



Optimizing the Production of Micro, Small, and Medium Enterprises Using the *Heijunka* Method and *Single Minute Exchange of Dies*

*Fiky Two Nando^a, Moch Isabil Liwaq^a, Muhamad Farhan Rizki^a, Vava Surya Pambudi^a, Auviano Bidana Friski^a

^a Universitas 17 Agustus 1945 Surabaya

*Email Correspondence: fikynando@untag-sby.acc.id

Abstract

Micro, Small, and Medium Enterprises (MSMEs) producing bags often face production challenges such as long setup times, unbalanced workloads, and excessive inventory, which reduce efficiency and productivity. This study aims to optimize the production process by applying the Heijunka and Single Minute Exchange of Dies (SMED) methods as part of the Lean Manufacturing approach. The analysis was conducted quantitatively based on actual production data of three types of bags over 27 working days with 13 workers and 8 working hours per day. The results show that the Heijunka method successfully leveled production variation into a daily combination of 30 units of Bag A, 33 units of Bag B, and 14 units of Bag C, resulting in a more stable workflow and reduced overproduction. The application of SMED reduced setup time from 1,560 minutes to 327.6 minutes per month, achieving 79% efficiency improvement, and decreased utilization from 105.36% to 102.6%. These findings indicate that the combination of Heijunka and SMED is effective in improving efficiency, flexibility, and production stability in bag SMEs without requiring significant investment, while enabling the company to meet customer demand on time.

Keywords: *Heijunka, SMED, Lean Manufacturing, Bag SMEs.*

Abstrak

Produsen tas Usaha Mikro, Kecil, dan Menengah (UMKM) menghadapi tantangan dalam proses produksi seperti waktu persiapan yang lama, ketidakseimbangan beban kerja, dan penumpukan persediaan, yang menurunkan efisiensi dan produktivitas. Penelitian ini bertujuan untuk mengoptimalkan proses produksi dengan menerapkan metode Heijunka dan Single Minute Exchange of Dies (SMED) sebagai bagian dari pendekatan Lean Manufacturing. Analisis dilakukan secara kuantitatif berdasarkan data aktual produksi tiga jenis kantong selama 27 hari kerja dengan 13 pekerja dan 8 jam kerja per hari. Hasil penelitian menunjukkan bahwa metode Heijunka mampu mendistribusikan variasi produksi secara merata menjadi kombinasi harian 30 unit Tas A, 33 unit Tas B, dan 14 unit Tas C sehingga alur kerja lebih stabil dan kelebihan produksi dapat ditekan. Implementasi SMED berhasil mengurangi waktu persiapan dari 1.560 menit menjadi 327,6 menit per bulan atau efisiensi sebesar 79%, serta menurunkan nilai pemanfaatan dari 105,36% menjadi 102,6%. Temuan penelitian ini menunjukkan bahwa kombinasi metode Heijunka dan SMED efektif dalam meningkatkan efisiensi, fleksibilitas, dan stabilitas proses produksi kantong UMKM tanpa memerlukan investasi besar, serta membantu perusahaan memenuhi permintaan pelanggan secara tepat waktu.

Kata Kunci: Heijunka, SMED, *Lean Manufacturing*, UMKM tas.



INTRODUCTION

Lean Manufacturing is a continuous improvement approach that focuses on reducing waste and increasing value streams to make the production process more efficient (Rizka et al., 2024). This concept aims to create value for customers by maximizing existing resources through the elimination of activities that are not value-added. In practice, various methods such as Just in Time, Kaizen, Heijunka, and SMED are often applied to improve production efficiency (Rewers & Diakun, 2021). This approach is not only relevant for large-scale industries, but also important for MSMEs that want to increase competitiveness through production processes that are efficient, flexible, and responsive to market demand.

Micro, Small, and Medium Enterprises (MSMEs) are one of the sectors that contribute significantly to the economy (Amalijah et al., n.d.). Most business actors in this sector use the Make to Stock (MTS) production system, which is to produce goods based on estimated demand and store them as stock (Harfeldt-Berg & Olhager, 2024). This system makes it easy to meet demand, but poses challenges when the production process is not efficient. Problems such as long setup times, workflow imbalances, and stock buildup are the main obstacles that reduce production efficiency and capacity. This condition requires MSMEs to improve the process so that the MTS system can run optimally.

