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Literature Review of the Effectiveness of Using Aggregate Planing in the Msme Industry

Antonius Cahyono[1]✉, Prihono[2], Indra Dwi Febrianto[3]

PGRI Adi Buana Surabaya[(1,2,3)]

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✉ Corresponding author:

[Antonwongso168@gmail.com]

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Abstract

This research investigates the effectiveness of using Aggregate Planning in the Micro, Small and Medium Enterprises (MSME) industry. Through a literature review using national and international scientific journal articles from 2018-2023, this research identified three main approaches to aggregate planning: Level Strategy, Chase Strategy, and Mixed Strategy. Level Strategy maintains production levels at a constant level, using inventory as a buffer to deal with fluctuations in demand. Chase Strategy adjusts production directly to market demand, minimizing inventory and carrying costs. Mixed Strategy, a combination of Chase Strategy and Level Strategy, combines the flexibility of Chase Strategy with the stability of Level Strategy to optimize production and inventory costs. This research describes how MSMEs in the children's clothing industry implement these three strategies. In Level Strategy, production is kept at a constant level, using inventory as a buffer. In the Chase Strategy, production is matched directly to demand, reducing inventory and carrying costs. In Mixed Strategy, the combination of strategies allows flexible response to demand fluctuations, minimizing inventory costs. The calculation results show that using Mixed Strategy allows companies to optimize production, reduce inventory costs, and respond quickly to variations in market demand. The total costs during this period were the result of production costs, inventory costs, overtime costs, and worker salaries, reaching a total of IDR 124,900,000. This research provides insight into how MSMEs can utilize aggregate planning with various strategies to increase their operational efficiency and flexibility in facing market dynamics.

Abstrak

Penelitian ini menyelidiki efektivitas penggunaan Aggregate Planning pada industri Usaha Mikro, Kecil dan Menengah (UMKM). Melalui tinjauan literatur menggunakan artikel jurnal ilmiah nasional dan internasional tahun 2018-2023, penelitian ini mengidentifikasi tiga pendekatan utama dalam perencanaan agregat: Level Strategy, Chase Strategy, dan Mixed Strategy. Level Strategy menjaga tingkat produksi pada tingkat yang konstan, menggunakan inventaris sebagai penyangga untuk menghadapi fluktuasi permintaan. Strategi Chase

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menyesuaikan produksi secara langsung dengan permintaan pasar, meminimalkan persediaan dan biaya penyimpanan. Mixed Strategy, kombinasi Chase Strategy dan Level Strategy, menggabungkan fleksibilitas Chase Strategy dengan stabilitas Level Strategy untuk mengoptimalkan biaya produksi dan inventaris. Penelitian ini menjelaskan bagaimana UMKM industri pakaian anak menerapkan ketiga strategi tersebut. Dalam Strategi Tingkat, produksi dijaga pada tingkat yang konstan, dengan menggunakan persediaan sebagai penyangga. Dalam Strategi Pengejaran, produksi disesuaikan langsung dengan permintaan, sehingga mengurangi persediaan dan biaya penyimpanan. Dalam Strategi Campuran, kombinasi strategi memungkinkan respons yang fleksibel terhadap fluktuasi permintaan, meminimalkan biaya inventaris. Hasil perhitungan menunjukkan bahwa dengan menggunakan Mixed Strategy memungkinkan perusahaan untuk mengoptimalkan produksi, mengurangi biaya persediaan, dan merespon dengan cepat variasi permintaan pasar. Total biaya pada periode tersebut yang merupakan gabungan dari biaya produksi, biaya persediaan, biaya lembur, dan gaji pekerja mencapai total Rp 124.900.000. Penelitian ini memberikan wawasan bagaimana UMKM dapat memanfaatkan perencanaan agregat dengan berbagai strategi untuk meningkatkan efisiensi dan fleksibilitas operasionalnya dalam menghadapi dinamika pasar.

