, with fluctuating and dynamic consumer demand, the Beverage Packaging Industry is faced with the problem of not optimally planning its production to produce an accurate product quantity that is close to the actual number of each distributor. This had an impact on production in 2019, the company was unable to produce according to customer demand. High demand while the resulting low production. The continuity of the production process to meet consumer demand requires good production planning (Fairuzzahira et al., 2020). Where production planning is planning about the products produced and the number of products that will be produced in the coming period (Jamalnia et al., 2019). Based on the problems above, it seems that improvements need to be made (Yuliastuti et al., 2019). Therefore, it is necessary to have an improved solution with an approach that can control production so the company can meet customer demands (Atikno et al., 2021). This research will integrate the aggregate planning approach with a statistical approach. Linear regression is needed to complete the data analysis method.

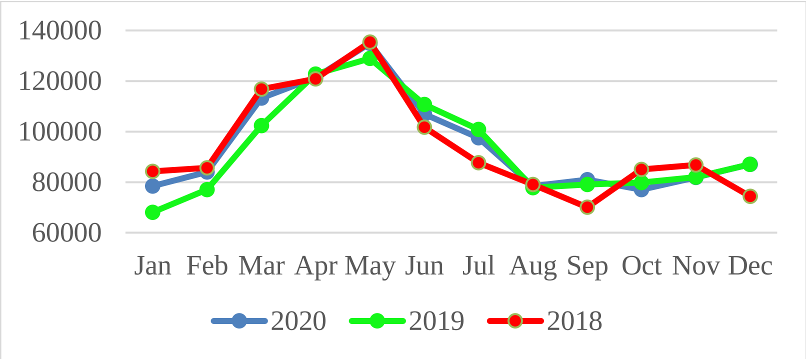

Figure 1. Total of demand (units) 2018-2020

One of the production planning is aggregate planning. Aggregate planning is in the form of the quantity planning process and certain timing through adjustment of factors production level, employees, inventory and other controllable factors (Bagchi & Paul, 2018). Aggregate planning is a method to estimate the amount of output that will be produced to meet demand during the planning period and adjusted to the company's production capacity (Cheraghalikhani et al., 2019). Aggregate planning allows the company to develop a strategy to use company resources well, to achieve effective and efficient capacity based on forecasts of future demand (Taufik et al., 2021). Effective means alignment between planning and the results obtained (Rosyidi & Zabadi, 2019). While efficient means being able to produce a certain output with existing resources as well as possible (Nivasanon et al., 2021).

The development of aggregate planning methods is often implemented in large manufacturing industries to plan and control their production (Jayakumar et al., 2017). The application of aggregate planning not only controls production in large industries but can be applied in small and medium industries (Oey et al., 2020). Several sources of previous research also noted that this method can be integrated with other methods to obtain complex research results (Schroeder & Larson, 1986). Aggregate planning is often combined with algorithms to get a good model that can efficiently and effectively solve all types of aggregate production planning (Biazzi, 2018). This method can suppress the occurrence of product shortages in the manufacturing supply by using two-level particle swarm optimization (Oktavianty & Sukmono, 2020) (Jang & Chung, 2020). There are many advantages to the company if implementing aggregate planning (Nisa & Kusuma, 2017). Aggregate planning is a method for planning and controlling production in the medium term so that companies can minimize their production costs (Juliantara & Mandala, 2020).

The purpose of this research is to plan and control production to help smooth the production process so that the company can meet consumer demand. Based on previous research references which state that aggregate planning can carry out production planning and control, this study will implement an aggregate planning method that is integrated with the linear regression method to determine the capacity of the raw materials so that it becomes novelty in this study .