The MSMEs studied in this study produce three types of bags, namely bag A, bag B, and bag C, each with different design characteristics and process time. This difference requires high flexibility in the change of production processes. However, the reality is that switching between products still takes a long time, so productivity decreases. In addition, fluctuations in demand for each type of bag make the production planning process unstable, which has an impact on long lead times and inconsistent output.

The problem is even more complex when there is a sudden change in orders, because MSMEs have difficulty adjusting their production schedules and capacity. This inability to adapt leads to longer product turnaround times and increased risk of delivery delays. In these conditions, the Heijunka and SMED methods are very relevant to be applied. Heijunka plays a role in leveling the variation in production so that the workflow remains stable even though demand changes (Sulaiman et al., n.d.) Meanwhile, SMED can speed up process turnaround by significantly cutting setup time (Sumasto et al., 2025).

By looking at these conditions, the application of the Heijunka and SMED methods is the right solution for bag MSMEs to optimize their production processes. These two methods can increase efficiency, speed up setup time, and create a stable and flexible workflow without requiring large investments (Boutbagha & El Abbadi, 2024). This study aims to analyze the initial conditions of the production process, implement the Heijunka and SMED methods, and evaluate changes in production performance after their implementation. The results are expected to be able to make a real contribution to increasing the efficiency and productivity of bag MSMEs while strengthening the literature on the application of Lean Manufacturing in small and medium industries.

RESEARCH METHODS

The data analysis method in this study is designed to optimize the production system in MSME Bag Producers through a Lean Manufacturing approach, particularly with the application of the Heijunka and Single Minute Exchange of Dies (SMED) methods. The analysis is carried out quantitatively based on actual production process data, which includes a workforce of 13 people, working hours of 8 hours per day in one

shift, an effective working period of 26 days per month, and three main types of products, namely Bag A, Bag B, and Bag C..

The initial stage of analysis begins with calculating the available working time as a basis for determining actual production capacity. The calculation is done by multiplying the number of workers, the number of working hours per day, the number of minutes in an hour, and the number of effective working days. This value becomes an important parameter in comparing actual capacity with market demand requirements. Next, the takt time is calculated, which is the time available to produce one unit of product so that all demand can be met on time. The formula for takt time is formulated as follows:

$$Takt\ Time = \frac{T_{available}}{D_{total}} \dots\dots\dots(1)$$

Tavailable = “total time available in one period (minutes)”
Dtotal = “total product demand in 1 period (units)”

Takt time value is used as a reference in evaluating the suitability of the actual cycle time with production requirements. If the actual cycle time is greater than the takt time, improvements are needed in the production system to meet demand on time (Amran & Imdam, 2009). The next stage is the application of the Heijunka method to even out production variations of the three types of bags so that the workload becomes more balanced and stable. In this study, production planning was carried out using a one-batch-per-day approach, which means that each day a combination of the three types of bags is produced according to the proportion of monthly demand. This leveling strategy aims to reduce workload fluctuations, avoid overproduction, and improve process flow stability so that capacity planning becomes more effective.

After production variations are leveled through Heijunka, the analysis continues with the application of the SMED method to minimize setup time during the changeover of production between different types of bags. (Bangun et al., 2023). Based on the initial conditions, the setup time was recorded as 20 minutes for each changeover. Through the application of the SMED principles, setup activities are distinguished into internal and external activities, where external activities are performed while the machine is still operating. Additionally, the steps were simplified and standardized so that the setup time could be reduced to less than 10 minutes..

The comparison between setup time before and after the implementation of SMED serves as the basis for evaluating process efficiency improvements. Furthermore, utilization rates are calculated to determine the extent to which working time capacity has been utilized in the production process. The utilization formula is expressed as follows:

$$U = \frac{T_{proces}+T_{setup}}{T_{available}} \times 100\% \dots\dots\dots(2)$$

U = “Utilization of working time total” (%)
Tprocess = “Production process time total” (minute)
Tsetup = “Setup timeTotal available” (minute)
Tavailable = “Working time” (minute)

Analysis of utilization values before and after the implementation of SMED provides an overview of the efficiency level achieved from improvements in the setup

process. Lower utilization values indicate that working time capacity is used more efficiently, allowing the production system to be more responsive to demand (Julian et al., 2021).