1. INTRODUCTION

In preparing production plans, one of the problems that management often faces is insufficient inventory or product inventory that is too large (overstock), as well as not being able to complete the production process on time. Output volume is influenced by market size and consumer demand . When the company's production numbers and market demand do not match, finished goods inventories can pile up in the company's warehouse. This can have an impact on the storage costs for finished goods that the company must pay each period. This can also cause losses due to the company's inability to meet consumer demand. Therefore, forecasting is a key stage in a company's production planning in order to reduce losses. (Nugroho & Andrean, 2021)

Design plays a critical role in proper supply chain performance. An issue that makes the design of supply chain procedures even more important is how waste products are managed efficiently. In other words, in supply chain design, special attention must be paid to returned products, a problem that demands the creation of a reverse supply chain. Furthermore, a suitable supply chain is a competitive advantage for companies and factories and helps them survive in the competitive market. Investigations carried out on supply chain models show that most of the research is devoted to studying progressive supply chains. If the forward supply chain is concerned with the flow from raw materials to the final product and from the producer to the consumer, then the reverse supply chain is concerned with the reverse flow from the consumer to the producer. In addition, some supply chains pay attention to reverse flow and forward flow (Yousefi et al., 2023)

aggregate planning method is one way to help MSMEs overcome challenges and prevent unnecessary expenditure. By applying this method, businesses must be able to estimate the amount of production, capacity and resources needed to meet demand in the coming period while spending as little as possible, thereby ultimately minimizing production costs. Referring to this background, this research aims to examine the effectiveness of using aggregate planning in the MSME industry.

2. METHODS

The method used in this research is a literature *review* which was carried out using the online search method for national and international scientific journal articles in several journal search engines such as Google Scholar, Science Direct, and the Garuda Portal. Article searches are based on the subject (title) with the keywords "aggregate planning" "UMKM" "Aggregate Planning". The articles used are limited to journals published in the last five years (2018-2023).

3. RESULT AND DISCUSSION

Aggregate Planning

A typical supply chain consists of sequential production, inventory and distribution operations (Hrabec et al., 2022) . Aggregate production planning simultaneously establishes optimal levels of production, inventory, and employment within a limited planning period to meet total demand for all products using the same limited resources (Cheraghalikhani et al., 2019) . Aggregate planning is a complex problem primarily because of the need to coordinate interacting variables so that the company can respond to demand in an effective manner. The general overview of the assumptions of the aggregate planning model is that market demand is deterministic, production costs in a certain planning period are linear or piecemeal. Then the costs that arise due to changes in the rate of production in a certain period are also linear or piecemeal. There are restrictions on the overall planning period because it varies for each planning period. Back orders may or may not be permitted, and other assumptions applicable to a particular model are introduced as necessary.

MSMEs

MSMEs are basically companies or businesses run by families, households, organizations or individual entrepreneurs. Due to their significant contribution to economic growth, MSMEs are very important in Indonesia. The food industry employs the majority of micro and small industries (IMK) in Indonesia. The Central Statistics Agency (BPS) reported that in 2020, there were 1.51 million IMK business units in the food industry. The food industry contributes 36 percent of all national IMK or 4.21 million business units. With a total of 632 thousand business units or 15% of the total national IMK, the wood industry and cork, rattan and bamboo commodities (apart from furniture) are the next most dominant sectors. With less than a thousand company units per sector, the two business fields that IMK has entered the least are computers and electrical equipment.