RESEARCH METHOD

This research focuses on planning and controlling production in the Beverage Packaging Industry to expedite the production process to create products on time. The method used is Linear Regression and Aggregate Planning. The choice of linear regression method as a predictive method in this study is based on its advantages in estimating the parameters of a simple model and the data used are time series based. Linear regression is one of the methods used in production to forecast or predict quality and quantity characteristics. This is because by estimating various product combinations, companies can maximize profits and estimate the right amount of production. This research is included in descriptive research using a quantitative approach. The descriptive technique describes or explains the forecasting process up to aggregate production planning. This research was conducted in the Beverage Packaging Industry which produces bottled tea located in Bekasi, Indonesia. This company was chosen because of fluctuating demand for products from customers and less than optimal production planning, so there is often a problem of excess product inventory when demand is low, on the contrary, there is a shortage of product inventory when demand increases. This has a negative impact on the company's operations where production costs are high, materials are not controlled and targets are not achieved. In addition, strategically the company is unable to compete in the global market because it does not meet customer demands. The product that is the focus of this research is the Box Bottle Tea 250 Slim. The primary data used comes from observations and interviews, while the secondary data comes from company documentation, such as data on the number of requests last year, raw materials, production capacity, production time, articles in journals and institutional annual reports.

This study uses a conceptual framework to determine problems, improvement planning objectives and expected improvement results. The following conceptual framework of this research can be seen in Figure 2.

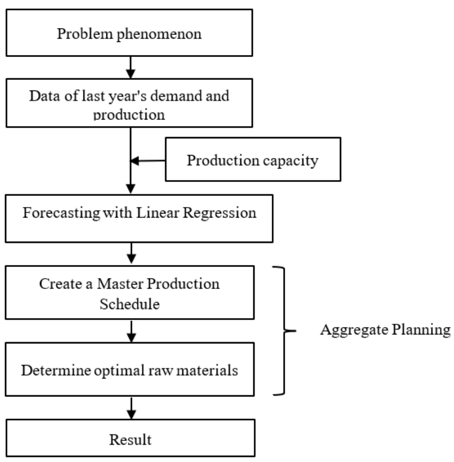

Figure 2. Conceptual framework

The first step is to define the problems that occur in the production of BBT 250 slim. Once the problem is found, then determine the target for improvement. Forecasting is done using Linear Regression. Furthermore, planning and controlling with Aggregate Planning includes making a Master Production Schedule (MPS) with a hybrid strategy and determining raw material requirements with lot for lot. This equation is determined by a = intercept is the point of intersection between the X and Y axes when the value X = 0, while b = the slope of the trendline, which is the rate of change in demand and the value of t = time index (t = 1,2, 3, ,,,, etc.) is the number of time periods. The X and Y equations are used to explain the demand variable and a certain time period in the regression equation so that the best model is obtained. Equation (1)-(4) are used to forecast with linear regression.

$$a = \frac{(\sum Dt^* \ \sum_t 2)-(\sum t^* \sum (dt^*t)}{n \sum_t 2-(\sum t)^2} \quad (1)$$

$$b = \frac{(n\sum Dt^*t)-(\sum Dt^* \sum t)}{n \sum_t 2-(\sum t)^2} \quad (2)$$

$$Ft' = a + b.t \quad (3)$$

$$\text{Unit Production Regular Time (UPRT)} = \frac{(\text{Workday x Capacity})}{\text{Hours}} \quad (4)$$

UPRT is a unit of calculation to determine the number of products produced according to the company's regular schedule.

RESULTS AND DISCUSSION

In this section, analysis is carried out for planning and controlling production with aggregate planning. Data analysis begins with defining the problems experienced by the Beverage Packaging Industry. Production planning in the Beverage Packaging Industry is based on the previous year's demand and production planning. The following is data on demand for BBT 250 slim products in 2020 which can be seen in Table 1.

Table 1. Comparison of demand with the realization in 2020

Month (2020)	Demand	Realization	Lost Sale
Jan	78,401	76,947	-1,454
Feb	84,000	87,902	3,902
Mar	113,289	84,855	-28,434
Apr	121,343	127,285	5,942
May	134,884	136,873	1,989
Jun	106,950	86,577	-20,373
Jul	97,508	76,914	-20,594
Aug	78,451	87,992	9,541
Sep	80,936	58,830	-22,106
Oct	77,004	66,095	-10,909
Nov	81,879	91,400	9,521
Dec	86,979	91,630	4,651
Total	1,141,624	1,073,300	-47,730

Table 1 shows that production demand and realization do not match. This is a problem in the Beverage Packaging Industry that needs good planning and control. Planning is done by considering the available production capacity. The following production capacity available during 2020 can be seen in Table 2. After last year's demand data is known, the next step is forecasting.