The final stage of this analysis is the evaluation of the results of implementing the Heijunka and SMED methods in an integrated manner. The evaluation is conducted to assess the extent to which production variations have been leveled, setup time has been minimized, and production capacity can be increased. The results of this evaluation serve as the basis for providing process improvement recommendations for SME Bag Producers, thereby creating a more efficient, flexible production system capable of meeting customer demands on time.

RESULTS AND DISCUSSION

Research Data

This research was conducted on SME Bag Producers that manufacture three different types of bags, namely Bag A, Bag B, and Bag C. The production process runs for one shift with a working duration of 8 hours per day and a total of 13 employees. The aim of this study is to apply the Heijunka method as a production leveling strategy and the SMED method to reduce setup time in order to improve production system efficiency. The data used were obtained from direct observations of production capacity, cycle time, and setup activities occurring during the production process.

Takt Time Calculation

Table 1. below shows the calculation results of takt time based on effective working time and total production demand.

Table 1. Takt Time Calculation

Parameter	Value
Working hours per day	8 hour (480 menit)
Working days per month	27 days
Working hours per month	12.960 minute
Total monthly production demand	2.077 unit

$$Takt\ Time = \frac{12960}{2077} = 6,24\ menit$$

Takt time calculation is carried out to determine the ideal production pace that must be met to ensure customer demands are fulfilled on time. With a total effective working time of 12,960 minutes and a total demand of 2,077 units, a takt time of 6.24 minutes per unit is obtained. This means that each bag must be completed within a maximum of 6.24 minutes to achieve the monthly production target.

Production Capacity Analysis

Next, a production capacity analysis is conducted to determine the system's actual ability to produce products. Table 2 shows the production capacity per type of bag based on the observed cycle time.

Table 2. Bag production capacity

Bag's Type	Cycle Time (menit)	Daily capacity (unit)	Monthly capacity (unit)
Bag A	5	96	2.592
Tas B	6	80	2.160
Tas C	7	69	1.863

The analysis results show that production capacity is much higher than actual demand. This condition indicates an opportunity to level production so that the process is more balanced and reduces waiting time and overproduction. Therefore, the Heijunka method is applied to reschedule in the form of daily batch combinations.

Table 3 shows the results of applying Heijunka based on total monthly demand, which is then averaged into daily production over 27 working days..

Table 3. Penjadwalan Produksi Harian dengan Heijunka

Bag's Type	Monthly demand	Daily production (unit)
Bag A	800	30
Bag B	900	33
Bag C	377	14

With the Heijunka approach, production is carried out in a combined manner in one batch per day: 30 units of Bag A, 33 units of Bag B, and 14 units of Bag C. This production pattern is more balanced compared to the previous large batch method, which produced a large quantity of a single type of bag at once. This leveling helps reduce workload fluctuations, decrease the amount of work-in-progress (WIP) inventory, and make the production flow more stable. A comparison of the production schedule can be seen in the graphic below.

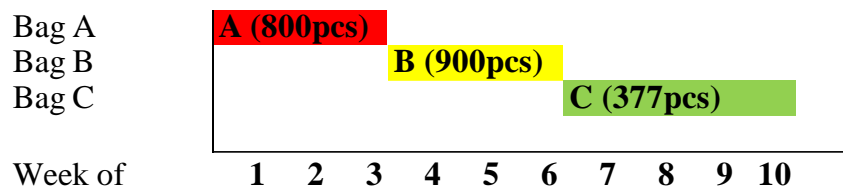


Figure 1. Production Schedule Before Heijunka

Figure 1 shows the production schedule before the implementation of the heijunka concept, where production activities are carried out gradually based on product type. During that period, the production of Bag A was carried out first from week 1 to week 3, followed by the production of Bag B from week 4 to week 6, and Bag C from week 7 to

week 10. This production pattern indicates a batch production system that tends to be uneven and results in workload fluctuations. Such conditions have the potential to cause accumulation of certain product inventories, long waiting times for the next product type, and imbalances in production capacity across periods.