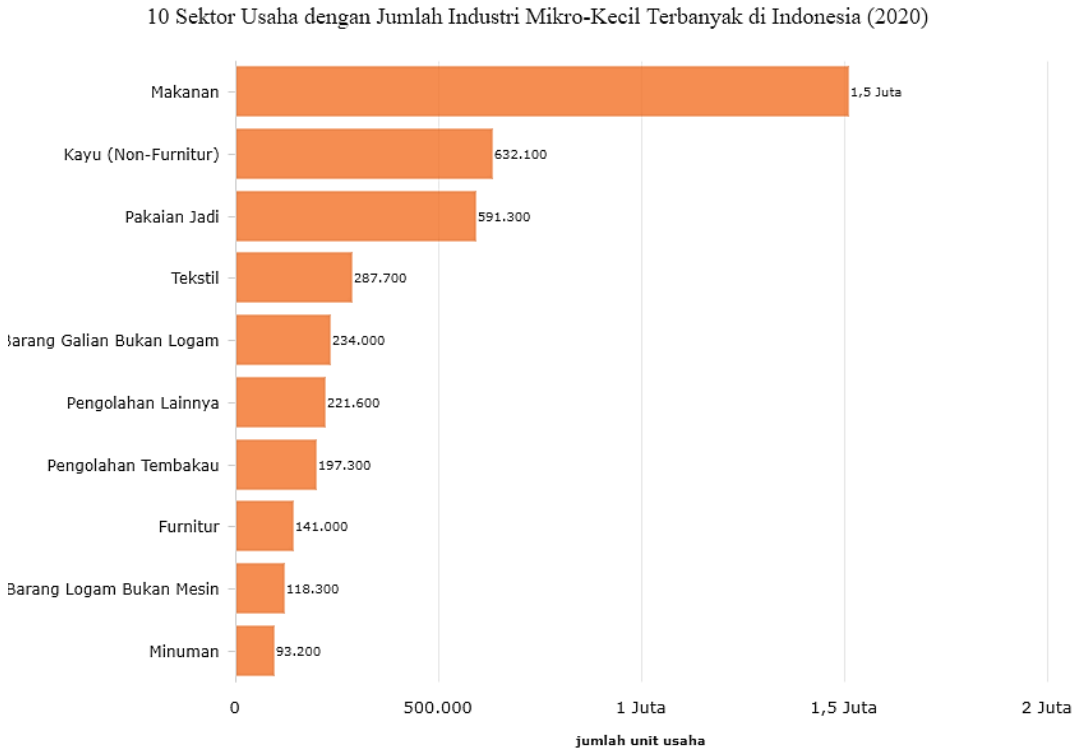

Figure 1 . 10 Largest Micro-Small Industrial Sectors in Indonesia (2020)
Source: (Ahdiat, 2022)

Table 1. Literature Review Results

No	Author, Year	Title	Method	Results
1	(Bueno et al., 2020)	Smart production planning and control in the Industry 4.0 context: A systematic literature review	systematic literature review	There are 3 factors driving the exploration of intelligent capabilities in Production Planning and Control, namely: - Digitalization with support for real-time communication, synchronization, visibility and traceability.

				- System integration that delivers predictability, interoperability, servitization, and reconfiguration. - Automation to be more adaptive, dynamic, responsive and robust
2	(Nugroho & Andrean, 2021)	Planning the T-Shirt Printing Production Process with Heuristic Aggregate Planning Method at Doublefive Store and Clothing Yogyakarta	Heuristic method	Based on research findings, the company's costs are lower if it uses a labor control approach than if it uses an inventory management method . The cost of the chosen approach is Rp. 20,442,987.22, with a difference of Rp. 10,025 from inventory control.
3	(Ensaftyan, 2022)	Bread Production Planning and Control Using the Heuristic Aggregate Planning Method at CV. Family Bakery	aggregate planning method heuristic for	Based on the findings of production planning and control using a heuristic aggregate planning approach, it provides maximum total production with minimum total production costs by regulating maximum overtime utilization. Total production using the heuristic aggregate planning approach with overtime control was 3,953,498 packs of bread/year, 2.8% higher than the total output in the previous period of 3,845,714 packs of bread/year. The total production costs using the heuristic aggregate planning approach with overtime control are IDR 1,069,040,000/year, lower than the company's total production costs in the previous year, namely IDR 1,153,714,000/year, and the company can save production costs of 7. 3%.
4	(Patrobas et al., 2021)	Analysis of Coconut Flour Production Planning Using the Aggregate Planning Method At PT. Tropica Coco Prima in Lelema, South Minahasa	Quantitativ e descriptive	The findings show that *the chase strategy* should be used for aggregate planning because it produces lower production costs compared to the level strategy and the *exponential smoothing method* with a constant of 0.2. The MAD and MAPE or bias values are the smallest and are able to make money from the original production costs. With *a chase strategy* , businesses can adjust the number of employees based on the volume of customer demand.
5	(Nirwansyah & Bastuti, 2022)	Controlling Panir Flour Production Using the Aggregate Planning Method at SME Delsha Food Muhammad	forecasting methods and aggregate planning methods	Due to its ability to reduce warehousing expenses, this research shows that *Chasing strategy* is the most cost effective. The weakness of implementing *the Chasing strategy* , namely employing temporary or contract workers, must still be taken into account. The business world may face risks due to substandard staff performance as well as possible production failures caused by high levels of human error.