Based on Table 1 and Table 2, forecasting is carried out using the Linear Regression method. This data processing is done by using Ms. Excel 2016. The following is the calculation of the constants and their variable coefficients. The regression equation above is interpreted if the independent variable increases by 107,851 it will reduce product demand by 1.956 units or rounding up to 2 units. Forecasting calculations for next year can be seen in Table 3.

Calculating constant according to equation (1)

$$a = \frac{(\sum 1.141.624 * \sum_t 650)-(\sum t78 * \sum 7,140,805)}{\sum_t 12*650-(\sum t78)^2} = 107,851$$

Calculating the coefficient of Variable X according to equation (2)

$$b = \frac{(12*\sum 7,140,805)-(\sum 1,141,624*\sum 78)}{12*\sum_t 650-(\sum t78)^2} = -1.956$$

The values of a and b are substituted into the equation (3), So the linear equation is as follows:

Y = a + b.X
Y = 107,851 - 1,956X

Table 2. Production capacity of BBT 250 slim

Month (2020)	Workday	Production Capacity	BBT 250 Slim (Dt)
Jan	22	360,000	105,895
Feb	19	360,000	103,939
Mar	20	360,000	101,982
Apr	20	360,000	100,026
May	21	360,000	98,070
Jun	23	360,000	96,113
Jul	23	360,000	94,157
Aug	22	360,000	92,201
Sep	21	360,000	90,245
Oct	23	360,000	88,288
Nov	21	360,000	86,332
Dec	21	360,000	84,376

Table 3. The calculation result of forecasting with Ms. Excel

Period (t)	Month	Demand (Ft)	t^2	Dt x t	a	b	Ft'=a+bt
1	Jan	78,401	1	78,401	107,851	-1,956	105,895
2	Feb	84,000	4	168,000	107,851	-1,956	103,939
3	Mar	113,289	9	339,867	107,851	-1,956	101,982
4	Apr	121,343	16	485,372	107,851	-1,956	100,026
5	May	134,884	25	674,420	107,851	-1,956	98,070
6	Jun	106,950	36	641,700	107,851	-1,956	96,113
7	Jul	97,508	49	682,556	107,851	-1,956	94,157
8	Aug	78,451	64	627,608	107,851	-1,956	92,201
9	Sep	80,936	81	728,424	107,851	-1,956	90,245
10	Oct	77,004	100	770,040	107,851	-1,956	88,288
11	Nov	81,879	121	900,669	107,851	-1,956	86,332
12	Dec	86,979	141	1,043,748	107,851	-1,956	84,376
Total		1,141,624	650	7,140,805			1,141,624

Based on Table 3, it can be seen that the forecast for the 2021 period is calculated. Then the calculation using a hybrid strategy can be carried out with production capacity. The calculation of UPRT uses formula (4) and the recapitulation of the results can be seen in Table 4.

UPRT = $\frac{(22\ x\ 360{,}000)}{24}$

= 330,000 (sample January)

Table 4. Recapitulation of RPA with strategy hybrid

Period (t)	UPRT	Production Total/ Carton	Total Demand BBT 250 Slim	Inventory
				20,802
Jan	330,000	330,000	105,895	244,907
Feb	285,000	285,000	105,938	423,969
Mar	300,000	300,000	101,982	621,987
Apr	300,000	300,000	100,026	821,961
May	315,000	315,000	98,070	1,038,891
Jun	345,000	345,000	96,113	1,287,778
Jul	345,000	345,000	94,157	1,538,621
Aug	330,000	330,000	92,201	1,776,420
Sep	315,000	315,000	90,244	2,001,176
Oct	345,000	345,000	88,288	2,257,888
Nov	315,000	315,000	86,332	2,486,556
Dec	315,000	315,000	84,376	2,717,180

Based on the results of the calculations in Table 4, we can know the total value of production per period. The results of the above calculations include the production of BBT 250 slim. The total production in Table 4 will be used as the Master Production Schedule (MPS). UPRT is used because it refers to regular production that is often run by the company so it is assumed that it can be used as MPS. MPS data is taken from the total production recapitulation data on the hybrid strategy. The following is the total production requirement per period as can be seen in Table 5.