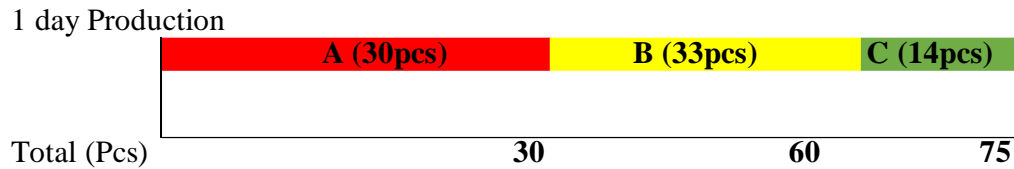


Figure 2. Production Schedule After Heijunka

Figure 2 shows the production schedule after the implementation of heijunka, or the production leveling system. In this system, production activities are arranged so that each product type (Bag A, Bag B, and Bag C) can be produced proportionally within a shorter period, for example, daily. Thus, the production flow becomes more balanced and flexible to changes in customer demand. Through the implementation of heijunka, the company can reduce workload variation, lower inventory levels, and shorten production lead time. Overall, the implementation of heijunka helps create a production system that is more stable, efficient, and responsive to market needs.

SMED Implementation

In addition to production leveling, this study also applied the SMED (Single Minute Exchange of Dies) method to reduce setup time between production changes. Before the improvements were implemented, setup time was recorded at 1,560 minutes per month. After applying the SMED principles, which include separating internal and external activities, converting internal activities to external ones, and simplifying procedures, setup time was successfully reduced to 327.6 minutes per month. This represents a 79% reduction in setup time.

Table 4. Comparison of setup before and after SMED

Concition	Setup Time (minute)	Decline (%)
Before SMED	1.560	-
After SMED	327,6	79%

The reduction in setup time directly impacts the increase in production system flexibility, allowing for faster changeovers between different types of bags, thus making mixed production scheduling according to Heijunka more realistic and easier to implement. Furthermore, the increased setup speed also affects overall work time utilization. Utilization calculations are carried out to determine the level of use of the available work time capacity. Utilization is calculated by comparing the total productive time (process and setup time) to the total available work time. Before SMED, utilization was recorded at 105.36%, whereas after implementing SMED, utilization became 102.6%. This slight decrease does not indicate a decline in performance, but rather is a

consequence of the significantly reduced setup time. This means the system becomes more efficient because it can produce the same output with less time.

CONCLUSION

This research proves that the implementation of the Heijunka method and Single Minute Exchange of Dies (SMED) can improve the efficiency and performance of the production process in MSMEs that produce bags. The main issues that initially arose, such as long setup times, workload imbalance, and high risk of inventory buildup, can be addressed through the application of these two methods. The Heijunka method successfully leveled the production variations of three types of bags, namely Bag A, Bag B, and Bag C, into a daily production combination of 30 units of Bag A, 33 units of Bag B, and 14 units of Bag C. This leveling made the production flow more stable, balanced the workload, and reduced the occurrence of work in process (WIP) and overproduction. In addition, production scheduling became more flexible and easier to adjust to demand fluctuations. The implementation of the SMED method also yielded significant results by reducing setup time from 1,560 minutes to 327.6 minutes per month, which represents a 79% reduction. This reduction was achieved through the separation of internal and external activities, the conversion of internal activities to external ones, and the standardization of work procedures. As a result, product changeovers can be carried out more quickly, and the production system becomes more responsive to changes in demand. In addition, the working time utilization value decreased from 105.36% to 102.6% after the implementation of SMED. This decrease indicates that the production process has become more efficient because the same output can be achieved in a shorter time.

Further research can be conducted over a longer period of time or under more fluctuating demand conditions to observe the consistency of implementing the Heijunka and SMED methods over different time frames. The use of other Lean methods such as Kanban, 5S, or Value Stream Mapping (VSM) can also be considered to support more comprehensive process improvements. Finally, testing the application of these methods in different types of industries or production capacities will provide additional insights into the flexibility and effectiveness of the approaches used.