Based on future demand projections, aggregate planning allows companies to design optimal strategies for using their resources to achieve effective and efficient capacity. Effectiveness is a balance between planning and results, while efficiency is the capacity to produce a certain output with the fewest resources **.** (Patrobas et al., 2021) Planners must select a facility's production levels for the next three to eighteen months based on projected demand, facility capacity, inventory levels, staffing, and related inputs. In aggregate planning, the quantity of goods produced, independent of the type of product, determines the production plan, rather than reducing it per product. There are generally three approaches that can be used for aggregate planning, depending on the trade-

off between costs associated with production capacity, inventory costs, and backlog costs. (Frenia & Rusdianto, 2023) ,

In large industrial enterprises, the aggregate planning method is often used to plan and control production. Aggregate planning can be used to control output not only in large industries, but also in small and medium-sized businesses. Several previous research sources also show that this strategy can be combined with other strategies to obtain complex research results. Aggregate planning is often integrated with algorithms to produce good models capable of solving all types of aggregate production planning efficiently and effectively. By using two-level particle swarm optimization, this strategy can eliminate product shortages in manufacturing supply. (Setiawan et al., 2022) .

Meanwhile. in research (Sari et al., 2022) on MSME Makmur Jaya, namely when demand exceeds overall production capacity, a way to reduce company expenditure costs is found through aggregate planning calculations. The cheapest estimated cost for planning production for the next 12 months is IDR 80,916,600.00 which can be used to apply the *Level Strategy technique* . Furthermore, according to (Jufriyanto, 2023) there are three marketing strategies, namely using and improving promotions through existing online media, improving services to consumers, and participating in marketing activity training.

Aggregate Planning Strategy

In aggregate planning, the company carries out calculations using three main strategies: pursuit strategy, level strategy, and mixed strategy, based on the results of previous forecast calculations. This strategy helps MSME companies determine how production, number of workers, and material costs will be adjusted to fluctuations in market demand. Decision making in aggregate planning is based on collected data, including labor quantities, labor costs, and material costs, which are documented in Table 2. By considering these data, companies can optimize their production strategies, manage costs efficiently, and respond to changes market properly.

Table 2. Supporting Data for Aggregate Planning for MSMEs in the Children's Clothing Industry

Preliminary data	
Current Workers	5
Hiring Cost	IDR -
Firing Cost	IDR -
Inventory Cost	IDR -
Worker/Person Salary	IDR3,500,000
Material Cost/unit	IDR 500
Stockout Cost	IDR -
Overtime Pay/day	IDR 100,000
Products/Employees/Day	IDR. 1,000

Currently, the company has 10 workers with a salary cost per worker of IDR 3,500,000 per month. The cost of raw materials per unit is IDR 500. Although hiring costs, firing costs and inventory costs are not mentioned, these costs must be considered in aggregate planning to calculate total production costs . In addition, the company pays an overtime salary of IDR 100,000 per day, which is an important factor in calculating additional production costs due to overtime. The products that can be produced by each worker per day are 1000 units, giving an idea of the level of worker productivity. This data provides the basis for calculating production costs, determining aggregate planning strategies, and optimizing company operations in the face of fluctuations in market demand.

Level Strategy

In Level Strategy, the company's production volume is maintained at a constant level, and the inventory formed during the production period can be used to meet excess demand for products at certain times. In other words, the company maintains production at a stable level, even though market demand fluctuates. The inventory that forms can act as a buffer to deal with unexpected spikes in demand, so that customers can still be served without experiencing stock shortages. Table 3 likely contains calculation results showing constant production levels and inventory built up over a certain period, providing a clear picture of how the company manages production and inventory to maintain a balance between product supply and demand.