Table 5. Master Production Schedule

	Period (Jan - Dec 2020)											
	1	2	3	4	5	6	7	8	9	10	11	12
BBT 250 Slim	330,000	285,000	300,000	300,000	315,000	345,000	345,000	330,000	315,000	345,000	315,000	315,000

Based on the MPS data in Table 5, the planned raw material requirements of the BBT 250 slim component are calculated using the lot for lot method in order to obtain optimal raw material requirements. Lot for lot was chosen because it is able to provide inventory in accordance with the required material so that the amount of inventory available is as minimal as possible. The number of orders is adjusted to the actual number of requests and results in no inventory being stored. So that the costs incurred are only in the form of ordering costs. The lot for lot method is a process to determine the optimal order size for each product item based on the calculation of net needs. The lot for lot method is closely related to determining the number of components or items that must be ordered or provided. This product is composed of several components that make up the Bill of Materials for the BBT 250 slim product which can be seen in Table 6. The following is the calculation of each raw material needed in the manufacture of the BBT 250 slim product sample in January.

Dry Tea
A = 330,000 carton x 24 pack = 7,920,000 pack
7,920,000 pack x 250 ml = 1,980,000 Liter : 6000 (per batch) = 330 batch
330 batch x 36 Kg (per batch) = 11,880 Kg

Sugar
B = 330,000 carton x 24 pack = 7,920,000 pack
7,920,000 pack x 250 ml = 1,980,000 Liter : 6000 (per batch) = 330 batch
330 batch x 2,950 Kg (per batch) = 1,120,079.6 Kg

Water
C = 330,000 carton x 24 pack = 7,920,000 pack
7,920,000 pack x 250 ml = 1,980,000 Liter : 6000 (per batch) = 330 batch
330 batch x 9500 liter (TCP and Sugar Syrup) = 3,135,000 Liter

Straw
D = 330,000 carton x 24 pack = 7,920,000 pack
7,920,000 x 1 pc = 7,920,000 pc

Carton
E = 330,000 x 1 pc = 330,000 pc

Paper
F = 330,000 carton x 24 pack = 7,920,000 pack
7,920,000 pack : 15000 pack (per roll) = 528 Roll

Table 6. Bill of Material of BBT 250 slim

No	Material		Symbol	Unit of Measure
	Level 1	Level 2		
1	Tea	Dry Tea	A	Kg
2		Sugar	B	Kg
3		Water	C	Lt
4	Packaging	Straw	D	Pc
5		Cartoon	E	Pc
6		Paper	F	Roll

Based on the results of the calculation of raw materials above, the company can determine and manage the inventory of raw materials every month. After the calculations are done, the data recapitulation is carried out. The following is a recapitulation of the calculation of raw material requirements for the 2021 period using the lot for lot method which can be seen in Table 7.

Table 7. Raw material requirements for the 2021 period

BBT 250 Slim		Tea (Kg)	Sugar (KG)	Water (lt)	Straw (Pc)	Carton (Pc)	Paper (Roll)
Material/ Batch (6000 lt)		36	2,950	9,500	1	1	15,000
Jan	330,000	11,880	973,500	3,135,000	7,920,000	330,000	528
Feb	285,000	10,260	840,750	2,707,500	6,840,000	285,000	456
Mar	300,000	10,800	885,000	2,850,000	7,200,000	300,000	480
Apr	300,000	10,800	885,000	2,850,000	7,200,000	300,000	480
May	315,000	11,340	929,250	2,992,500	7,560,000	315,000	504
Jun	345,000	12,420	1,017,750	3,277,500	8,280,000	345,000	552
Jul	345,000	12,420	1,017,750	3,277,500	8,280,000	345,000	552
Aug	330,000	11,880	973,500	3,135,000	7,920,000	330,000	528
Sep	315,000	11,340	929,250	2,992,500	7,560,000	315,000	504
Oct	345,000	12,420	1,017,750	3,277,500	8,280,000	345,000	522
Nov	315,000	11,340	929,250	2,992,500	7,560,000	315,000	504
Dec	315,000	11,340	929,250	2,992,500	7,560,000	315,000	504
Total	3,840,000	138,240	11,328,000	36,480,000	84,967,200	3,840,000	6,114
Average	320,000	11,520	944,000	3,040,000	7,080,600	320,000	509.5