BIBLIOGRAPHY

- Amalijah, E., Andari, N., & Narastri, M. (n.d.). *Peningkatan Produktivitas Kearifan Lokal Kerajinan Tangan Tas Rajut Sebagai Bentuk Identitas Bangsa*.
- Amran, T. G., & Imdam, I. A. (2009). PERANCANGAN JADWAL PRODUKSI DENGAN MENGGUNAKAN METODE HEIJUNKA UNTUK MENDUKUNG PENGEMBANGAN SISTEM PRODUKSI KONVENSIONAL KE SISTEM PRODUKSI TOYOTA (STUDI KASUS: PT ADYAWINSA DINAMIKA). In *INASEA* (Vol. 10, Issue 2).
- Bangun, C. S., Purnama, D., & Suwandi, A. (2023). Using the Single Minute Exchange of Die (SMED) Method to Minimize Machine Setup Time: A Case Study. *International Journal of Research and Review*, 10(12), 429–434. <https://doi.org/10.52403/ijrr.20231247>
- Boutbagha, M., & El Abbadi, L. (2024). Heijunka-Levelling customer orders: a systematic literature review. *International Journal of Production Management and Engineering*, 12(1), 31–41. <https://doi.org/10.4995/ijpme.2024.19279>

- Harfeldt-Berg, M., & Olhager, J. (2024). The customer order decoupling point in empirical operations and supply chain management research: a systematic literature review and framework. In *International Journal of Production Research* (Vol. 62, Issue 17, pp. 6380–6399). Taylor and Francis Ltd. <https://doi.org/10.1080/00207543.2024.2314164>
- Julian, L., Kusuma, I., & Nurkertamanda, D. (2021). *IMPLEMENTASI METODE SINGLE MINUTE EXCHANGE OF DIE (SMED) UNTUK MEMPERSINGKAT WAKTU SET-UP MESIN PADA PT. BIMUDA KARYA TEKNIK*.
- Rewers, P., & Diakun, J. (2021). A heijunka study for the production of standard parts included in a customized finished product. *PLoS ONE*, 16(12 December). <https://doi.org/10.1371/journal.pone.0260515>
- Rizka, A., Asbari, M., & Setiawan, R. A. (2024). Penerapan Prinsip Lean Manufacturing untuk Efisiensi Operasional dan Produktivitas: Tinjauan Literatur. *Jurnal Ilmu Sosial, Manajemen, Akuntansi Dan Bisnis, Vol. 01*.
- Sulaiman, M., Yusuf, N., Fauzi, D. A., Solehudin, S. A., Hidayat, R., Prastyo, Y., & Bangsa, U. (n.d.). *Review: Journal of Multidisciplinary in Social Sciences Implementing Heijunka Improves Production Time Efficiency at PT Toyota*. <https://lenteranusa.id/>
- Sumasto, F., Arofah, A., Pratama, I., & Purbaningrum, S. (2025). Application of Single Minute Exchange Die (SMED) Method to Minimize Setup Time on 350T Capacity Molding Machine. *Jurnal Inovasi Teknologi Dan Rekayasa*, 10, 33–40.

ACKNOWLEDGMENTS

The author would like to express his deepest gratitude to all parties who have provided support in the preparation of this research. Special thanks are expressed to the supervisors and the entire faculty of the Industrial Engineering Study Program who have provided very valuable direction, guidance, and input during the research process.

The author also expressed his gratitude to the management and employees of MSME bag manufacturers who have been willing to provide data, information, and access to the production process. Without the help and support of various parties, the research entitled "Optimizing the Production of Bag MSMEs Using the Heijunka and SMED Methods" will not be completed properly. So that this research can be carried out properly.

FUNDING INFORMATION

This Research used the author's personal funds.

CONFLICTING INTEREST STATEMENT

The authors state that there is no conflict of interest in the publication of this article.

HISTORY OF ARTICLE

Submitted : March 29, 2025
Revised : May 30, 2025
Accepted : June 29, 2025
Published : June 30, 2025