Table 3. Strategy Level Calculation Results Data (in thousands)

Month	Worker	Production (Units)	Demand (Units)	Inventory (Units)	Production cost	Inventory Costs	Salary expense	Total Cost
Feb-23	1	10	9500	0.5	Rp. 5,000	Rp. 250	Rp. 3,500	Rp. 8,750
Mar-23	1	10	9200	0.8	Rp. 5,000	Rp. 400	Rp. 3,500	Rp. 8,900
Apr-23	1	10	9300	0.7	Rp. 5,000	Rp. 350	Rp. 3,500	Rp. 8,850
May-23	1	10	9600	0.4	Rp. 5,000	Rp. 200	Rp. 3,500	Rp. 8,700
Jun-23	1	10	9400	0.6	Rp. 5,000	Rp. 300	Rp. 3,500	Rp. 8,800
Jul-23	1	10	9700	0.3	Rp. 5,000	Rp. 150	Rp. 3,500	Rp. 8,650
Total								Rp. 52,650

Data on production, demand, inventory, production costs, inventory costs, and payroll costs are calculated based on the Level strategy, where production is kept at a constant level and inventory is used to offset fluctuations in demand. Total costs are the result of production costs, inventory costs, and salary costs during the period in question. The total production costs for aggregate planning using the Level Strategy method are IDR 52,650,000.

Chase Strategy

The chase strategy is a method used to organize production in such a way that inventory can be minimized and stable. In this strategy, production is adjusted directly to fluctuating market demand, so the company does not need to keep large inventories. Thus, inventory storage costs can be minimized. Table 4 may contain calculation results using a chase strategy, which includes production adjusted to market demand in each specific period. This data provides an overview of how companies use chase strategies to keep inventory at minimal levels, increase operational efficiency, and reduce inventory costs in order to appropriately meet customer demand.

Table 4. Chase Strategy Calculation Results Data (in thousands)

Month	Number of workers	Hiring & Firing	Worker	Production (Units)	Demand (Units)	Inventory (Units)	B. Production	Inventory Costs	Salary expense	Total Cost
Feb-23	0.005	-	1	10	9.5	0.5	Rp. 5,000	Rp. 250	Rp. 3,500	Rp. 8,750
Mar-23	0.005	-	1	10	9.2	0.8	Rp 5,000	Rp. 400	Rp. 3,500	Rp. 8,900
Apr-23	0.005	-	1	10	9.3	0.7	IDR 5,000	Rp. 350	Rp. 3,500	Rp. 8,850
May23	0.005	-	1	10	9.6	0.4	IDR 5,000	Rp. 200	Rp. 3,500	Rp. 8,700
Jun-23	0.005	-	1	10	9.4	0.6	IDR 5,000	Rp. 300	Rp. 3,500	Rp. 8,800
Jul-23	0.005	-	1	10	9.7	0.3	IDR 5,000	Rp. 150	Rp. 3,500	Rp. 8,650
Total										Rp.52,650

Table 4 displays the calculation results using the Chase Strategy for the last six months. In this strategy, the number of workers and production is adjusted according to market demand each month, keeping inventory at a minimum level. In February 2023, with five workers, production of 10,000 units meets demand for 9,500 units with an inventory of 500 units. During March through July, the number of workers and production remains constant, but inventory fluctuates to adjust to variations in demand. Production costs, inventory costs, and salary costs are calculated, resulting in total costs of IDR 52,650,000 for the period. This table provides an overview of how companies use Chase Strategy to maintain inventory as efficiently as possible, minimize inventory costs, and meet market needs in a timely manner, creating efficient and cost-effective operations in the process.

Mixed Strategy

Mixed Strategy is an approach that involves changing more than one controllable variable, including a combination of Chase Strategy and Level Strategy. In this strategy, companies can adjust production, number of workers, and inventory according to fluctuations in market demand. A company may maintain a fixed production

level (Level Strategy) to meet steady demand, while also allowing for production adjustments (Chase Strategy) at certain times in case of sudden spikes in demand or market changes. Table 5 is the result of calculations using this strategy, which may include data on how production, headcount, and inventory are organized in response to changes in demand, providing a comprehensive picture of how Mixed Strategy is used to optimize production, reduce inventory costs, and maintain customer satisfaction by face variations in market demand.