Calculation of raw material requirements in 2021 using the Hybrid and Lot for Lot methods is much smaller than the company's calculations based on 2020 data. This interprets that calculations using aggregate planning are more efficient. The comparison of the average material requirements in 2020 and the 2021 plan can be seen in Table 8.

Table 8. Comparison of raw material requirements

Material	Average 2020	Average 2021	Unit of Measure
Dry Tea	11,760	11,520	Kg
Sugar	1,010,000	944,000	Kg
Water	3,072,000	3,040,000	Lt
Straw	7,130,000	7,080,600	Pc
Cartoon	338	320	Pc
Paper	628	509.5	Roll

CONCLUSION

The results showed that to support the smooth production can do planning and control on the material. Controlled materials can reduce high production costs, determine production capacity and meet customer needs so as to support smooth production. Production planning with forecasting calculations using the Linear Regression method produces a model Y = 107,851 – 1.956X. Based on the analysis of aggregate production planning, the calculation of the main raw material needs in 2021 using the Hybrid and Lot for Lot method is much smaller than the company's calculation based on the data in 2020. Based on the calculation with the hybrid strategy, it can be seen that the production plan for the next period is 12 months. Calculation data for forecasting is used for one year only. This research can be continued in further research by planning and controlling production using the time series forecasting method, so that more accurate forecasting calculations will be obtained and in the long term.

REFERENCES

Atikno, W., Setiawan, I., & Taufik, D. A. (2021). Key Performance Indicators Implementation : Literature Review and Development for Performance Measurement. Indonesian Journal of Industrial Engineering & Management, 2(3), 189–197.

Bagchi, S. S., & Paul, R. (2018). Aligning Aggregate Planning with (s,S) Inventory Model in a Stochastic Demand Environment. International Journal of Strategic Decision Sciences, 9(1), 29–44.

https://doi.org/10.4018/IJSDS.2018010103

Biazzi, J. L. (2018). Aggregate Planning for Probabilistic Demand With Internal and External Storage. Journal of Operations and Supply Chain Management, 11(1), 37–52. https://doi.org/10.12660/joscmv11n1p37-52

Cheraghalikhani, A., Khoshalhan, F., & Mokhtari, H. (2019). Aggregate production planning: A literature review and future research directions. International Journal of Industrial Engineering Computations, 10(1), 309–330. https://doi.org/10.5267/j.ijiec.2018.6.002

Dahlia, & Andri. (2021). Implementasi Data Mining untuk Prediksi Persediaan Obat pada Puskesmas Kertapati menggunakan Regresi Linier Berganda. Jurnal Sistem Dan Informatika, 15(2), 95–103. https://doi.org/10.30864/jsi.v15i2.331

Fairuzzahira, F., Sukardi, S., & Arkeman, Y. (2020). Perencanaan Produksi Agregat CV XYZ Dengan Jumlah Tenaga Kerja Tetap. Jurnal Aplikasi Bisnis Dan Manajemen, 6(2), 291–302. https://doi.org/10.17358/jabm.6.2.291

Gulsun, B., Tuzkaya, G., Tuzkaya, U. R., & Onut, S. (2009). An Aggregate Production Planning Strategy Selection Methodology based on Linear Physical Programming. 16(2), 135–146.

Jamalnia, A., Yang, J., Feili, A., Xu, D., & Jamali, G. (2019). Aggregate production planning under uncertainty : a comprehensive literature survey and future research directions. The International Journal of Advanced Manufacturing Technology, 102(183), 159–181. https://doi.org/https://doi.org/10.1007/s00170-018-3151-y

Jang, J., & Chung, B. Do. (2020). Aggregate production planning considering implementation error : A robust optimization approach using bi-level particle swarm optimization. Computers & Industrial Engineering, 142(4), 1–12. https://doi.org/10.1016/j.cie.2020.106367

Jayakumar, A., Krishnaraj, C., & Raghunayagan, P. (2017). Aggregate Production Planning For A Pump Manufacturing Company : Chase Strategy. International Research Journal of Engineering and Technology, 04(12), 628–632.