Table 5. Calculation Result Data Using Mixed Strategy

Month	Regular Working Days	Overtime Work Days (Days)	Total Production Reg. (Units)	Total Overtime Production (Units)	Number of Workers Reg. (Person)	Qty Worker overtime (Person)	Total Production Reg. (Units)	Total Overtime Production (Units)
Feb-23	20	4	1000	200	5	2	5000	400
Mar-23	22	3	1000	150	5	2	5000	300
Apr-23	20	5	1000	250	5	2	5000	500
May-23	22	2	1000	200	5	1	5000	200
Jun-23	20	3	1000	150	5	2	5000	300
Jul-23	22	2	1000	200	5	1	5000	200

Table 6. Mixed Strategy Calculation Results Data (Continued)

Overall Production Total	Demand (Units)	Inventory (Units)	Production cost	Inventory Costs	Overtime expense	Worker Salaries	Total cost
5400	9500	400	IDR 2,500,000	IDR 200,000	IDR 400,000	IDR 17,500,000	IDR 21,000,000
5300	9200	300	IDR 2,500,000	IDR 150,000	IDR 300,000	IDR 17,500,000	IDR 20,750,000
5500	9300	500	IDR 2,500,000	IDR 250,000	IDR 500,000	IDR 17,500,000	IDR 21,000,000
5200	9600	200	IDR 2,500,000	IDR 100,000	IDR 200,000	IDR 17,500,000	IDR 20,600,000
5300	9400	300	IDR 2,500,000	IDR 150,000	IDR 300,000	IDR 17,500,000	IDR 20,950,000
5200	9700	200	IDR 2,500,000	IDR 100,000	IDR 200,000	IDR 17,500,000	IDR 20,600,000
Total			IDR 15,000,000	IDR 950,000	IDR 1,900,000	IDR 105,000,000	IDR 124,900,000

Tables 5 and 6 show the calculation results using Mixed Strategy for the last six months. In this strategy, a combination of Chase Strategy and Level Strategy is implemented by maintaining regular production at a certain level (Level Strategy) while also allowing workers to work overtime (Chase Strategy) to respond to fluctuations in market demand. Each month, the number of regular and overtime working days, regular production per worker, overtime production per worker, number of regular workers, and number of overtime workers are set to meet different demands. Total total production, demand, inventory, production costs, inventory costs, overtime costs, worker salaries, and total costs are calculated by considering these variables. Thus, Mixed Strategy allows companies to optimize production, minimize inventory costs, and maintain customer satisfaction by responding

with flexibility to variations in market demand. The total costs during this period were the result of production costs, inventory costs, overtime costs, and worker salaries, reaching a total of IDR 124,900,000.

4. CONCLUSION

Based on the results of calculations and analysis using three main strategies in aggregate planning, namely Level Strategy, Chase Strategy, and Mixed Strategy, it can be concluded that the choice of aggregate planning strategy has a significant impact on the operational efficiency and production costs of MSME companies in the Children's Clothing Industry. In a Level Strategy, production is maintained at a constant level, with inventory acting as a buffer to deal with fluctuations in market demand. On the other hand, Chase Strategy allows companies to adjust production directly to fluctuations in market demand, reducing the need for large inventories. Therefore, even if inventory costs are low, production costs and worker salaries can increase significantly.

The Mixed Strategy approach combines elements of Level Strategy and Chase Strategy, allowing for flexibility in addressing variations in market demand. In this strategy, regular production is maintained at a certain level, while overtime production is used to respond to spikes in demand. Although inventory costs and production costs are relatively low, overtime costs must be taken into account, which can increase total production costs. Overall, the selection of an aggregate planning strategy must consider the trade-off between production costs, inventory costs, and labor costs. Companies need to carefully evaluate their market needs and production capacity to choose the most suitable strategy. In the context of MSMEs in the Children's Clothing Industry, Mixed Strategy may be the best choice because it provides flexibility in responding to fluctuations in demand without sacrificing production stability and optimizing the use of human resources. However, companies must continue to monitor and manage overtime costs carefully to ensure operational sustainability and company profits in the long term.

5. REFERENCES

Ahdiat, A. (2022). *Mayoritas Industri Mikro-Kecil Bergerak di Sektor Makanan*. Databoks. https://databoks.katadata.co.id/datapublish/2022/03/30/mayoritas-industri-mikro-kecil-bergerak-di-sektor-makanan

Bueno, A., Godinho Filho, M., & Frank, A. G. (2020). Smart production planning and control in the Industry 4.0 context: A systematic literature review. *Computers and Industrial Engineering*, *149*(August), 106774. https://doi.org/10.1016/j.cie.2020.106774

Cheraghalikhani, A., Khoshalhan, F., & Mokhtari, H. (2019). Aggregate production planning: A literature review and future research directions. *International Journal of Industrial Engineering Computations*, *10*(2), 309–330. https://doi.org/10.5267/j.ijiec.2018.6.002

Ensaftyan, M. B. (2022). *Perencanaan Dan Pengendalian Produksi Roti Menggunakan Metode Aggregate Planning Heuristik Di CV . Family Bakery Produksi Untuk Minimasi Biaya " heuristik untuk proses perencanaan dan pengendalian produksi roti secara menyeluruh*. *17*(November), 136–144. https://doi.org/10.52072/arti.v17i2.409

Frenia, Z. V. C., & Rusdianto. (2023). SEIKO : Journal of Management & Business Analisis Perencanaan Produksi Kitchenware Dengan Metode Aggregate Planning. *SEIKO : Journal of Management & Business*, *6*(2), 319–328.

Hrabec, D., Hvattum, L. M., & Hoff, A. (2022). The value of integrated planning for production, inventory, and routing decisions: A systematic review and meta-analysis. *International Journal of Production Economics*, *248*(November 2021). https://doi.org/10.1016/j.ijpe.2022.108468

Jufriyanto, M. (2023). Strategi Pemasaran Pada UMKM Ikhtiar dengan Analisis SWOT dan Weighted Aggregated Sum Product Assesment (WASPAS). *JISI: JURNAL INTEGRASI SISTEM INDUSTRI*, *10*(2).

Nirwansyah, M. J., & Bastuti, S. (2022). Pengendalian Produksi Tepung Panir Dengan Metode Perencanaan Agregat Pada UKM Delsha Food. *Prosiding SEINTEK Universitas Pamulang*, *1*(1), 174–185.

Nugroho, I. A., & Andrean, E. (2021). PERENCANAAN PROSES PRODUKSI PENYABLONAN T-SHIRT DENGAN METODE AGGREGATE PLANNING HEURISTIK DI DOUBLEFIVE STORE AND CLOTHING YOGYAKARTA. In *Jurnal Teknologi Technoscientia* (Vol. 11, Issue 1, pp. 31–35).

Patrobas, G., Hassan, A., & Pondaag, J. (2021). Analisis Perencanaan Produksi Tepung Kelapa Dengan Metode Agregat Planning Pada PT. Tropica Coco Prima Di Lelema Minahasa Selatan. *Jurnal EMBA*, *9*(3), 1173–1182.

Sari, S., Pitaloka, D. A., Hergiyan, S., Siburian, B., Bagus, I., & Yordan, P. (2022). Analisis Metode Agregat Planning untuk Minimasi Biaya pada UMKM Makmur Jaya-Jakarta. *Jurnal Teknik*, *11*(02), 59–68. http://jurnal.umt.ac.id/index.php/jt/index

Setiawan, I., Nurdiansyah, N., Tosin, M., Lusia, V., & Wahid, M. (2022). Aggregate Planning Implementation for Planning and Controlling The Materials in The Beverage Packaging Industry. *Spektrum Industri*, *20*(1), 91–100. https://doi.org/10.12928/si.v20i1.25

Yousefi, O., Rezaeei Moghadam, S., & Hajheidari, N. (2023). Solving a multi-objective mathematical model for aggregate production planning in a closed-loop supply chain under uncertain conditions. *Journal of Applied Research on Industrial Engineering*, *10*(1), 25–44.