Juliantara, I. K., & Mandala, K. (2020). Perencanaan Dan Pengendalian Produksi Agregat Pada Usaha Tedung UD Dwi Putri di Klungkung. E-Jurnal Manajemen, 9(1), 99. https://doi.org/10.24843/ejmunud.2020.v09.i01.p06

Kirana, D. H. (2020). The Analysis of Aggregate Planning Implementation to Satisfy the Changes of Consumer Demand in PT. PIC. Jurnal Ekonomi Dan Bisnis Terapan Universitas Padjajaran, 16(2), 21–29.

Magdalena, R. (2020). Analysis of the Aggregate Heuristic Planning for Planning and Controlling the Amount of Production to Minimize Costs. Operations Research: International Conference Series, 1(1), 1–12. https://doi.org/10.47194/orics.v1i1.18

Ning, Y., Pang, N., & Wang, X. (2019). An Uncertain Aggregate Production Planning Model Considering Investment in Vegetable Preservation Technology. Mathematical Problems in Engineering, 2019, 1–10. https://doi.org/10.1155/2019/8505868

Nisa, A. K., & Kusuma, T. Y. T. (2017). Perencanaan Dan Pengendalian Produksi Dengan Metode Aggrate Planning di C-Maxi Alloycast. Integrated Lab Journal, 5(2), 51–62.

Nivasanon, C., Srikun, I., & Aungkulanon, P. (2021). Aggregate production planning: A case study of installation elevator company. Proceedings of the International Conference on Industrial Engineering and Operations Management, 5357–5365.

Oey, E., Wijaya, W. A., & Hansopaheluwakan, S. (2020). Forecasting and aggregate planning application – a case study of a small enterprise in Indonesia. International Journal of Process Management and Benchmarking, 10(1), 1–21. https://doi.org/10.1504/IJPMB.2020.104229

Oktavianty, V. N., & Sukmono, T. (2020). Optimalisasi Penentuan Biaya Minimum Pada Pengendalian Persediaan Bahan Baku Dengan Menggunakan Metode Dynamic Programming (Studi Kasus di PT. XYZ). Spektrum Industri, 18(1), 15–22.

Rosyidi, M. R., & Zabadi, F. F. (2019). Perencanaan Produksi pada Produk Hollow dengan Ukuran 15 mm X 35 mm X 0.30 mm. Jurnal Rekayasa Sistem Industri, 8(1), 27–38. https://doi.org/10.26593/jrsi.v8i1.3099.27-38

Schroeder, R. G., & Larson, P. D. (1986). A reformulation of the aggregate planning problem. Journal of Operations Management, 6(3), 245–256. https://doi.org/10.1016/0272-6963(86)90001-X

Tannady, H., & Pratama, Y. D. (2019). Analisis Perencanaan Persediaan Bahan Baku Menggunakan Metode Economic Order Quantity Dengan Pertimbangan Stockout Cost (Studi Kasus Pada PT. Multi Logam Presisi). Spektrum Industri, 17(2), 93. https://doi.org/10.12928/si.v17i2.13944

Taufik, D. A., Setiawan, I., Wahid, M., Rochim, A., & Tosin, M. (2021). Integration of linear regression and aggregate planning for Hino OW 190/200 Leaf Spring production planning and control in the automotive component industry. Operations Excellence: Journal of Applied Industrial Engineering, 13(2), 245. https://doi.org/10.22441/oe.2021.v13.i2.023

Yuliastuti, G. E., Rizki, A. M., & Tama, I. P. (2019). Optimization of Multi-Product Aggregate Production Planning using Hybrid Simulated Annealing and Adaptive Genetic Algorithm. International Journal of Advanced Computer Science and Applications, 10(11), 484–489.